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September 12, 2013
Project No. 3-61M-119774.02

Oregon Department of Environmental Quality
Cleanup and Environmental Response
2020 SW Fourth Avenue, Suite 400
Portland, Oregon 97201

Attention: Ms. Erin McDonnell

Subject: Annual Progress Report, Remedial Investigation and Feasibility Study
Intel Corporation
3585 SW 198th Avenue
Aloha, Oregon

Dear Ms. McDonnell:

On behalf of Intel Corporation (Intel), AMEC Environment & Infrastructure, Inc. (AMEC) is submitting this progress report as required by the remedial investigation and feasibility study (RI/FS) agreement between Intel and the Oregon Department of Environmental Quality (DEQ). The RI and FS have been completed. The project is now in the advanced stages of site remediation, focusing on natural attenuation (NA) monitoring.

NA monitoring began in 2011 when reporting was semiannual. The first NA monitoring report was submitted to the DEQ on August 12, 2011, and it covered January through June. The DEQ later (November 7, 2011) modified the reporting schedule to annual. This progress report (117) documents activities during the most recent reporting period (July 2012 through June 2013).

SUMMARY

- NA monitoring occurred in July and October 2012, and in January and April 2013. Monitoring tracks declining concentrations of tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), and 1,2-dichloroethane (1,2-DCA) toward Federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and Oregon risk-based concentrations (RBCs).
- Most MCLs have been met, the only exceptions being slight exceedances for VC at two wells in the shallow aquifer and, depending on the date, one or four wells in the deeper

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aquifer. Prior TCE exceedances at well AW-24 in the shallow aquifer declined below the TCE MCL by May 2013.

- The TCE RBC was exceeded in the shallow aquifer (in approximately 30% of the total number of wells sampled during the past year), but at decreasing frequencies and generally decreasing concentrations.
- The TCE RBC was exceeded in the deeper aquifer (in only 16% of the total number of wells sampled during the past year), but at decreasing frequencies and generally decreasing concentrations.
- The VC RBC was exceeded in the shallow aquifer (in approximately 57% of the total number of wells sampled during the past year), but at decreasing frequencies and generally decreasing concentrations (except at well AW-10-36 where the VC concentration remained steady at around 2 micrograms per liter [μg/L]).
- The VC RBC was exceeded in the deeper aquifer (in approximately 75% of the total number of wells sampled during the past year), but at decreasing frequencies and generally decreasing concentrations.
- The 1,2-DCA RBC was exceeded in only one well (AW-19-35) in the shallow aquifer, in concentrations of approximately 1 μg/L.
- The 1,2-DCA RBC was exceeded in one well (AW-15) in the deeper aquifer, in concentrations between 1 and 2 μg/L.

ACTIONS TAKEN

- On July 16, 17, and 18, 2012, quarterly NA monitoring was conducted.
- On July 31, 2012, the annual monitoring report (progress report 117) was submitted to the DEQ.
- On September 25, 2012, DEQ comments on the annual monitoring report were received.
- On October 15, 16, and 17, 2012, annual NA groundwater monitoring was conducted.
- On January 21 and 22, 2013, quarterly NA groundwater monitoring was conducted.
- On April 15, 16, and 17, 2013, semiannual NA groundwater monitoring was conducted.
- On May 19 and June 12, 2013, supplemental groundwater samples were obtained for laboratory testing from monitoring well AW-24.

In addition, quarterly NA groundwater monitoring was completed from July 22 to 24, 2013.

ACTIONS SCHEDULED

- The interim remedial action measure (IRAM) groundwater recovery system will continue to operate.
- NA groundwater monitoring will continue according to the following schedule:
  - July 2013 - Quarterly sampling (completed July 22 to 24)
  - October 2013 - Annual sampling
  - January 2014 - Quarterly sampling
  - April 2014 - Semiannual sampling

SAMPLING AND ANALYSIS

NA GROUNDWATER MONITORING

Objectives

The remedial action objectives for the site consist of the following:

- Protect future hypothetical on- and off-site groundwater beneficial use by treating on-site volatile organic compounds (VOCs) in the Willamette Silt (shallow) and the valley fill (deeper) aquifers to MCLs before ceasing hydraulic containment, and allowing NA to reduce off-site VOC concentrations to RBCs;
- Treat VOCs to MCLs in a reasonable time frame; and
- Provide lateral and vertical hydraulic containment of VOCs while treatment occurs.

