YAKUTAT TLINGIT TRIBE

TRIBAL RESPONSE PROGRAM 2009

ANKAU SALTCHUCKS
SITE INVESTIGATION REPORT

Prepared by

RIDOLFI

March 2011

Tribal Response Program

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EXECUTIVE SUMMARY

This site investigation focused on dioxin contamination in shellfish tissue and soils associated with the Ocean Cape Radio Relay Station (OCRRS) located on the Ankau Saltchucks (Figure 1). Dioxins were detected in soil and shellfish tissue samples collected near the Yakutat Tlingit Tribe (YTT) Culture Camp and adjacent to the Ankau Bridge. The Culture Camp is a youth summer camp used by the YTT to teach cultural heritage. The camp is located on a former military site adjacent to the Ankau Saltchucks. In 2000, the Tribe stopped using the camp because of concerns about possible exposure of camp participants to chemical contamination that the Tribe believes is associated with former military activities at the site (Sensmeier, 2006).

During June 2010, 10 shellfish tissue samples were collected from eight locations within the Ankau Saltchucks. These samples were analyzed for dioxins and furans. One composite soil sample was collected from within the Culture Camp area adjacent to the Ankau Saltchucks and was analyzed for dioxins and furans and herbicides.

All 17 dioxin and furan congeners with toxicity equivalence factors (TEFs) were detected in the soil sample. For the analysis of herbicides in soil, method detection limits were sufficiently low to detect each of the herbicides that was included in the analyses. None of these herbicides were detected above risk-based-concentration (RBC) values for residential soils.

The total dioxin TEQ concentration of 62.6 ng/kg is over 14 times higher than the RBC value for residential soils. The results of this soil dioxin sampling confirmed previous sample results that indicated elevated dioxin concentrations in soils in the vicinity of the Culture Camp.

A dioxin “congener profile” was developed for the soil sample by calculating the relative percentage of each congener contained in the sample. The profile developed for the soil sample was visually compared to a number of dioxin source profiles compiled by USEPA.

Based on visual comparison, the soil sample profile most resembled the source profile for pentachlorophenol. The next closest visual match for the soil profile was the source profile for diesel exhaust. Following comparison of the soil profile to established profiles, the soil sample was analyzed for pentachlorophenol. The laboratory analysis detected 280 µg/kg of pentachlorophenol in the soil.

Analysis of the composite soil sample from the Culture Camp area confirmed the results of previous sampling that had identified elevated concentrations of dioxins and furans in site soils. Since it is difficult to draw defensible conclusions based on a single sample, more extensive soil sampling should be conducted to define the extent of dioxin contamination in and around the Culture Camp.

While a congener profile was developed based on the distribution of dioxin and furan congeners detected in the soil sample, it is uncertain how well a single sample might represent a pattern that can be tied to a specific source. However, the presence of pentachlorophenol in the soils supports YTT's assertion that the dioxins are related to military activities in the area and not from burning at the Yakutat dump.

More extensive soil sampling for dioxins and furans would provide a more robust basis for developing a representative dioxin profile. In addition to more extensive soil sampling, expanded investigation to identify potential dioxin sources should be conducted.

Dioxin and furan congeners were detected in 8 of the 10 shellfish tissue samples. In all tissue samples, most dioxin and furan congeners were either not detected or were detected just above the analytical detection limits.

Dioxin concentrations in shellfish tissue were calculated using two different methods; first by calculating a toxicity equivalence (TEQ) concentration for each sample assuming a concentration equal to one half the method detection limit for any non-detected congeners, and second by calculating a TEQ assuming a concentration of zero for non-detected congeners.

When total dioxin TEQ concentrations were calculated assuming a concentration equal to one half the method detection limit for non-detected congeners:

- All 10 samples exceeded the risk-based concentration (RBC) established by USEPA.
- All concentrations were similar, with the maximum concentration about twice as high as the minimum concentration.
- There were no obvious correlations between dioxin concentrations and sample locations or shellfish species.

