North Pole Refinery Technical Project Team
May 1, 2012
DEC Offices-Fairbanks Alaska

Technical Project Team Members in Attendance

Bill Butler	City of North Pole, Director of City Services (via telecon)
Dr. Dave Barnes	UAF, Civil and Environmental Engineering, Department Chair
Cindy Christian	DEC, Drinking Water Program, Compliance Program Manager
Ann Farris	DEC, Contaminated Sites Program, Project Manager
Loren Garner	FHRA Groundwater Program Manager
Nim Ha	DHSS, Health Educator
Lee Johnson	DEC Drinking Water Program
Elizabeth Page	Koch Remediation & Environmental Services, Director

Support Personnel in Attendance

Rebecca Andresen	Arcadis
Brian Angerman	Barr Engineering (via telecon)
Steve Bainbridge	DEC, DEC Contaminated Sites Program, Director
Stephanie Buss	SPB Consulting, Toxicologist
Dave Dahlstrom	Barr Engineering (via telecon)
Todd Dejournett	Barr Engineering (via telecon)
Denise Elston	DEC, SPR-Contaminated Sites, Program Specialist (via telecon)
Jim Fish	DEC, SPR-Contaminated Sites, Program Specialist
JoAnn Grady	Grady and Associates, Team Facilitator
Ali Hamade	DHSS, DPH – Epidemiology
Ty Keltner	DEC, Public Information Officer (via telecon)
Kimberly Lake	Johnson and Wright (via telecon)
Dr. Mary Beth Leigh	UAF, Assistant Professor, Microbiology
Mark Lockwood	Shannon & Wilson (via telecon)
Dr. Brian Magee	Arcadis, Principal Toxicologist (via telecon)
Dr. Bill Farland	FHRA consultant (via telecon)
Andrew Ohrt	Barr Engineering (via telecon)
Shannon Price	FHRA
Phil Roberts	Williams
Gary Remple	Barr Engineering (via telecon)
Max Schwenne	OASIS Environmental, Project Manager
Eric Zentner	Boreal Communications Strategies

INTRODUCTIONS AND ACTION ITEM REVIEW

The meeting began at 9:00 AM Alaska time as team members introduced themselves and reviewed the action items from the previous meeting. The team agreed that all other action items from the previous

meeting had been completed. The team reviewed and approved the agenda of the meeting after making minor changes to the order of the presentations.

TOXICOLOGY AND CHEMISTRY SUBGROUP UPDATES

Ms. Buss updated the team on recent developments within the Toxicology subgroup. The National Toxicology Program (NTP) will soon begin the first of the three tiers of studies that it intends to conduct on the toxicology of sulfolane. The first tier of studies will be conducted to determine how different species respond to varying doses of the substance. The first of these studies is expected to be conducted over a period of 28 days and its formal reporting of the results should be available within the current year. The second series of studies will be devoted to assessing how sulfolane affects a number of factors such as the immune response and the reproduction and development of the subject species. Once the data from the first two tiers of studies is available, the NTP will determine if the third tier, design and implementation of studies which will consist of long-term carcinogenic studies, should be pursued. Ms. Buss informed the team that the National Institute of Occupational Safety and Health (NIOSH) has expressed interest in conducting its own studies on sulfolane. She said that representatives of NIOSH are collaborating with the NTP, one of their partner agencies, in the development of their independent studies.

Ms. Buss updated the team on recent developments within the Chemistry Subgroup. The subgroup has finished its review of the revised key elements documents. ESI has completed its review of validated samples and reported any issues to the subgroup. Ms. Buss said that the subgroup will review the SOPs of the project laboratories once they are updated to reflect the changes made in the key elements document.

The team agreed to defer discussions on the risk assessment to a future meeting, to be scheduled ASAP.

THE UNIVERSITY OF ALASKA FAIRBANKS' MICROBIOLOGICAL STUDIES

Dr. Mary Beth Leigh of the University of Alaska Fairbanks (UAF) presented an update on the summer schedule for various studies that the university is conducting on the biodegradation of sulfolane. The studies will be focused on elucidating the role of biological activity in the degradation of sulfolane that has been measured in different parts of the remediation system. Dr. Leigh hypothesizes that biological activity is contributing significantly to the degradation of sulfolane since the performance of the system is exceeding expectations. She described how the studies will attempt to isolate and identify the sulfolane degrading microbes throughout various parts of the system and will develop DNA-based methods for detecting them amidst the site's general microbial population.

