SECTION 7

Summary and Conclusions

The following sections summarize the findings of the RI conducted for the Lava Cap Mine Site. Conclusions are also presented following the summary.

7.1 Summary

The following discussions summarize material presented earlier in this report.

7.1.1 Nature and Extent of Contamination

The Lava Cap Mine is located in an area of Nevada County where historic and current mining operations are widespread. The Mine is in the LCC watershed. LCC joins with CC just above Lost Lake. CC flows through Lost Lake down to its confluence with Little Greenhorn Creek (LGC). LGC flows several miles in a southeastern direction into Greenhorn Creek, then Rollins Reservoir.

The finely ground tailings associated with mining activities at the Lava Cap Mine contain elevated concentrations of inorganic constituents, including arsenic and various other metals. Based on the HHRA, arsenic is the only significant risk driver identified for the areas impacted by releases from the Lava Cap Mine Site. Arsenic also is the primary risk driver in the ERA, although numerous other inorganic constituents represent potential risks to ecological receptors.

Without exception, tailings-impacted areas are uniformly high in arsenic, while reference area concentrations are consistently much lower. Based on the risk assessment results and the consistent presence of elevated arsenic concentrations in Lava Cap Mine wastes (both mine tailings and mine discharge), arsenic concentrations have been used to delineate the extent of Lava Cap Mine-related impacts (see Figures 4-2, 4-3, 4-4, and 4-8).

Transport of tailings as suspended and/or dissolved constituents in LCC and CC surface water flows appears to be the most significant migration pathway at the Lava Cap Mine Site. The extent of flooding along LCC, associated with the January 1997 flood event (Figure 4-1), and the extent of arsenic impacts around the Deposition Area and Lost Lake (based on samples from upslope areas) (see Figure 4-8) have been used to determine the approximate extent of Lava Cap Mine impacts downstream of the mine.

Summaries of the analytical results from testing of environmental media (soils, sediments, surface water, groundwater, and air) for arsenic follow. Table 7-1 presents a summary of arsenic concentrations detected in surface soil, sediment, surface water, and groundwater throughout the Lava Cap Mine Site and surrounding areas, including the reference areas.

Reference Areas

As expected, nearly all the metals and other inorganic constituents detected in mine tailings and source area samples are also present in samples collected from the reference areas, but at lower levels. This was expected because all of the inorganic metals are naturally occurring in geologic materials from the Lava Cap Mine area.

Arsenic concentrations in reference area surface soil and sediment show relatively uniform levels. Arsenic is at very low levels in surface water collected in LCC above the mine. The upgradient monitoring well does have elevated levels of arsenic. This upgradient well is completed in a different formation (the lava formation present along the ridge line) than the rest of the monitoring and residential wells sampled at and downgradient of the mine. Most of the residential wells sampled downgradient of the mine have little or no arsenic. This implies that the upgradient well may not be a representative reference location for all areas of the site.

Source Areas

Contaminant source areas at the site include those areas where mine tailings and other mining wastes are present. This includes the waste rock/tailings pile and soil and water in historic mine buildings. The source area also incorporates mine discharge from the collapsed adit (continuous) and tailings pile seeps (seasonal), and discharge from the base of the log dam (continuous). The current volume of tailings and waste rock below the adit discharge point is estimated at approximately 167,000 cubic yards. More than 10,000 cubic yards (estimated) of tailings were released during the January 1997 dam collapse and storm event.

Table 7-1 presents a summary of arsenic results for concentrations in source area surface soil, subsurface soil, sediment, surface water, groundwater, and ambient air. Arsenic concentrations are highest in surface soil inside the mine buildings and adit discharge sediment.

Subsurface soil samples from borings in the tailings/waste rock areas have elevated arsenic concentrations that tend to decrease with depth. Arsenic concentrations of the deepest samples are all below 100 mg/kg, except in Boring 5B.

Samples of ponded water from sumps in the historic mine building yield the highest arsenic concentrations detected during the RI (14,300 µg/L). In addition to the ponded water in the mine buildings, there are three other surface water sources at the mine with elevated arsenic levels: the collapsed adit discharge, the waste rock/tailings pile seep, and the tailings pile underflow that discharges from the base of the log dam. The adit discharge and seepage from the base of the log dam flow on a year-round basis. The waste rock/tailings pile seeps are seasonal. During the RI field program (October 1999 through September 2000), the seeps were active from December 1999 through the end of July 2000. Monthly sampling of selected source area surface water show that arsenic concentrations fluctuate with the volume of water discharged. Arsenic concentrations are highest during the low flow periods (late summer) and lowest during the high flow periods (winter to early spring).

