Sulfolane Investigation Update

Provided by the Technical Project Team to inform the North Pole community on recent developments in the investigation and remediation of soil and groundwater contamination related to the North Pole refinery.

December 2013

Additional sampling continues to provide more pieces of the puzzle

Scientists have a better picture of the sources of sulfolane and petroleum contamination after last summer's sampling at the Flint Hills Resources Alaska's (FHRA) North Pole refinery site, and they've learned more about the extent of the contamination. It's all work that will help design ways to clean up and control the contamination.

Last summer's work should provide enough information to transition from the site characterization to the feasibility study, steps that are set in state law as part of the cleanup process, assuming the data collected to date is sufficient. FHRA and the Alaska Department of Environmental Conservation (DEC), and their contractors, will analyze the results this winter.

Site Characterization

In complex contaminated sites, site characterization is usually a multiple-year process, and it has been so for this site. The site characterization step, which began in November 2009, was extended to include last summer's work because there were still unknowns about how sulfolane moves and reacts in Interior Alaska's unique environment and geology, such as the permafrost. That extension meant that the schedule for the site needed to be revised. (See *Cleanup timeline* graphic, p. 5.)

A field technician performs groundwater sampling from a monitoring well at Flint Hills Resources' North Pole refinery in 2013. Results from this sampling will be included in the site characterization report that FHRA will submit to DEC in December 2013. (FHRA photo)

Under the revised schedule, FHRA is to submit reports this winter (2013-2014) on the data that was collected last summer. The feasibility study (explained in the "Feasibility study" section, p. 5) is scheduled to be completed in the fall of 2014, and the final cleanup plans are set to be complete in the spring of 2015.

The investigation of sulfolane contamination in North Pole has been unprecedented for any contaminant in Alaska due to the distance that sulfolane has traveled – the plume is roughly 3½ miles long, 2½ miles wide and at least 300 feet deep – and the number of private drinking water wells that it has affected. (Health officials since 2010 have advised people to not drink water impacted by sulfolane.)

*(Continued, see **Cleanup process**, p. 4)*

In this Issue

North Pole Open House on Sulfolane

Tuesday, January 14, 2014 • 5–7 p.m.

at the North Pole City Hall
125 Snowman Lane

Come meet with staff overseeing the investigation and remediation of the sulfolane groundwater plume in North Pole. The open house is designed to update the community on the project and answer questions.

For more information, call DEC at (907) 451-2182.

Report from Flint Hills

By FHRA

The summer and fall of 2013 was a busy time for Flint Hills Resources Alaska (FHRA). The company's employees, along with its consultants and contractors such as Rolling Stone Inc., Slayden Plumbing & Heating, Great Northwest Inc., Homestead Drilling, GeoTek Alaska Inc., ARCADIS, Shannon & Wilson Inc., Barr Engineering, Arctic Home Living and others, have worked hard on a number of projects both on and off the refinery property.

So far this year, 17 homes and businesses have had a long-term water solution provided, bringing the total of long-term solutions installed in the community to 303. FHRA also conducted an additional door-to-door survey of homes inside the city limits of North Pole in the affected area to ensure people are aware of the Alaska Department of Health and Social Services' recommendation to use non-impacted water for the watering of vegetable gardens. FHRA worked with homeowners in the few cases that were identified to be without a garden water source (other than a well impacted by sulfolane) to enable them to have access to a water source for gardening activities. The goal of this survey was to make sure residents were aware of the gardening recommendation and to facilitate access to an adequate source for each gardener.

One project that received quite a bit of attention from the community was the permafrost mapping survey. This work was conducted by a company that specializes in the technology and process of permafrost mapping. This survey included a helicopter carrying a survey instrument from a cable and flying in a grid pattern over designated areas both in and outside the plume area. The instrument measured electromagnetic fields to collect information about the depth and thickness of permafrost beneath the ground surface. Understanding permafrost formations helps the technical teams working on the groundwater project to better understand groundwater movement and aid in the prediction of future plume behavior.

As part of the onsite investigation phase, there were about 80 monitoring wells installed and about 240 soil and water samples collected over the summer and fall. This work produced water and soil data that are being analyzed. This information will be included in the site characterization report that will be submitted to the Alaska Department of Environmental Conservation in December 2013.