When total dioxin TEQ concentrations were calculated, assuming a concentration of zero for non-detected congeners:

- Two samples exceeded the RBC established by USEPA.
- Four samples exceeded a more protective RBC that is more representative of a subsistence consumption rate.
- Samples in the north and west portions of the study area typically had higher dioxin concentrations than samples in the south and east portions.
- The crab sample collected in the northwest portion of the study area had the highest detected dioxin concentration.

The majority of dioxin and furan congeners detected in shellfish tissue samples were present at levels only slightly above current analytical detection limits. To better understand the potential for health risks to shellfish consumers, and to determine if the higher detected concentrations in

the northwest portion of the study area represent dioxin distinct source areas, more extensive shellfish tissue sampling and analysis should be conducted.

To help determine whether dioxin concentrations in shellfish in the Ankau Saltchucks are attributable to localized sources or more regional dioxin sources, areas determined to best represent “natural background” conditions should be selected, and shellfish should be sampled in these relatively unaffected areas.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

° C	degrees Celsius
ARI	Analytical Resources Inc.
AXYS	AXYS Analytical Services Ltd.
GPS	global positioning system
MDL	method detection limit
MRL	method reporting limit
ng/kg	nanograms per kilogram
OCRRS	Ocean Cape Radio Relay Station
PCP	pentachlorophenol
ppt	parts per trillion
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
Ridolfi	RIDOLFI Inc.
RBC	risk-based concentration
TEQ	Toxicity Equivalence
TEF	Toxicity Equivalent Factors
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
WHO	World Health Organization
YTT	Yakutat Tlingit Tribe

1.0 INTRODUCTION

This site investigation report describes the analytical results from the tissue and soil investigation conducted in June 2010 at the Ankau Saltchucks near Yakutat, Alaska (Figure 1). This report has been prepared on behalf of the Yakutat Tlingit Tribe (YTT). All field and analytical methods were conducted in accordance with the YTT Quality Assurance Project Plan (QAPP) (Ridolfi, 2010). The QAPP was submitted to and approved by the United States Environmental Protection Agency (USEPA), a work plan requirement of the Tribal Response Program under YTT's current agreement with USEPA.

1.1 Purpose and Objectives of the Investigation

The site investigation focused on soil and tissue dioxin contamination associated with the Ocean Cape Radio Relay Station (OCRRS) located on the Ankau Saltchucks (Figure 1). Dioxins were detected in soil and shellfish tissues samples collected near the YTT Culture Camp and adjacent to the Ankau Bridge. The Culture Camp is a youth summer camp used by the YTT to teach cultural heritage. The camp is located on a former military site adjacent to the Ankau Saltchucks. In 2000, the Tribe stopped using the camp because of concerns about possible exposure of camp participants to this contamination, which the Tribe believes is associated with former military activities at the site (Sensmeier, 2006). Former military sites were also located upland of the Ankau Bridge. These sites are shown on Figure 2.

At the request of the Yakutat Tlingit Tribe, RIDOLFI Inc. (Ridolfi) compiled and evaluated existing dioxin data collected within the usual and accustomed lands of the Yakutat Tlingit Tribe. The data reviewed for this evaluation were collected for and summarized in reports prepared for the U.S. Army Corps of Engineers (USACE) and the Yakutat Tlingit Tribe related to the former Yakutat Air Force Base and OCRRS facilities.

Information from previous studies demonstrates that dioxin Toxicity Equivalence (TEQ) exceeds recommended screening levels in soils and tissue samples at the OCRRS site. Additionally, the discovery of a drum of Esteron during USACE field activities in 1985 indicates the use of this herbicide for vegetation control at military sites in the past. Use of Esteron is of concern since it is a mixture of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), the same ingredients contained in the military defoliant Agent Orange. During the manufacturing process, the product became contaminated with the dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The 2,3,7,8-TCDD congener is the most toxic dioxin congener.