Arsenic concentrations in groundwater beneath the waste rock/tailings pile portion of the source area are variable, but generally fall in the 100 to 500 µg/L range.

Arsenic is detected in just one of four air samples collected in the source area at the mine. The concentration exceeded the EPA PRG.

Insert

TABLE 7-1 (1 PAGE)

Mine Area

The mine area refers to all areas at the mine outside of the specific source areas discussed above. Mine area samples include surface soil, sediment, surface water, groundwater, and air. Samples were collected from the vicinity of mine residences, areas surrounding the historic mine buildings, and areas outside the waste rock/tailings piles. Arsenic results for the mine area samples are summarized in Table 7-1.

All groundwater samples collected from residential wells at the mine contain arsenic. Arsenic concentrations range from 11.2 to 528 µg/L. The highest concentrations are in a well originally installed to provide drinking water to a new residence at the mine. Based on water quality data, it appears that this well likely intersects the subsurface mine workings (arsenic concentrations are similar to those in the mine discharge from the adit. Because of elevated arsenic, this well is not used to supply the residence. Maximum arsenic concentrations detected in the other residential wells at the mine range from 17.6 µg/L to 56.8 µg/L.

One of the air samples collected in the mine area contained arsenic at 0.067 µg/m^3, nearly 150 times greater than the EPA PRG.

Data show that elevated concentrations of arsenic are present around both the historic mine buildings and the residences. Sampling away from the waste rock/tailings pile areas indicates that arsenic concentrations in surface soil are reduced to near reference area levels a relatively short distance (10s of feet) from the areas covered with waste rock or tailings.

Little Clipper Creek below the Log Dam

In the areas along LCC below the log dam, tailings were carried in the January 1997 flood water as suspended solids and dissolved constituents in the LCC surface water flows. These tailings and associated constituents were deposited on the ground surface as the flood waters receded to normal levels. In the LCC corridor, flood water levels likely returned to normal fairly quickly after the initial event, because of the relatively steep gradient and confined nature of the stream corridor along most of this stretch. A relatively thin coating of tailings probably was deposited over the entire area reached by the flood waters. Three smaller deposition areas with more substantial accumulations of tailings have been identified along LCC between the log dam and the LCC/CC confluence. Over time, tailings associated with the floodwater deposition will slowly erode and be carried by overland flow back into the LCC channel. In the stream channel itself, there are limited areas with much sediment accumulation. Sediment samples were collected from five locations along LCC in this stretch and they all contain elevated arsenic. This indicates that wherever sediment can accumulate in the LCC channel, tailings impacts are present.

Arsenic concentrations detected in samples collected along the LCC drainage between the log dam and the LCC/CC confluence are summarized in Table 7-1. These samples indicate that arsenic concentrations for surface soil, sediment, and surface water are elevated above reference levels but are lower than those detected at the mine. Elevated levels of arsenic have also been detected in groundwater samples from one residential well located along the LCC drainage below the mine.

Deposition Area and Lost Lake

The Deposition Area and Lost Lake data set consists of the Deposition Area, Lost Lake, and surrounding properties. In the Deposition Area and around Lost Lake, the lateral extent of the tailings impact from the 1997 flood was established by analysis of surface soil samples collected at higher elevations above the floodplain and lake. Results from these samples indicate that throughout the Deposition Area and around Lost Lake, all samples below an elevation of 2,468 feet above msl have been impacted by releases from the mine.

Arsenic concentrations in samples from the Deposition Area and Lost Lake are summarized in Table 7-1. Concentrations in subsurface soils within the Deposition Area do not attenuate significantly with depth below ground surface. Drilling observations, combined with sample results, indicate that the materials present from the ground surface all the way down to the bedrock beneath the Deposition Area are comprised primarily of tailings. The total thickness of tailings-impacted soil ranges from 22 to 28 feet in the two deeper Deposition Area soil borings. Although borings were not drilled into Lost Lake, based on site history (Lost Lake was created as a tailings impoundment) and data from Deposition Area borings, it is presumed that all sediment filling Lost Lake is tailings-impacted. Using the approximate shape of the original stream canyon and the current ground surface elevation, the estimated volume of tailings-impacted sediments deposited in the Deposition Area and Lost Lake is approximately 500,000 cubic yards.