(Above) A soil sample taken on the refinery's property on Aug. 21, 2013. Analyses of these and other samples were conducted for sulfolane, benzene and other contaminants of concern. This information will be included in the site characterization report that FHRA will submit to DEC in December 2013. (FHRA photo)

(Right) A Flint Hills contractor drills into the ground to install a new monitoring well, one of 80 installed this summer. (FHRA photo)

From the Project Manager's Desk

It's been a year since I started managing the sulfolane investigation. My experience started with a number of challenges, most of them of a technical nature. However, one of the main challenges I encountered was how to reach out effectively to you – the people of North Pole who live, work, or own property in or near the plume area.

I began by putting myself in your shoes and asking, "What would I like to know?" What came to mind was that I'd want to know, first, "Who's making sure that the water I drink is safe?" And second, "Who can I ask for information when I need it?"

That's why, when I introduced myself in our February 2013 newsletter, I wanted to make sure that you know I'm here to answer your questions. Many of you contacted me. Then, last May, we asked for your feedback in a questionnaire we mailed to your homes. Thank you all for your questions and feedback! Your feedback during this process is extremely valuable.

Another enormous challenge I've encountered is understanding the distribution of the sulfolane contamination – a challenge our entire technical team faces. Over the past several years, during our site characterization and investigation process, new unknowns and difficulties have emerged. The first step was to determine the extent of the plume to ensure all impacted residents were protected.

Now the challenges have evolved to include, among many others, understanding:
(1) how the plume got that far and that deep,
(2) why some wells are so much more impacted than others,
(3) how the permafrost impacts the groundwater flow and sulfolane distribution,
(4) how sulfolane degrades,
(5) if it can be cleaned up, and
(6) what the most efficient and effective method to clean it up would be.

Flint Hills Resources Alaska (FHRA) will deliver a draft of the 2013 Site Characterization Report at the end of the year. When that happens, the technical team will be at a point in the cleanup process where we must move toward developing remediation (cleanup) alternatives, considering everything we know about the contamination and everything that we don't know. We'll do that using a conceptual site model – a way of integrating all the site information. The conceptual site model will tell us if there's missing data that needs to be collected at the site. It will also facilitate the selection of remedial alternatives to be evaluated in the next step of the process (as described the **Cleanup Process** article on p. 5, "Feasibility study" section).

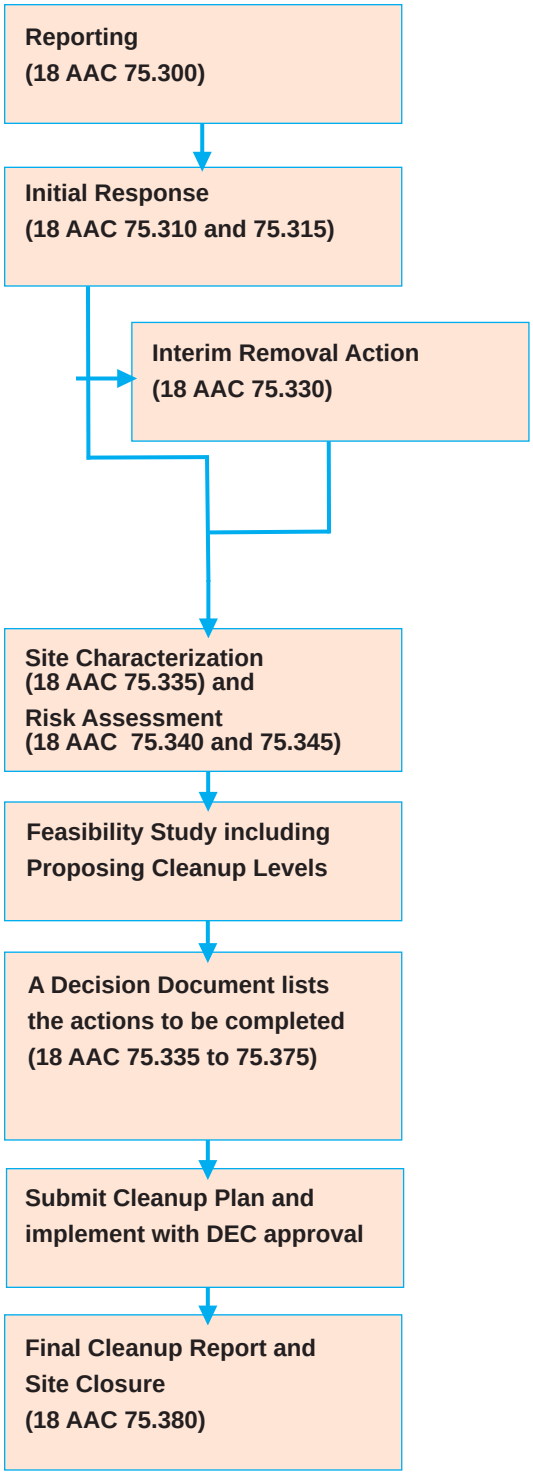
On DEC's behalf, I thank you for your patience and understanding throughout this process. The cleanup process is one that can be filled with uncertainties; it is our job to make the best effort to reduce those uncertainties to acceptable levels. See you at the Jan. 14 Open House!