The target VOCs in the Willamette Silt are PCE, TCE, VC, and 1,2-DCA. The target VOCs for the valley fill are TCE, VC, and 1,2-DCA.

The cleanup goals for the target VOCs are Federal Safe Drinking Water Act Primary Drinking Water MCLs and DEQ RBCs for residential tapwater. The cleanup strategy consists of actively remediating the Willamette Silt by injecting lactate treatment solution to drive reductive dechlorination to reach the MCLs. After attaining the MCLs, the strategy changes to monitored NA for both the Willamette Silt and the valley fill, while maintaining hydraulic containment. NA monitoring began in 2011, including the installation of three additional monitoring wells (AW-23, AW-24, and AW-25) to provide improved coverage of the eastern site area.

In November 2011 the DEQ modified the RBCs. The revised RBCs were specified in the December 2011 NA monitoring plan except for 1,2-DCA. No RBC was available for this compound and the DEQ instead used a United States Environmental Protection Agency (EPA) Regional

Screening Level of 0.15 µg/L. In June 2012, the DEQ established an RBC of 0.14 µg/L for 1,2-DCA. This report evaluates progress toward current RBCs, and all tables and figures in this report reflect this. The MCLs and current RBCs are summarized below:

VOC	MCL (µg/L)	Tapwater RBC (µg/L)
TCE	5	0.43
PCE	5	11
VC	2	0.025
1,2-DCA	5	0.14

Monitoring Background

Groundwater monitoring has occurred at different frequencies and in different wells since 1982. The modern groundwater database begins in 1996, after site characterization was completed and the monitoring network expanded. Routine semiannual groundwater monitoring in the Willamette Silt and the valley fill (deep aquifer) began in August 2000 and continued through February 2007.

After lactate-solution injection began in August 2007, monitoring focused on performance monitoring in treatment arrays in the Willamette Silt. In April and December 2010, semiannual monitoring was again conducted at the request of the DEQ to provide updated groundwater quality data for the entire site.

Full-scale active treatment ceased on January 11, 2011, and the project transitioned to NA monitoring. The first year of NA monitoring was originally planned to occur in February, May, August, and November 2011, with up to three classes of wells sampled in each event depending on whether monitoring is quarterly, semiannual, or annual. The classes are defined as the following:

- Class 1: All recent (2006 to 2010) detections below reporting limits or below RBCs.
- Class 2: Some recent detections above RBCs, but none above MCLs.
- Class 3: One or more recent detections above MCLs.

Class 1 wells are not needed for NA monitoring, but will be sampled at least once every five years, or before site closure, whichever occurs first. Class 2 wells will be sampled semiannually while the extraction wells are still operating and once per year after the wells are shut down. Class 3 wells will be sampled quarterly while the extraction wells are still operating and during the first year after the wells are shut down, after which monitoring will be semiannual. Over time, all wells should change to Class 1.

NA monitoring actually began in March 2011, after the additional wells were constructed. The next monitoring event occurred in May 2011. The remaining events for 2011 were planned for August and November. The August event was intended to represent seasonal low-water-level conditions. The DEQ, however, requested that the low-water event take place in October and that it consist of annual sampling. The revised sampling schedule is specified in the revised NA monitoring plan.

Scope

The samples obtained were analyzed for VOCs using EPA Method 8260. To help assess whether the geochemical environment remained conducive to enhanced reductive dechlorination, some of the Willamette Silt samples were also analyzed for dissolved gases (methane, ethane, and ethene) as called out below. During sampling, field measurements were made at each well of pH, specific conductance, dissolved oxygen (DO), and oxidation-reduction potential (ORP).

Table 1 summarizes the groups of wells that were sampled, by class, during the most recent monitoring period (July 2012 through April 2013). All four zones in valley-fill multilevel monitoring well MLW-4 were sampled ("zones" do not refer to laterally continuous hydrostratigraphic levels but instead to the relative positions of monitoring zones in individual multilevel monitoring wells, with "zone 1" being the deepest zone).