Dr. Leigh clarified that the DNA-based detection methods that have been proposed for the studies will indicate whether sulfolane degrading microorganisms are present, but they will not indicate the species-identity of those organisms. She said that the university will attempt to compare the unknown organisms with cultures of sulfolane- degrading microorganism that are known to exist at the site. It will later decide whether to perform the more expensive DNA sequencing tests to identify the species of those organisms. The team discussed the presentation. Ms. Page offered to provide the project's

geochemical data to the university researchers to allow them to consider whether varying geochemical parameters are affecting the biological processes of sulfolane degrading microorganisms at specific locations within the project area. The team agreed that it would be useful to coordinate the university's research activities with FHRA's ongoing sampling efforts.

ACTION ITEM: Dr. Leigh and Dr. Barnes will meet with representatives of Shannon & Wilson and FHRA to coordinate their microbiological studies with FHRA's ongoing sampling efforts and to obtain existing geochemical data that may be pertinent to those studies.

THE UNIVERSITY OF ALASKA FAIRBANKS' ANALYSIS OF OTHER ATTENUATION FACTORS

Dr. Barnes described the ongoing efforts of UAF researchers to characterize other attenuation factors at the site. He explained that UAF has been working with Shannon & Wilson to install pressure transducers in key monitoring wells in order to gain a more detailed understanding of the movement of contamination within the plume. He said he hopes this information will allow researchers to evaluate whether the observed decreases in sulfolane concentration are the result of attenuation or whether they are merely the result of the contamination being transported within the plume. Dr. Barnes said that the data from the pressure transducers will be compiled with Dr. Shur's permafrost analysis to develop mathematical models to test the researcher's hypotheses concerning the presence of sulfolane at remarkably deep depths. He said it should also help explain the unusually small aspect ratio of the plume. Dr. Barnes hopes that the data will also clarify other puzzling elements within the project, such as the role of Badger Slough and gravel pits, in the interactions between surface water and ground water at the site.

THE SITE CHARACTERIZATION SUBGROUP

Mr. Schwenne updated the team on recent developments within the Site Characterization subgroup. The subgroup is currently discussing how it will evaluate the potential influence of permafrost on the migration of sulfolane and the extent to which sulfolane has apparently spread within the sub-permafrost regions of the affected area. The subgroup is considering whether the data from drinking water wells logged as being installed beneath permafrost is adequate to characterize the sub-permafrost areas or whether the characterization of these areas will necessitate the installation of monitoring wells that are drilled through the permafrost layer.

Mr. Schwenne said that the subgroup is currently discussing how it will apply the Remedial Action Objectives (RAOs) in its selection of the remediation technologies outlined in the Feasibility Study (FS). He expressed his position that the team must establish more precise RAOs before it can select among the available technologies and finalize the FS. Ms. Page replied that the current RAOs are based on the range of possible cleanup levels and that range need not affect the selection among technologies. Ms. Farris interjected that ADEC is discussing the matter internally and will need to provide guidance to FHR. Mr. Garner suggested that a recommended alternative will be presented in the cleanup plan rather than the FS to allow the use of a range through the process. The team agreed to continue to keep the issue in the forefront of its discussions in the subgroup.

GROUND WATER REVIEW

Mr. Garner presented an overview on FHRA's ongoing site assessment and field work. He turned the presentation over to Mr. Dahlstrom who updated the team on the status of recent efforts to obtain water data to characterize the vertical gradient of the affected aquifer. Mr. Dahlstrom informed the team that during the previous October, FHRA resurveyed all site monitoring wells, including several of the monitoring wells that had been affected by frost-jacking. The resurvey will have implications for the data logger program since they had to offset changes to the water level measurements from the affected wells. Several of the data loggers were out of service from the fourth quarter of 2011 until the last few weeks. He added that while they have all been replaced and are operating normally, the data gap from that period will be reflected in the Site Characterization Report (SCR). Mr. Dahlstrom said that his group will likely perform annual resurveys of the wells with transducers which may result in step-changes in the data in future reports.