Sincerely,

Tamara Cardona

Technical Project Team (TPT) Project Manager
Contaminated Sites Program, Spill Prevention & Response Division
Alaska Department of Environmental Conservation
Phone: **(907) 451-2192**, Email: **tamara.cardona@alaska.gov**

Cleanup process of the Alaska Department of Environmental Conservation



"18 AAC 75.xxx" refers to Title 18 of the Alaska Administrative Code of Regulations, Chapter 75, and its specific sections, where these steps are mandated and described.

Cleanup process, *Continued from Page 1*

To understand how sulfolane behaves in the environment, scientists have gone far beyond typical soil and groundwater sampling.

FHRA's work last summer included installing and sampling additional monitoring wells:

- On the refinery property and offsite in the plume area to better define sulfolane source areas,
- At offsite "hot spots" (areas that have higher concentrations than others), and
- At the groundwater plume boundaries (areas where elevated levels of sulfolane decrease below DEC's site-specific cleanup level of 14 parts per billion sulfolane for groundwater).

There are some residential wells in the plume area that draw water from below permafrost. FHRA began sampling some of those deep wells regularly last summer. There aren't any monitoring wells that go below the permafrost.

Some of the work FHRA did last summer that is far beyond "typical" soil and groundwater sampling includes:

- Using geophysical surveys to estimate the various locations and depths of the permafrost,
- Collecting very detailed soil samples to get a picture of where the sulfolane is stored in soil, and
- Doing other testing to understand where the contaminated groundwater flows.

The company also increased its ability to recover sulfolane from the groundwater below the refinery site, as well as a number of other activities. (See **Report from Flint Hills** article, p. 2.)

Also last summer, a DEC contractor collected samples from seven gravel pits and the Badger Slough in the plume area to see if sulfolane was present. The sampling showed that it was not present in surface water. (See **Gravel Pits** article, p. 6.)