Smaller groups of wells in the Willamette Silt were also sampled and tested for dissolved gases, as listed below:

- July 2012: AW-10-26, AW-10-36, AW-17, AW-18, AW-19, and IWC-5. (The IWC-5 sample was also tested for VOCs.)
- October 2012: AW-10-26, AW-10-36, AW-17, AW-19, AW-20, AW-21, AW-22, AW-24, OW-1, and RW-10. (Groundwater obtained from P-9 and IWC-5 was also sampled and tested for VOCs.)
- January 2013: AW-10-26, AW-10-36, AW-21, and AW-22.
- April 2013: AW-10-26, AW-10-36, AW-22, P-16, P-17, and IWC-5. (The IWC-5 sample was also tested for VOCs.)

Analytical Results and Data Verification: Laboratory results through April 2013 are summarized in Attachment 1. The field records and laboratory reports for the July and October 2012; and the January and April 2013 samples are found in the following attachments:

- Attachment 2 - July 2012
- Attachment 3 - October 2012

- Attachment 4 - January 2013
- Attachment 5 - April 2013

Before interpretation, the laboratory data for VOCs were reviewed to verify that they were of adequate quality. The verification reports are provided in Attachment 6. Verification found that all data are acceptable for use, with some minor qualifications that do not affect the ability to monitor site groundwater quality. Details are specified in the verification reports.

The appropriate qualifiers are attached to the relevant data shown in the groundwater detection summary found in Attachment 1 and related tables and figures. As reported by the laboratory, all detections between the method reporting limit (MRL) and the lower method detection limit (MDL) are qualified as estimated values.

Progress Evaluation - Methodology: Information used to evaluate progress toward the cleanup goals consists of the following:

- Well location map (Figure 1);
- Water level maps showing hydraulic containment (Figures 2, 3, 4, and 5);
- Cross sections (Figures 6, 7, 8, and 9);
- Maps depicting the locations of MCL and/or RBC exceedances in the Willamette Silt (Figures 10 to 21);
- Maps depicting the locations of MCL and/or RBC exceedances in the valley fill (Figures 22 to 32);
- Mass concentrations vs. time plots (Attachment 7); and
- Molar concentrations vs. time plots (Attachment 8).

Progress toward the MCLs and RBCs is summarized in color codes in Table 2 for the Willamette Silt and in Table 3 for the valley fill. Over time, as RBCs are attained, newer data entries will lack color. (For information purposes, the tables also contain data for other compounds that have exceeded their MCLs, even though risk assessment found that cleanup was not required for them.)

To indicate progress toward RBCs, the tables contain estimated values (designated by the "J" code), because values below MRLs (but above MDLs) are reported by the laboratory as estimated values. This convention must be noted, because some RBCs are so low that they are below standard analytical method MRLs. By convention, when a sample does not contain an analyte above its MDL, the result is shown without color coding and is taken to indicate that the RBC has been attained because the practical limit to concentration measurement has been reached.

If target concentrations have not yet been reached, NA performance evaluations typically focus on whether NA is proceeding and, if so, at a rate sufficient to reach RAOs[1]. Because post-treatment NA rates will change, as the induced effects of enhanced (lactate) treatment diminish, it is important to distinguish immediately-post-treatment conditions from longer-term conditions. To assist in making this distinction, process monitoring data are also developed and reviewed. Process monitoring data consist of field groundwater geochemical measurements of critical parameters (pH, oxidation-reduction potential, and dissolved oxygen) and laboratory measurement of dissolved gases (methane, ethene, and ethane). The process monitoring data are summarized in Table 4, where the green color signifies that the geochemistry remains conducive to reductive dechlorination as induced by lactate treatment and, as shown by the dissolved gas data, that dechlorination has begun and if necessary, is continuing.

Progress Evaluation - Willamette Silt: Progress toward the cleanup goals is summarized in Table 2. As noted in progress report 113, excellent progress has been made for the Willamette Silt, as indicated by the fact that most contaminant concentrations have already declined below the MCLs.