Based on the limited sampling conducted to date, the greatest risk to members of the Yakutat Tlingit Tribe appears to be through the consumption of shellfish, particularly from the area of the Ankau Saltchucks. Shellfish tissue collected from this area ranged from about 10 to more than 100 times higher than human health-based screening levels. In relation to other media

sampled, including soil, sediment, and surface water, the shellfish samples appear to have disproportionately high dioxin concentrations.

As a preliminary method for evaluating the potential for human health risk, sample concentrations were compared to risk-based concentrations (RBCs) developed by the U.S. Environmental Protection Agency. The results of the evaluation are presented in Appendix A.

The purpose of this limited investigation is to conduct additional sampling to supplement previous studies. For this reason, we conducted the following sampling activities:

- Soil sampling in the Culture Camp area, with lower analytical detection limits, to determine a source profile for the dioxins and determine if herbicides are also present in the Culture Camp.

- Seafood sampling in other areas within the Ankau Saltchucks, to determine if elevated tissue concentrations are localized or wide-spread.

1.2 Site Description

The city of Yakutat is located on the Gulf of Alaska at the mouth of Monti Bay, approximately 420 miles east-southeast of Anchorage in the northern part of the Alaska Panhandle (Figure 1). The northwest-trending St. Elias Mountains border the Yakutat area to the northeast. The Tongass National Forest, which is under jurisdiction of the U.S. Forest Service, is located to the northeast and east of Yakutat; and the Wrangell-St. Elias National Park, which is under jurisdiction of the National Park Service, is located to the northwest across Yakutat Bay. The city occupies the site of an earlier Eyak and Tlingit permanent village. In the Tlingit language, the name Yakutat (*Yaakwdáat*) means “the place where canoes rest.”

The U.S. military has had a presence in the area surrounding the city of Yakutat and on Phipps Peninsula since at least 1929. Army, Navy, and Air Force facilities were constructed during the 20th century. The most important of these facilities are the airfield (also known as the Yakutat Air Force Base or the Yakutat Air Base), the naval facility area, and the Ocean Cape Radio Relay Station (OCRRS) area. Each of these facility areas comprises a number of sites or clusters of sites. In addition, artillery positions and associated control or observation positions were located along the coast of the peninsula. In the course of operating and subsequently closing the facilities, the Army, Navy, and Air Force stored fuels, used and disposed of hazardous materials, and disposed of solid waste, demolished buildings, and other structural debris in open dumps.

The YTT Culture Camp is located approximately 5 miles west of the community of Yakutat on the Phipps Peninsula at the end of Point Carrew Road, along the western edge of the Ankau Saltchucks (Figure 1). Barracks associated with the OCRRS were formerly located at the Culture Camp, but were removed by USACE in as part of the 1984 cleanup of military sites.

2.0 STUDY DESCRIPTION AND METHODS

This section provides a description of the study including sample locations, contaminants of concern, the field methods used, the analyses performed, and the quality of the data. A more detailed description of the study methods can be found in the QAPP prepared by RIDOLFI Inc. (Ridolfi, 2010).

2.1 Sample Locations

Table 1 presents sample identification information and the analyses performed for each sample. Figure 2 shows the areas that were targeted for sample collection. A total of seven (six primary and one field duplicate) composite clam samples were collected. Two composite clam samples were collected in the Culture Camp area, two from clam beds located between the Culture Camp and the Ankau Bridge, and one near the bridge and one at the mouth of the Ankau Saltchucks. Two composites crab samples were also collected from two areas within the Ankau Saltchucks.

In addition to the seafood samples, one soil sample was collected in the Culture Camp area, for dioxin/furan and herbicide analysis.

2.2 Contaminants of Concern

The tissue composite samples were analyzed for dioxins/furans. The soil sample was submitted for dioxin analysis with sufficiently low detection limits to determine a congener profile of the dioxins to assist in identifying the potential source of the dioxin contamination. The soil sample was also submitted for herbicide analysis. All samples were analyzed for the 17 dioxin/furan congeners identified in Table 2 and Table 3. These results were used to calculate the TEQ for each sample.