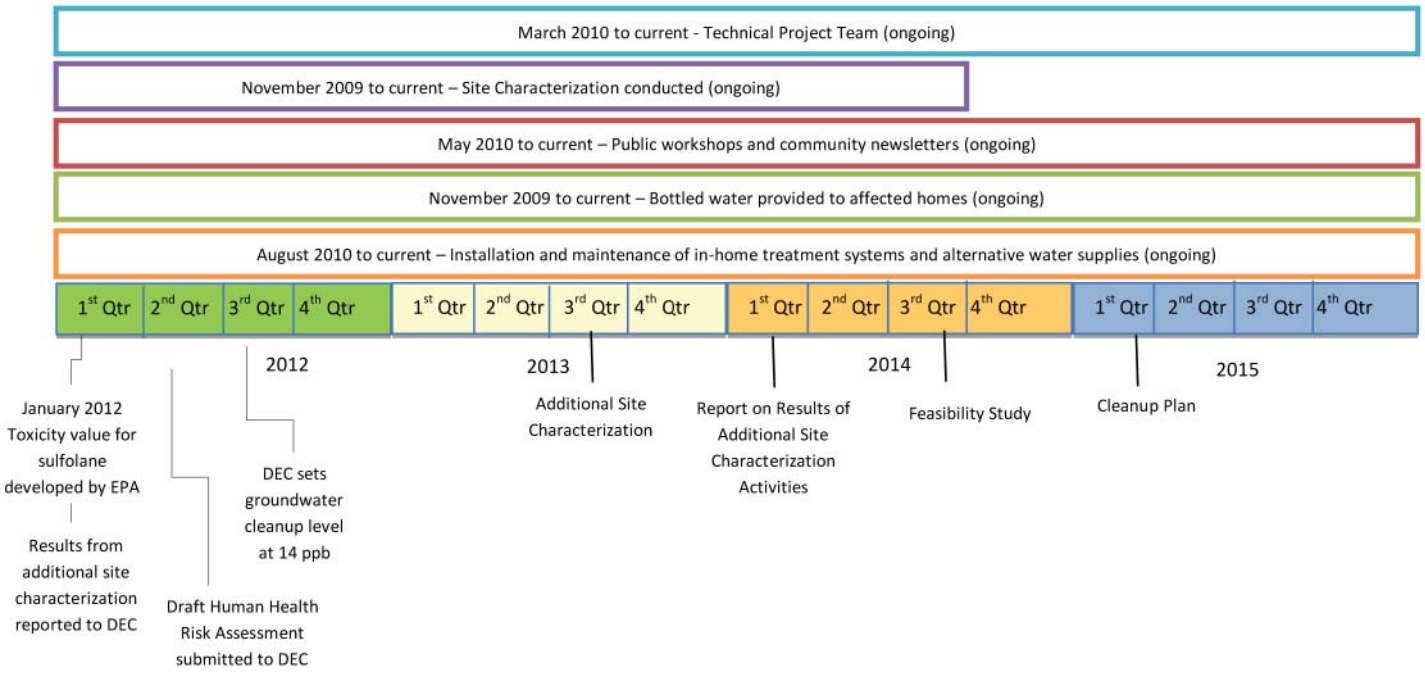
Last summer's work, and previous site characterization work, was based on the following goals:

- Eliminate exposure to the community for as long as it takes to clean up the site.
- Identify all the sources of sulfolane.
- Establish a monitoring network that measures sulfolane migrating off the refinery.

Risk assessment

A risk assessment is part of the site characterization; it's the step in which information is gathered about the site and how people may be exposed to contamination. (See the "Cleanup Process" diagram at left.) Regulators use the risk assessment, as well as other information, to determine the final cleanup levels. DEC in 2012 set the final cleanup level for sulfolane in groundwater at the site at 14 parts per billion,

Cleanup timeline for the North Pole Refinery, sulfolane contamination*



*Timeline reflects final deliverables.

which means that groundwater with more than 14 parts per billion sulfolane must be remediated.

Interim action

Since site characterization takes time, interim actions may be taken to ensure that people and the environment are safe during the process. Interim actions are especially important for large areas of contamination or sites with a chemical about which limited information is known. Both instances apply in the case of the refinery sulfolane plume.

DEC's goals during interim actions are similar to those during the site characterization:

- Eliminate the current exposure to sulfolane,
- Achieve and maintain control of the sources of contamination,
- Eliminate releases or leaking issues,
- Minimize the potential for new spills,
- Aggressively respond to and clean up any new spills that may occur.

The interim actions at the site have included FHRA providing alternative sources of drinking water to people in homes with sulfolane in their wells. On the refinery property, the interim actions include FHRA's "pump and treat" system that pumps contaminated groundwater and treats it by removing sulfolane and petroleum contamination. The pump and treat system has operated at the refinery since 2001; it has been upgraded since then as recently as last summer.

Feasiblity study

Once the site characterization allows an adequate understanding of the contamination, the next step is the feasibility study, where FHRA researches, evaluates and recommends to DEC one or more cleanup techniques based on criteria in federal regulations set by the U.S. Environmental Protection Agency: protectiveness, practicality, effectiveness, conformity with state and federal regulations, and consideration of comments from the public.

When the feasibility study is complete and DEC approves it, cleanup techniques will be determined, based on the previous steps: site characterization, the feasibility study and established cleanup level.

Cleanup plan

Next, FHRA will develop a cleanup plan, subject to DEC approval as well. The plan takes into account current and future use of the site; the degree of treatment; and protection of human health and safety and the environment. How FHRA will minimize the spread of contamination and monitor the extent of contamination in the future are also part of the cleanup plan.