CORELATION BEWTEEN SEASONAL VARIATION IN THE DIRECTION OF GROUNDWATER FLOW AND CHANGES IN THE SULFOLANE CONCENTRATIONS OBSERVED AT CERTAIN POINTS WITIHIN THE PROJECT AREA

Mr. Dahlstrom described his team's efforts to evaluate a possible correlation between seasonal variation in the direction of groundwater flow and changes in the sulfolane concentration observed at certain points within the project area. His team calculated the direction of groundwater flow by using data from three wells that were installed by the United States Geological Survey (USGS) and have been operated by the Army Corps of Engineers (ACOE) for the past several years. He added that while measurements in these wells have been suspended during the winter months since 2006, they provide a period of record which can be compared to the historical concentration data from various monitoring wells within the site. With the exception of some timing differences associated with spring surge events, the data from the USGS wells correlated quite well when they were compared with water level data taken from Monitoring Well (MW) 151A and MW 170.

Mr. Dahlstrom said that in evaluating the correlation, the team considered several factors such as the position of the monitoring wells relative to the source area, the volumetric rate of the flow and its effect on dilution, the lag time between the water level flux and the changes in concentration, and the hydraulic-gradient through the period of record. He pointed out a few examples of monitoring wells wherein the concentration of sulfolane fluctuated with changes in the direction of groundwater flow in relation to a nearby source area. He added that while the concentration in these wells increased when water was flowing to them from a source area and decreased when water was flowing in the other direction towards the source area, the average concentration of sulfolane observed in the wells decreased from year to year.

Mr. Dahlstrom said that although there is considerable uncertainty in the analysis given various data gaps, the team concluded that it is likely that seasonal changes in the direction of groundwater flow, and the hydraulic-gradient, are the primary causes of the fluctuations in sulfolane concentration that have

been observed in many project wells. He added that his team believes the trend of decreasing concentration observed in many of the wells with seasonal fluctuations indicates that attenuation is occurring. Mr. Garner commented that many of the ongoing studies will hopefully clarify the extent to which that trend can be attributed to dilution, abiotic or biotic factors, or to the operation of the remediation system

BENCH TESTING

Mr. Dejournett described the procedure and results for recent testing that was carried out to explain observations of sulfolane being unexpectedly removed from contaminated water as it passed through various components of the remediation system. The objectives of the testing were to determine, more specifically, where the removal is occurring within the system, to determine the mechanisms responsible for the removal, and to determine the chemical pathways attributed to sulfolane being 'broken down'. Mr. Dejournett said that results of the bench testing indicate that the observed degradation is occurring in the air stripper units, the gallery pond, and the sand filters and it is associated with the oxidation of iron and manganese in the groundwater and concentrated in the backwash solids within these components. He briefly described how the results of the testing suggest that the degradation may be occurring through biotic mechanisms in addition to the abiotic mechanisms associated with the oxidation of iron and manganese.

Mr. Dejournett elaborated on the findings of the testing that were related to the abiotic component of the observed degradation. He presented a slide summarizing the theoretical chemical pathways for the degradation of sulfolane in the remediation system as evidenced by the daughter products found in the bench testing, and as corroborated by the chemical literature on sulfolane degradation. Mr. Dejournett described one of the pathways as an oxidation reaction involving iron oxide. He pointed out other pathways and stated their prevalence depends on conditions within the system such as the pH of the water and its oxygen content. Mr. Dejournett informed the team that the aforementioned pathways were analyzed in a synthetic ground water system and the daughter products within those pathways were not found in the pilot tests. He explained that the information on the daughter products indicates that they have a greater volatilization than sulfolane, or adhere/absorb more strongly to organic material, and consequently would tend to attenuate more rapidly than sulfolane and thus be short-lived in actual site conditions.