Progress also continues to be made toward the RBCs, with generally decreasing trends as shown by the summary in Table 2. Current detections above RBCs, MCLs, or both are summarized below for PCE, TCE, VC, and 1,2-DCA. The locations of detections exceeding MCLs or RBCs are shown on Figures 10 to 21, using the same color coding as in Table 2. Findings from the past year of monitoring are summarized below:

- PCE was not detected above its MCL and RBC.
- TCE continued to be detected above its MCL in only one well, AW-24, at concentrations ranging from 5.6 to 8.9 µg/L, a lower range than the 11 to 13 µg/L detected during the previous reporting period. This well is located near the downgradient site boundary in an area not treated with lactate solution. After April 2013, the TCE concentration in AW-24 declined to less than 5 µg/L.
- TCE was detected above only its RBC at seven other wells, in concentrations ranging from 0.67 to 4 µg/L. The largest of these concentrations were reported in the samples from AW-10-36 (3.6 µg/L) and AW-17-35 (4 µg/L).
- VC was detected slightly above its MCL in all samples from AW-10-36 and in the April 2013 sample from OW-1.

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[1] Wilson, John T. 2011. An Approach for Evaluating the Progress of Natural Attenuation in Groundwater. EPA, EPA600/R-11/204 (December).

- VC concentrations exceeding only the RBC were reported from samples from 13 other wells (see Table 1) in concentrations of up to 0.77 µg/L. Most of these concentrations were less than 0.5 µg/L.
- No sample contained 1,2-DCA in a concentration exceeding its MCL.
- Samples from only one well (AW-19) contained 1,2-DCA in concentrations (0.68 to 1.1 µg/L) exceeding 1,2-DCA's RBC of 0.14 µg/L.

Data from well IWC-5, located in the service courtyard, are also reviewed here. The well is in an area that was treated in August 2010 with a one-time injection of slow-release carbon substrate. The well was first sampled in May 2011 and the results were reported in the previous annual report. Sample results obtained in July and October 2012 and in April 2013 continue to show that no MCLs were exceeded and that only the VC RBC continued, intermittently, to be exceeded.

Progress Evaluation - Valley Fill: Progress toward cleanup goals is summarized in Table 3. Detections above RBCs, MCLs, or both are summarized below for PCE, TCE, VC, and 1,2-DCA. The locations of detections exceeding MCLs or RBCs are shown on Figures 22 to 32. Findings from the past year of monitoring are summarized below.

- TCE was not detected above its MCL.
- The TCE RBC was exceeded slightly four times, at AW-15 in July 2012 (0.78 µg/L) and in April 2013 (0.54 µg/L); and at MLW-3 (zone 4) in October 2012 (0.49 J µg/L) and in January 2013 (0.49 J µg/L).
- VC was detected slightly above its MCL of 2 µg/L at only one location, in January 2013 at AW-14 (2.2 µg/L).
- VC was detected at higher concentrations (2.8 to 8.1 µg/L) above the MCL at MLW-3/zone 4 in July and October 2012 and in January and April 2013.
- VC was detected at concentrations exceeding only the RBC at nine other wells (see Table 2).
- The 1,2-DCA MCL was not exceeded.
- The 1,2-DCE RBC was exceeded at only one well, AW-15, in July (1.7 µg/L) and in October (1.2 µg/L) 2012; and in April 2013 (1.4 2.4 µg/L).

Discussion: Monitoring data show that most MCLs have been met in both aquifers. The RBCs for TCE, VC, and to a much lesser extent, 1,2-DCA, continue to be exceeded but in only a few wells and at lower concentrations over time.

The only wells in the Willamette Silt where MCLs were still exceeded were AW-24 (near the eastern site boundary) and AW-10-36 (located about 100 feet west and upgradient of the site boundary [see Figure 1]). The TCE MCL was exceeded at AW-24 and the VC MCL was exceeded at AW-10-36. In addition, the VC concentration at well OW-1 (near extraction well EW-1) slightly exceeded its MCL in April 2013. The VC MCL at OW-1 was similarly slightly exceeded in January 2012.

During 2013 TCE concentrations at AW-24 have declined below the TCE MCL since additional efforts at flushing were made using the onsite liquid ring pump ([LRP] see Table 2).

VC concentrations at AW-10-36 continued to be detected slightly above the VC MCL of 2 µg/L (see Table 2). The VC concentrations at this well have increased since 2007 from less than 1 µg/L; review of the dissolved-gas data for the well shows that lactate-treated water may not have yet arrived at the location of the well, possibly due to the lactate–treated water bypassing the well's location by flowing more to the east-northeast than was expected. Monitoring well AW-20 is located approximately 50 feet upgradient from AW-10-36 and it clearly shows the effects of lactate treatment as shown by its dissolved gas data (see Table 4).