To date, DEC has asked FHRA to meet the goal of zero contaminant migration offsite and to implement aggressive treatment at the refinery.

Throughout the whole cleanup process, DEC seeks public participation. So far, that has included a site-specific website, regular newsletters, open houses, public meetings, group email list postings, mailings, surveys and fact sheets. DEC encourages the public to remain engaged as the cleanup process transitions from the site characterization phase into the cleanup phase.

Gravel pits: Sulfolane not detected

Surface water samples collected this summer from seven gravel pits and the Badger Slough north of the Flint Hills Resources Alaska (FHRA) refinery showed no evidence of sulfolane. One sediment and one groundwater sample showed very low concentrations.

The samples were collected from areas within the sulfolane groundwater plume to see if sulfolane could be detected in the gravel pits that are directly above contaminated groundwater, said Jane Paris, a senior hydrogeologist with ERM, an Alaska Department of Environmental Conservation (DEC) contractor.

DEC did the sampling to ensure that when the gravel is being mined, sulfolane-impacted gravel would not be transferred to another area, possibly contaminating that area. Pond No. 6 (see aerial map, p. 7) is the only gravel pit in the sulfolane plume that's currently being mined for gravel.

DEC also did the sampling to ensure that it was safe to eat the fish in Kimberly Lake – the only place in the plume area that the Alaska Department of Fish and Game stocks with fish.

The results show that the surface water does not contain sulfolane and there's no danger in moving gravel to other areas.

The results also show that there's no sulfolane in any part of Kimberly Lake, so sulfolane is not expected to accumulate in the lake's plants and animals, including fish, said Stephanie Buss, a toxicologist and DEC contractor.

"As far as sulfolane, eating fish from Kimberly Lake is not expected to be a health concern," said Ali Hamade, an Environmental Public Health program manager with the Alaska Department of Health and Social Services.

To do the sampling, DEC identified 11 gravel pits or ponds – some were dug years ago as gravel pits but gravel was never extracted – in the area of the sulfolane groundwater plume north and northwest of the refinery. Landowners gave permission for seven of the 11 to be sampled.

Of the seven ponds, including Kimberly Lake, the technicians sampled three locations at each of six of the gravel pits, in one location at one pit, and three locations at Badger Slough. All together, there were 22 surface water samples, 22 sediment samples and nine for groundwater.

The two samples that showed sulfolane aren't a cause for concern, Paris said. One was in a sediment sample. It had 10.9 parts per billion sulfolane, which is lower than DEC's screening level* of 38 parts per billion for sulfolane in soil. DEC doesn't have a screening level for sediment, so the level for soil is used for comparison. The difference between sediment and soil is that sediment is located in areas where it's saturated by water most of the time, such as the bottom of a pond.

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"As far as sulfolane, eating fish from Kimberly Lake is not expected to be a health concern."

—Ali Hamade, Environmental Public Health program manager DHSS

The other sample with a sulfolane detection came from shallow groundwater. It had 20.6 parts per billion sulfolane. That's above the DEC's cleanup level for the site of 14 parts per billion, but it's lower than known sulfolane levels in deeper groundwater in the same area. Drinking water wells in that area are currently under FHRA's alternate water supply program.