INJECTION AND TRACER TESTING

Mr. Ohrt presented information on the recent injection and tracer testing that was carried out at the project site. The objectives of the testing were to determine the implementability of an injection-based remedial alternative and to determine the hydro-geological parameters for the site, particularly with regard to groundwater velocity. To address these objectives, his team carried out an injection test, a constant rate test, as well as a tracer injection test. While the monitoring and analysis of the tracer test is still underway, the preliminary results of the testing indicate that the groundwater velocity is consistent with the predictions of the conceptual site model. Mr. Ohrt said that while they have not

decided whether to propose an injection-based remedial alternative for the site, the results of the initial injection testing indicate that injectability-based remedial alternatives are implementable for the site.

AIR SPARGE TESTING

Mr. Angerman presented a summary of the observations from recent air sparge tests conducted at the site. The objectives of the testing were to determine the operating conditions necessary to remove sulfolane from affected on-site areas using an air sparge system. He presented a detailed overview of the system used to conduct the tests and explained that the system consists of two lines of air sparge points, one of which was operated continuously and the other of which was pulsed. He summarized the results of the tests and commented that they observed effective removal of sulfolane from both the continuously operated line and the pulsed line. Mr. Angerman's team intends to reduce the flow rate of the system and to consider altering its pulsing frequency to attempt to optimize its operation and to determine if there are mechanical or technical ways that it can be improved.

The team discussed Mr. Angerman's presentation. Ms. Farris asked whether the team attributed the removal of sulfolane to an abiotic reaction. Mr. Angerman replied that the air sparge and bench testing indicate that the first step of the degradation process is abiotic, but the subsequent steps appear to be biotic. They have documented that the reaction occurs very rapidly and that it can occur at very low temperatures. He added that it is particularly rapid when oxygen and air are provided as in the case of the air sparging. Ms. Farris asked whether anything other than oxygen could limit the abiotic reaction. Mr. Angerman replied that iron and manganese seem to play a role in the reaction and might prove to be limiting factors. He added that one reason they pulsed one of the lines was to allow iron and manganese to penetrate the treatment zone. He said they will continue reviewing the data on dissolved iron and manganese to further clarify their roles in the degradation process.

THE 2012 SITE CHARACTERIZATION REPORT WORK PLAN

Mr. Ohrt briefly reviewed the content of the 2012 Site Characterization Work Plan. He outlined the objectives of the next phase of well installations which include: further delineation of the sulfolane plume and the depth to the top of permafrost, further delineation of the capture zone and evaluation of the treatment system, and further delineation of the detections observed in the on-site pore water piezometer. Mr. Ohrt said the document includes plans to continue the on-site soil investigation to resolve "hot spots" that were found in the initial soil sampling. It also reflects changes in the scope of the investigation of certain areas that were initiated by new observations of light non-aqueous phase liquid (LNAPL) contamination. The work plan describes an evaluation of new techniques such as the use of laser-induced fluorescence (LIF) in conjunction with a geo-probe to further evaluate the extent of LNAPL contamination in the area. The work plan also includes the proposal for additional pressure transducers and monitoring wells, and the second phases of the subsurface microbiological studies and stable isotope evaluation.

THE DRINKING WATER SUBGROUP

Ms. Christian and Mr. Johnson updated the team on recent developments within the Drinking Water subgroup. Ms. Christian said that the final approval for the new city wells was issued April 30th, 2012. She said that the wells are now fully approved to operate without restrictions or caveats. The team discussed the permitting process for drinking water systems that are currently under design. The team agreed that it would be useful if FHRA could provide certain information on these systems to ADEC so that the department can anticipate questions from the owners about their progression through the permitting process.

ACTION ITEM: Mr. Price will provide ADEC specific information on the drinking water systems that are currently under design so the department can be prepared to answer any questions they receive from the public on the permitting process.

RISK COMMUNICATION SUBGROUP

The team briefly reviewed last minute details for the Community Open House, scheduled to be held that evening at the North Pole Mall. The team agreed to convene at 4:00PM for set up. The Open House was scheduled to run from 5:30PM-7:30PM.

DELIVERALBES AND UPCOMING MEETINGS

The team discussed the schedule for the upcoming meetings of the Technical Project Team (TPT). The team agreed to hold a preliminary risk assessment comment resolution meeting by teleconference on May 8th at 1:00 PM Alaska Time. The team confirmed that the next TPT meetings will be held in the ADEC's Fairbanks office on June 26th and July 25th.

The meeting adjourned at 1:07 PM Alaska Time.