Surface water samples collected from the permanent pond in the Deposition Area near the LCC/CC confluence have elevated arsenic concentrations ranging from 599 to 1,160 µg/L. Groundwater samples collected from shallow monitoring wells completed in the tailings-impacted soils of the Deposition Area also contain elevated arsenic concentrations, ranging from 235 to 2,430 µg/L. However, none of the residential wells sampled around Lost Lake and Deposition Area contain arsenic above 1 µg/L.

Arsenic was not detected in air samples collected from the two Deposition Area locations sampled. However, conditions at the time of sampling were not ideal for detecting air particulate transport (i.e., there was little wind and conditions were not particularly dry).

Surface soil samples collected from lower elevations (generally within 25 feet of the lake shoreline) on residential properties around Lost Lake generally have elevated arsenic concentrations, ranging from 5.1 to 848 mg/kg. Most of these samples were collected below the elevation of 2,468 feet above msl, which delineates impacted from non-impacted surface soil. Arsenic concentrations in the higher elevation samples (those that are upslope from the lake towards the residences) collected above elevation 2,468 feet around Lost Lake and the Deposition Area range from 6.6 to 38.4 mg/kg. This concentration range is similar to reference area concentrations.

All sediment samples collected from Lost Lake, shallow and deep samples from both the northern and southern lobes, contain elevated arsenic concentrations ranging from 304 to 1,140 mg/kg.

Surface water samples collected from Lost Lake have arsenic concentrations ranging from 5.8 to 70.6 µg/L. Arsenic concentrations generally are higher in the southern lobe of the lake than in the northern lobe. Arsenic concentrations in surface water samples from CC through the Deposition Area and in Lost Lake were highest during the October 1999 sample event, when flow rates and lake levels were the lowest.

Downgradient of Lost Lake

The area downgradient of Lost Lake is also impacted by releases from Lava Cap Mine. The majority of suspended solids ~~in~~cluding tailings, carried in the LCC/CC drainage below the mine ~~li~~kely settle out in Lost Lake and the Deposition Area. However, in the 1997 flood event, the surface water flowing over the Lost Lake Dam reportedly was milky in appearance. This indicates suspended sediment associated with the 1997 event entered the drainages beyond the Lost Lake Dam. Surface soil sample results from the relatively large, flat area near the confluence of CC and LGC indicate that some deposition of tailings likely occurred in this area. Some tailings associated with the 1997 event most likely were carried further down the watershed. The sediment sample results support this possibility as arsenic concentrations in the furthest downgradient sediment sample from LGC are still above the PRG and reference levels. Although concentrations are much lower than those detected further upstream towards Lost Lake, the results indicate that Lava Cap Mine-related impacts likely extend some distance further downstream. Additional sampling downstream in LGC will be performed to better delineate the downstream extent of Lava Cap Mine impacts.

The arsenic concentration detected in the furthest downstream surface water sample (collected from LGC just down from the LGC/CC confluence) was the lowest of any non-reference area surface water sample collected during the May 2000 sampling event (15.9 µg/L). However, this data point and those at the base of the Lost Lake Dam confirm that there is continuous loading of arsenic from the Lava Cap Mine Site into the LGC drainage.

Arsenic concentrations from samples in the area downgradient of Lost Lake are summarized in Table 7-1.

7.1.2 Fate and Transport

Contaminant transport away from the source areas at the mine can occur via the following media: sediment, surface water, groundwater, and air. Migration of contaminants from the Lava Cap Mine occurs primarily via tailings transport in LCC southward and mine discharge directly into LCC. Historically, tailings transport away from the mine likely occurred extensively during active mining operations (primarily the 1934 through 1943 time period) via direct releases of tailings into LCC for transport down to Lost Lake, which served as a tailings impoundment. Since the end of mining operations, tailings releases have occurred through and over the log dam by leakage, flooding, or partial dam failure.

The catastrophic flood event that caused the partial log dam failure during January 1997 caused an estimated 10,000 cy of tailings to be transported down the LCC/CC/Lost Lake/LGC drainage system. Evidence of tailings deposition is observed in all reaches of this system. Prior major storm events over the last 50 years would also have resulted in significant releases from the mine, although not likely as large as the 1997 event because of the dam failure. In addition, it is probable that small but steady releases of tailings past the log dam have been occurring routinely since mining operations ended in 1943.