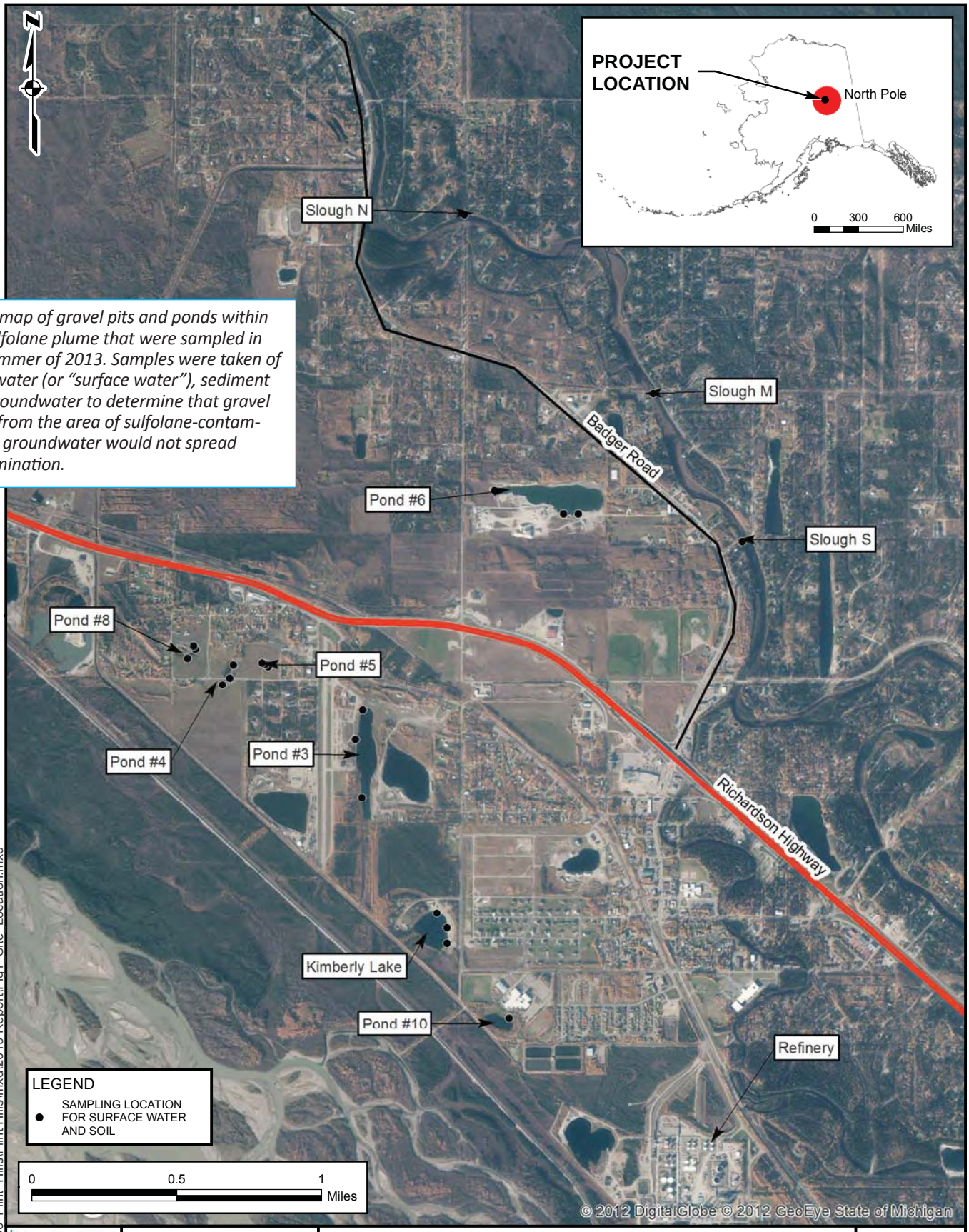
For each area that was sampled, the technicians first took a surface water sample several feet out from shore.

For the sediment samples, the technicians dug a hole in the bank of the gravel pit a couple of feet from the water. They dug down about a foot until they hit water. Then they scooped out saturated soil (sediment) from the side or bottom of the hole, below the water at the bottom of the hole. They used new scoops for every sample to avoid cross-contamination.

For the groundwater samples, the technicians dug a pit 2 to 3 feet below the ground surface until they hit about 6 inches of water, and took a sample of that.

"We're pleased that the results show there are no concerns about mining gravel in the sulfolane plume or fishing in the ponds," Paris said. "Things can and do change over time, of course, so we'll keep our eyes on the plume movement to decide if later we need to conduct more sampling."

* *Screening levels or criteria are risk-based levels that are used initially at a site before site-specific data is available; the levels are very conservative because there are so many unknowns about the site.*



Aerial map of gravel pits and ponds within the sulfolane plume that were sampled in the summer of 2013. Samples were taken of pond water (or "surface water"), sediment and groundwater to determine that gravel taken from the area of sulfolane-contaminated groundwater would not spread contamination.