To attempt to find the southern edge of lactate-treated water downgradient from AW-20, groundwater from piezometers P-16 and P-17 to the north of AW-10-36 was sampled in April 2013 and tested for dissolved gases. The results did not show clear evidence of lactate effects (see Table 4), perhaps because these piezometers may be too shallow (15 feet) to access the deeper part of the Willamette Silt where the most significant groundwater flow occurs in thicker, sandier layers.

To decrease the VC concentration at AW-10-36, Intel is evaluating whether to use the LRP to flush groundwater from near the well as has been done at well AW-24. This could be done by extending a suction hose from the nearby RW-10 vault to AW-10-36 (see Figure 1), and securing the area with temporary fencing. Pumping of AW-10-36 may also result in sweeping lactate-treated water to the well. If enhanced flushing is implemented, additional groundwater monitoring for VOCs and dissolved gases would be performed at the well to track its effects. Intel will notify the DEQ if this plan is implemented.

Because of these slight MCL exceedances, Intel plans to continue operating the hydraulic containment system to restrict the impacted groundwater in the Willamette Silt to the site. As containment is maintained, continued progress toward RBCs is expected on the basis of review of the dissolved gas data and the time-series plots. While the induced effects of lactate treatment have peaked and are waning, geochemical conditions conducive to reductive dechlorination are still present in most locations within the Willamette Silt.

For the valley fill, similar progress continues to be made solely by means of flushing the aquifer by pumping extraction well EW-6 combined with natural attenuation. The only MCL exceeded in the valley fill was VC at MLW-3 (zone 4) where concentrations from July 2012 through April 2013 ranged from 2.8 to 8.1 µg/L (Table 3). In April 2013, however, the duplicate sample from the well contained VC in a concentration of only 1.8 µg/L.

The MCL exceedances at MLW-3/zone 4 are consistent (as noted in previous reports) with the continued capture of groundwater by EW-6, which causes VOC-impacted groundwater formerly at the location of well AW-13 to migrate westward through the location of MLW-3 en route to the extraction well. EW-6 extraction should continue until concentrations have declined at MLW-3 and sufficient time has been allowed for the VOCs to migrate from MLW-3 to the extraction well.

This also applies to AW-14, which is located south of EW-6. VOC concentrations at AW-14 increased from when the well was installed (May 1997) into 2002 because the groundwater gradient in the upper part of the valley included a lateral component as well as a vertical component. When EW-6 began operating in 2002, the local horizontal hydraulic gradient was reversed and the VOC-impacted groundwater at AW-14 began migrating back toward EW-6, causing the total VOC concentrations at AW-14 to decrease from 114.75 µg/L in February 2002 to 5.13 µg/L in April 2013. EW-6 extraction should therefore continue until sufficient time has been allowed for the VOCs to migrate from AW-14 to the extraction well.

Progress toward RBCs continues to be made in both waterbearing zones, but attainment of the VC RBC will likely take some time because it is so low (0.025 µg/L). Preliminary modeling (not presented here) suggests that all RBCs would nonetheless be attained in less than 30 years, the standard exposure duration used in risk assessment. On this basis, Intel explored whether a residual risk assessment based on a shorter exposure duration would show that the site does not pose unacceptable risk. Discussions with Mike Poulsen (DEQ toxicologist) indicated, however, that the key impact on VC risk results from six years of childhood exposure which is considered by the EPA to be the same as a lifetime of adult exposure using the adult slope factor. This means that shortening the overall exposure duration has only a very modest impact on the risk level.

Intel, therefore, plans to maintain hydraulic containment with locally enhanced flushing efforts to address wells where a few MCLs are still exceeded, and to continue NA monitoring with some modifications as allowed by the NA monitoring plan. Over time, as concentrations continue to diminish, Intel may wish to consider a statistically based residual risk assessment to show that the site does not pose unacceptable risk to the hypothetical off-site use of groundwater.

The planned changes to the monitoring program consist of moving seven wells from class 3 to class 2, and by monitoring the class 2 wells twice per year and the class 3 wells four times per year. The change will be implemented in October 2013, the annual event.