Future movement of contaminated sediment and tailings will be in the form of:

- Continued transport through the dam
- Flood events that wash tailings over the dam

- Surface runoff through tailings deposition areas that moves tailings back into the creeks
- Additional movement of tailings already present in the creeks to downstream deposition areas

Repair or replacement of the log dam or implementing some other controls on the tailings pile would eliminate or greatly reduce tailings transport away from the mine. Until this is done, some tailings will continue to flow into the drainage system, though the amount will be low, except during large winter storm events.

Past releases have established the Deposition Area immediately north of Lost Lake, which must be considered another tailings source area. Overland flow during significant winter storms and spring runoff could potentially transport tailings back into CC, where they would migrate further downstream. The expected amount of mass transport via this mechanism would not be high, except during major storms that flood the Deposition Area.

Elevated constituent concentrations are present in the mine discharge occurring through the caved adit and in the form of tailings pile seeps (both surface seeps and seepage through the base of the log dam). These discharges flow into LCC, impacting downstream surface water. The mine discharge through the adit represents water draining the subsurface shafts and tunnels of both the Lava Cap and Banner Mines, which are interconnected. Groundwater in contact with the mine adit water and shallow groundwater beneath (and within) tailings-impacted sediments is also affected.

There are currently no physical controls on migration of dissolved contaminants in surface water or groundwater (potential transport of dissolved contaminants away from the mine in groundwater is not well defined at this time). Migration will continue as long as contact with mine tailings or mixture with mine discharge continues. Groundwater flow paths are not well known because of the fractured nature of the aquifer and the paucity of available data. If groundwater flow closely follows topographic relief, impacted groundwater would be expected to be confined to the LCC and CC drainages. However, fracture patterns may run independent of topography, producing groundwater flow directions that are quite different from surface water flow paths.

An arsenic was only reported above the detection limit in two ambient air samples. The potential for exposure to arsenic and other metals through air transport may be underestimated when air monitoring data is considered on its own, however, the HHRA corrects for the deficiency in air data by applying modeling techniques that if anything are likely to overestimate exposure through the inhalation pathway. Only a limited number of air samples were collected during the RI field program, and most of the sampling was done during times of light winds and relatively moist conditions at the site. Because meteorology and human activity varies throughout the year, conditions could occur that would cause concentrations to exceed the levels reported during the two sampling events, increasing the potential for exposure.

Factors that could contribute to elevated arsenic concentrations in ambient air near contaminated areas are:

- Gusty winds
- Dry soil
- Motorized vehicle activity

- Human foot traffic
- Wildlife
- Construction activity
- Removal of vegetation

7.1.3 Risk Assessment

The baseline human health and ecological risk assessments indicate that many areas at and downgradient of the mine, impacted by mine-related contamination, contain levels of inorganic constituents, particularly arsenic, that pose a significant potential risk to human and ecological receptors.

Human Heath Risk Assessment

The HHRA (Appendix E) concludes that arsenic is the primary risk driver in impacted areas and is the only constituent that contributes significantly to the estimated risks. The HHRA evaluates potential risks to mine workers; mine residents; residents / recreational users along LCC below the mine; residents and recreational users around Lost Lake; recreational users of the Deposition Area; and recreational users of CC below Lost Lake. Six exposure units at the mine and in downgradient areas are identified for estimating potential risks.