M:\GIS\Projects\0149896 Flint Hills\Flint Hills\mxd\2013 Report\Fig1 Site Location.mxd

Source: **********

DATE: JUNE 2013
CHKD: J.P.
DRWN: S.M.C.
PROJ. No.: 0149896

825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

SITE LOCATION

GRAVEL PITS & BADGER SLOUGH
GRAVEL PITS SURFACE WATER AND GRAVEL SAMPLING REPORT
North Pole, Alaska

FIGURE 1

DEC hears from North Pole residents

The Alaska Department of Environmental Conservation (DEC) has heard from 172 people who answered an agency survey questionnaire, responding with questions and comments on topics ranging from concerns about the health effects of sulfolane to impacts on property values and how to plan for a water supply while building a new home in the sulfolane plume area.

DEC mailed out the survey in June to 1,092 North Pole residents who live in or near the plume, using the Fairbanks North Star Borough address records, and had 59 returned as undeliverable. The survey asked people to answer questions such as whether they know if their property is in the sulfolane plume, what water they're using for drinking and gardening, and what they'd like to know about the sulfolane investigation.

Tamara Cardona, DEC's project manager for the North Pole refinery site, said the response to survey has been very positive.

"We heard from people we've never heard from. The information that we've gleaned from people's responses is extremely valuable to the project," she said. "Survey responses are still trickling in. Thank you so much to everyone who took the time to respond."

Of the 172 people who answered the survey,123 said they live in the plume area. Most of the 172 said they work, live, recreate, visit, own property and/or have friends or family in the plume area.

"We heard from people we've never heard from. The information that we've gleaned from people's responses is extremely valuable to the project... Thank you so much to everyone who took the time to respond."

—Tamara Cardona, DEC's project manager

DEC has followed up individually with the roughly 50 people who asked questions or said they had concerns.

Of the people who have property in the plume area, about 30 percent said they're on city water, and 15 percent said they don't have a well. Of those who have a well, less than 1 percent said they don't have an alternate water supply.

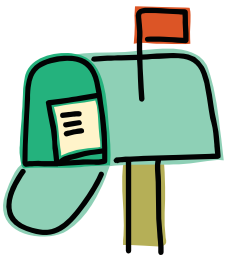
Of the people who said they have an alternate water supply, 24 percent have a granular-activated carbon filter water treatment system and 17 percent have bottled water delivered. Less than 1 percent have a tank and get drinking water delivered, either arranging it themselves or through Flint Hills Resources.

Of the 92 respondents who said they live in the plume area and garden, 25 percent use untreated well water to water their gardens, and 11 percent use city water, tank water from a Flint Hills-installed tank or something else, such as rainwater. Less than 1 percent use treated well water.

Some of the respondents didn't know if they live in the plume area. DEC has contacted those residents and told them whether they live in the plume.
For people who aren't sure whether they live in the plume, they should contact Tamara Cardona (907-451-2192, Tamara.Cardona@alaska.gov).

If you live in the plume area and your well hasn't been tested yet, please contact Shannon Price in the Flint Hills Groundwater Office (907-488-0723, Shannon.Price@fhr.com) as soon as possible to have your well tested.

(See the Project Contacts box below for more contact information.)



Project Contacts

DEC, Spill Prevention and Response Division, Contaminated Sites Program
Tamara Cardona, Environmental Program Specialist and TPT Project Manager
(907) 451-2192, tamara.cardona@alaska.gov

DHSS, Division of Public Health, Epidemiology Section
Ali Hamade, Environmental Public Health Program Manager
(907) 269-8086, ali.hamade@alaska.gov

DEC, Division of Environmental Health, Drinking Water Program
Cindy Christian, Compliance Program Manager
(907) 451-2138, cindy.christian@alaska.gov

Flint Hills Resources
Marisa Sharrah, Koch Companies Public Affairs
(907) 488-5103, marisa.sharrah@kochps.com
Jeff Cook, Koch Companies External Affairs
(907) 488-5104, jeff.cook@kochps.com

City of North Pole
Mayor Bryce Ward
(907) 488-8584, mayor@northpolealaska.com

Fairbanks North Star Borough
Mayor Luke Hopkins
(907) 459-1300, mayor@co.fairbanks.ak.us

dec.alaska.gov/spar/csp/sites/north-pole-refinery