The proposed class groups for the Willamette Silt are:

- Class 1 (AW-1, AW-2, AW-3, AW-4, AW-5, AW-6R, AW-8B, AW-9A, AW-9B, RW-5, RW-6, RW-7, RW-9, TW-1, and TW-2).
- Class 2 (AW-8A, AW-10-26, AW-17, AW-18, AW-19, AW-20, AW-21, AW-22, AW-23, AW-25, RW-1, RW-2, RW-3R, RW-4, RW-6, RW-8, and RW-10).
- Class 3 (AW-10-36, AW-24, and OW-1).

The proposed class groups for the valley fill are:

- Class 1 (AW-16, MLW-2 [all three zones], MLW-2 [both zones], and MLW-4 [all four zones]).
- Class 2 (AW-10-50, AW-10-68, AW-11, AW-12, AW-13, AW-15, and MLW-3 [zones 1, 2, and 3]).
- Class 3 (MLW3 zone 4).

Intel requests DEQ concurrence on these modifications, with the understanding that Intel may perform additional monitoring and that the results of additional monitoring would be provided to DEQ in annual reports.

IRAM Groundwater Treatment

Groundwater extracted by the hydraulic containment system is treated and discharged to an on-site storm sewer under a National Pollutant Discharge Elimination System (NPDES) permit. As part of system monitoring, pre- and post-treatment groundwater samples are obtained from the system and tested for VOCs. The post-treatment samples are also tested for total dissolved solids (TDS). Intel submits the data for the post-treatment samples to the Water Quality Division of DEQ, under Intel's NPDES permit reporting requirements. Treatment data through June 2013 are summarized in Attachment 9. The table and figures in Attachment 9 show historical and current permit requirements. The table summarizes the untreated influent and the treated effluent water quality data since the system began operation in 1996. The figures show the influent and effluent concentrations of TCE, VC, 1,1-dichloroethane (1,1-DCA), and total VOCs.

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METHANE MONITORING

As explained in progress report 111, elevated levels of methane were detected in various wells during summer 2009. Monitoring has shown that methane levels declined through summer 2009 and have remained at low levels. To be protective, however, the DEQ requested a formal methane monitoring plan. The plan was approved by the DEQ on May 21, 2010. Subsequent weekly measurements have been reported to the DEQ and no issues have been detected. Because full-scale active treatment has been completed, and because methane levels had declined to low levels, the frequency of methane monitoring was decreased in 2011. The measurements are summarized in Attachment 10.

Recent monitoring has continued to show a lack of issues. On this basis and given that 1) almost 3 years have elapsed since lactate injection ceased, and 2) that during those years, both methane gas levels and dissolved methane concentrations in groundwater have declined, Intel requests DEQ concurrence that methane gas monitoring can be terminated.

PROBLEMS

No unanticipated problems were encountered during the reporting period.

If you have any questions or comments concerning this report, please contact the undersigned at (503) 639-3400.

Sincerely,

AMEC Environment & Infrastructure, Inc.

Russ Bunker, R.G.
Associate Geologist

Reviewed by:

John L. Kuiper, R.G.
Vice President

RB/lp

REGISTERED PROFESSIONAL
OREGON
RUSSELL C. BUNKER
GEOLOGIST

EXPIRES 6/30/14

Attachments:	Tables	1 through 4
	Figures	1 through 32
	Attachment 1	Groundwater Results Summary
	Attachment 2	July 2012 Groundwater Monitoring Field Records and Laboratory Reports
	Attachment 3	October 2012 Groundwater Monitoring Field Records and Laboratory Reports
	Attachment 4	January 2013 Groundwater Monitoring Field Records and Laboratory Reports
	Attachment 5	April 2013 Groundwater Monitoring Field Records and Laboratory Reports
	Attachment 6	Groundwater Data Verification Reports
	Attachment 7	Mass Concentrations vs. Time Plots
	Attachment 8	Molar Concentrations vs. Time Plots
	Attachment 9	IRAM Treatment Summary
	Attachment 10	Methane Monitoring Summary

RB/lp

c: Leonard Cano; Intel, Hillsboro, Oregon
Tom Cooper; Intel, Santa Clara, California
Ralph Moon; HSA Engineers and Scientists