- Exposure Unit 1: Encompasses mine workers in the area associated with Lava Cap Mine historical operations and associated facilities and waste materials.
- Exposure Unit 2: Consists of residents in the Lost Lake vicinity who are recreational users of Lost Lake. These receptors may be exposed to contaminants in groundwater from domestic wells and to contaminated soil or sediment during recreational activities around Lost Lake. Residents / recreational users engaging in recreational water activities may be exposed to contaminated soils and sediments around the shoreline and to contaminated surface water while swimming. Residents / recreational users could also potentially be exposed to contaminants as a result of ingesting contaminated fish.
- Exposure Unit 3: Encompasses residents living on the Lava Cap Mine property away from the historic mining facilities and waste materials. It is assumed that these residents would not be directly exposed to soil in the source areas, but could be exposed to soil from the surrounding areas at the mine. The residents may also be exposed to contaminants in groundwater from domestic wells.
- Exposure Unit 4: Consists of residents living along LCC between the mine and the Deposition Area above Lost Lake who are recreational users of the creek area. Residents engaging in recreation activities may be exposed to contaminated soil and sediment in and along LCC and to contaminated surface water while wading in LCC. Residents may also be exposed to contaminants in groundwater from domestic wells.
- Exposure Unit 5: Consists of recreational users of the Deposition Area above Lost Lake. The recreational users could be exposed to contaminated soil or sediment in the Deposition Area or to contaminated surface water while wading. The most likely recreational users of the Deposition Area are residents living in the Lost Lake vicinity. If a resident is a frequent recreational user of both Lost Lake and the Deposition Area, the estimated risks from Exposure Units 2 and 5 may need to be combined to develop a total risk.

- Exposure Unit 6: Consists of recreational users along CC below Lost Lake. The recreational users could be exposed to contaminated soil or sediment along CC or to contaminated surface water while wading. The most likely recreational users of the area along CC below Lost Lake are residents living in the Lost Lake vicinity. If a resident is a frequent recreational user of both Lost Lake and the area below Lost Lake, the estimated risks from Exposure Units 2 and 6 may need to be combined.

Results of the baseline risk assessment for the six exposure units (see Table 6-2) indicate that potential cancer risks for both current receptors and future hypothetical receptors exceed EPA’s risk management range of 10^{-6} to 10^{-4}. The estimated potential cancer risks in all exposure units range from 10^{-5} to 10^{-3} with most of the scenarios having risk estimates that are greater than the corresponding background cancer risks. Noncancer HI estimates for all exposure units exceed one and most exceed their respective background noncancer HI, indicating the potential for noncancer health impacts. The risk driver for all exposure units and media is arsenic.

Ecological Risk Assessment

The ERA evaluates risks to fish, sediment biota (benthic invertebrates), amphibians (e.g., red-legged frogs), terrestrial plants, soil invertebrates (earthworms), soil microbial processes, and several species of birds and mammals (e.g., American dipper, red-tailed hawk, green heron, California quail, mink, ornate shrew, California vole, and long-tailed weasel) from mine-related contaminants in surface water, sediment, and soil. The ERA concludes that mine-related contaminants pose a potential risk to ecological receptors at the mine and in all downgradient areas impacted by mine releases.

The ERA results indicate that multiple COPECs in soils, sediments, and surface waters at the Lava Cap Mine Site present ecological risks to multiple receptors. Overall, arsenic is the primary risk driver (i.e., potential risk was determined for five or more of the receptors evaluated) in all areas. Additionally, antimony, cadmium, copper, cyanide, lead, mercury, silver, and zinc are dominant risk drivers in the Mine Area. However, potential mercury risk is likely overestimated, because literature-derived toxicity values are for the highly bioavailable organic (i.e., methyl-mercury) form of mercury and the mercury found in the samples is more likely to be in the less bioavailable inorganic form. In the Midgradient, Lake, and Downgradient areas there were no risk drivers other than arsenic that were considered dominant, although zinc and selenium posed risk to at least one receptor in each of these areas. Nickel does not present risk to any receptor outside of the Mine Area, and risk from lead and antimony decreases with distance from the Mine Area with no risk from either lead or antimony present in the Downgradient Area.

7.2 Conclusions

Results of the RI show that mine-related contaminants associated with source areas have impacted both the surrounding areas at the mine and downgradient areas along LCC and CC, extending through Lost Lake to LGC.

Arsenic contamination occurs at levels that pose a significant threat to human and ecological receptors at the mine and in areas downgradient of the mine directly impacted by tailings and mine discharges. Other inorganic constituents associated with mine-related wastes also are detected at levels that represent potential risks to various ecological receptors.

Arsenic contamination levels are highest in the source areas at the mine, inside the mine buildings, and in the adit discharge pond. Continued migration of dissolved and suspended contaminants from the mine is occurring through year-round adit discharges and tailings pile seepage out of the log dam. Seasonal flow from waste rock/tailings pile surface seeps add to the contaminant migration. Flow over and through the waste rock/tailings pile and past the log dam during significant storm events also results in continued migration of contaminants from the mine.