2.3 Field Methods

This section discusses how the tissue and soil samples were collected and processed.

2.3.1 Tissue Sampling

The shellfish species selected for this study included butter clams and Dungeness crab. The areas sampled were selected in the field by the sampling team. The general locations for sample collection are shown on Figure 2. A global positioning system (GPS) reading was taken and the location served as the center point of the sampling area with a 10-foot radius for collecting butter clams. Samplers wore nitrile gloves and specimens were collected by hand to the extent possible. Samplers minimized the use of metals tools such as rakes and shovels.

After picking or digging, shellfish were rinsed in ambient seawater at the site to remove sand particles and placed in a plastic bag. A sample label was affixed to the bag, and the bag was placed in a cooler with Blue Ice ®, or similar product, until processed. Samplers attempted to

collect specimens of a size typically harvested for subsistence consumption. For each sample, the process of collecting and rinsing was repeated until a minimum of 400 grams (about one pound) was collected. This is equivalent to a 1-quart jar tightly packed or approximately half of a one-gallon resealable plastic bag. A field form for shellfish (Appendix B) was completed for each sample.

Dungeness crabs were collected from two target sample areas within the Ankau Saltchucks. Three individual crabs were collected from each target area, and combined, to represent a single, composite crab sample for that area. A field form for crab (Appendix B) was completed for each sample.

The two composite samples represent a total of six crabs (three crabs per area for two areas). Dungeness crabs were collected using standard commercial crab pots and ancillary gear. The pots were fished from YTT boats. Sample collection equipment was uncontaminated with grease or oil. The pots were baited with fish heads. The bait was placed in small containers inside the trap to disperse the smell of the bait and attract the crabs.

All of the sampled crabs were male with a carapace length greater than 6.25 inches; this is the current legal catch. Individual crabs were photographed, measured, weighed, and examined for any discoloration, abnormalities, or lesions. Only unbroken crabs were retained for analysis. Each crab was killed by a rapid blow to the area on the underside of the carapace below the eyestalks. Each crab was wrapped in decontaminated aluminum foil, bagged in a zip loc bag, labeled, and placed in a cooler with Blue Ice ®, or similar product, until processed.

Clams were shucked and crab muscle was removed in Yakutat, packed in laboratory-supplied jars and sent to the laboratory for homogenization and analysis. Sample processors wore nitrile gloves while preparing samples and changed gloves between samples. The area designated for processing was covered with plastic sheeting then aluminum foil. The aluminum foil was replaced between samples. Sample processing implements were decontaminated between each sample and at the end of each day.

Tissues packed in laboratory-supplied 8-oz. glass jars had a minimum of one-half inch head space to allow for expansion if freezing is required. Sample label information on the collection container was transferred to the label on the glass jar. Samples were packed in iced coolers in the field then frozen until the shipment is sent to the laboratory.

2.3.2 Soil Sampling

One soil sample was collected in the Culture Camp area, in an area previously identified as dioxin contaminated.

Within the sample area, a grid was measured and marked. Grid points were marked with temporary survey flags at approximately 1-foot intervals to create a diamond pattern sampling

grid with a total of nine equidistant sub-sampling points. If obstructions (such as trees, roots, stumps, and rocks) were encountered at a particular subsampling point, that subsampling point was relocated from that grid-point to the nearest accessible location.

Each soil sub-sample was collected using a precleaned disposable polypropylene spoon. To collect each sub-sample, the top 1-inch of surface material was scraped to the side. Sample material was then collected from 1 to 3-inches below the new surface.

A portable scale was used to weigh each sub-sample and obtain approximately 120 grams to contribute equal portions to the composite sample. The sub-samples were placed in a disposable Teflon bag where they were homogenized before being transferred to the sample container. Excess sample material was returned to the area where it was collected.