Elevated arsenic levels are detected in surface soils, sediments, and surface water along the LCC/CC drainage below the mine. The concentrations are uniformly high in areas where deposition of tailings-impacted sediment has occurred along the LCC/CC drainage.

The largest Deposition Area is located above Lost Lake and below the LCC/CC confluence. Soil and sediment in this Deposition Area and in Lost Lake contain high arsenic concentrations.

The lateral extent of the area impacted by mine releases, including those associated with the 1997 flood event is estimated using the approximate limit of flooding shown on Figure 4-1 and evaluating sample results upslope from the Deposition Area and Lost Lake (Figure 4-8). All areas below elevation 2,468 feet above msl around the Deposition Area and Lost Lake appear to be impacted by tailings deposition during the 1997 event in conjuction with historic mine releases.

Arsenic concentrations in LCC, CC, and Lost Lake fluctuate with surface-water flow rates throughout the year. Periods of low water flows (i.e., late summer) correspond to the highest arsenic concentrations in these downstream surface water bodies. Conversely, high flow periods have the lowest arsenic concentrations. This is because during the low-flow periods, nearly all the flow in the LCC/CC drainage comes from mine discharges.

7.2.1 Data Limitations and Recommendations for Future Work

The RI field program was proposed and executed in a phased manner to focus sampling and field efforts in a scientifically sound and cost-effective manner. Limited additional sampling and analysis will be necessary in the future to address data gaps or uncertainties that could effect evaluation of remedial alternatives in the FS or decisionmaking for selection of a remedy. In addition, EPA expects that additional RI fieldwork will be needed to more thoroughly assess potential migration of contaminated groundwater away from the mine.

The following bullets outline some of the key data limitations and recommendations for future work:

- Access for sampling is not available for all potentially impacted properties or in all potential reference areas. This limits the degree to which RI sampling results can characterize these areas.
- To date, characterization of environmental samples has been based primarily on determination of the total metal concentrations in the samples. Only limited speciation of the specific types of metals present was completed as part of this RI. The risk

evaluations generally make the conservative assumption that total concentrations represent the most bioavailable species. This approach tends to overstate potential risks from exposure to environmental media.

- The lack of information on groundwater flow paths limits how well contaminant movement can be defined within this media. Additional information should be gathered to better characterize this potential pathway. The first recommendation would be to gather more information on residential well construction and stratigraphy from appropriate record archives (e.g., county agencies). Supplemental site-specific information on groundwater flow paths could be developed through installation of additional monitoring wells in the surficial geological materials and shallow bedrock aquifers downgradient of the mine. Nested well pairs would help to characterize the vertical gradients between the two aquifers. Installing monitoring wells in the vicinity of the residential wells with elevated arsenic concentrations could help to determine if migration pathways exist from suspected contaminant source areas (i.e., shallow groundwater beneath the waste rock/tailings pile at the mine and beneath LCC) towards residential wells.

- In addition to additional monitoring of potential flow paths, several other data collection efforts would help determine whether the contaminated shallow groundwater at Lava Cap Mine represents a significant threat to other aquifer units and receptors in the area. Information that should be gathered includes supplemental information on groundwater chemistry in residential wells, redox conditions in surface water and in the various groundwater flow systems, and arsenic speciation in groundwater and surface water.

- The furthest downgradient samples were collected just below the LGC/CC confluence. It is likely that tailings released from the Lava Cap Mine have migrated further downstream than the last sampling location. The LGC channel should be visually surveyed for possible deposition areas further downstream than the final RI sample. Collection of samples from any observed deposition areas would help determine if Lava Cap Mine impacts extend further downgradient in LGC.

The ambient air data collected during the RI field program to evaluate potential contaminant transport via the air particulate pathway are limited because the field conditions observed during sampling were not ideal for evaluating this pathway. To make up for the lack of reliable ambient air data, the HHRA addresses the inhalation pathway using surface soil data and conservative modeling assumptions regarding air transport. However, additional air monitoring may be warranted in the future to assess the potential impacts of large earthmoving activities such as those that may be necessary as part of a remedial action. Of particular concern would be activities during drier, windier times of the year (e.g., late summer). Any additional air sampling performed should attempt to use longer sampling periods with higher flow rates to increase the amount of air sampled. Larger air volumes result in a larger mass of particulates on the filters and lower reporting limits (air results are reported in $\mu g/m^3$ so the larger the volume of air pulled through the sampler, the lower the reported detection limit is).