2.4 Analyses

Chemical analysis of tissue and soil samples for dioxins/furans were conducted by AXYS Analytical Services Ltd. (AXYS) in Sydney, British Columbia using EPA Method 1613B. The project reporting limits for dioxin/furan analysis were the laboratory method detection limits (MDL), which are listed for all 17 congeners in Table 2.

Chemical analysis of the soil sample for herbicides was conducted by Analytical Resources Inc. (ARI) of Tukwila, Washington using EPA Method 8151A. Following comparison of the soil profile, the soil sample was analyzed for pentachlorophenol using EPA Method 8041.

Project screening levels for dioxins in tissue and soil are listed in Table 2 and for herbicides in soil in Table 3.

Once the dioxin data were received from the laboratory and validated (Section 2.5), the Toxicity Equivalence or TEQ was calculated for each sample. Although dioxins and furans are structurally-related, they each have different properties and varying levels of toxicity. In the environment, dioxins are almost always found as mixtures, rather than as single compounds. To determine the toxicity and evaluate the risks of complex mixtures of dioxins and furans, scientists use a shorthand method for comparing the toxicity of different types or mixtures of dioxins to the toxicity of 2,3,7,8- TCDD, the most toxic dioxin compound. This method is called the “Toxicity Equivalence” or TEQ. A total of 17 dioxin and furan compounds have been determined to have similar types of toxic effects, and each of these 17 has been assigned a factor, known as a “Toxicity Equivalence Factor”, or TEF, that expresses how toxic it is in comparison to 2,3,7,8-TCDD. For example, a dioxin compound that is only half as toxic as 2,3,7,8- TCDD would have a TEF of 0.5. When dioxin samples are sent to a laboratory for analysis, the concentrations of these 17 dioxins and furans are typically reported.

To calculate a single concentration for a mixture of dioxins and furans, the concentration of each individual compound is multiplied by its TEF to convert the concentration to an equivalent

concentration of 2,3,7,8-TCDD. The equivalent concentrations are then summed to represent a total TEQ concentration for the entire sample. Concentrations of dioxins are typically reported in units of nanograms per kilogram (ng/kg) or as parts per trillion (ppt). The total TEQ values calculated for this project will be calculated using the most recent (2005) TEF values recommended by the World Health Organization (WHO) (Van den Berg et al., 2006).

2.5 Quality Assurance / Quality Control (QA/QC) Summary

The analytical data were reviewed for accuracy, precision, and completeness; and an independent data quality assurance/quality control (QA/QC) review was completed. The data QA/QC report is included as Appendix C. Complete qualified analytical results for this sampling event are presented in Table 2.

All deliverables required by the project are present and data packages are complete. Recommended sample holding times and conditions were met. Method blanks show trace levels of target compounds which resulted in qualification of associated samples. Compound identification and quantitation is acceptable. Raw data show no indications of system anomalies. The laboratory duplicate criteria were met. Overall analytical performance is considered acceptable, and data quality is sufficient for project use.

3.0 ANALYTICAL RESULTS

3.1 Screening Levels and Reporting Limits

For purposes of screening the analytical results, the laboratory data for tissue and soil samples were compared to the risk-based concentrations (RBCs) developed by the U.S. Environmental Protection Agency, Region 3 (USEPA, 2009). The RBC values for fish tissue were developed based on potential risks to a recreational fisher, and therefore may not be adequately protective of subsistence shellfish consumers, who would likely consume more shellfish for a longer period of time. The RBC value is intended to be protective for a person consuming 54 grams of fish and shellfish per day (about seven 8-ounce servings per month) for 30 years. An RBC value based on an average subsistence fisher exposure (assuming one 8-ounce serving per day for an entire lifetime) would be 10 times lower than the USEPA RBC screening value. The RBC value for soils is based on a residential exposure scenario.

Laboratory method reporting limits (MRLs) were targeted to be below these screening levels to the extent possible. Laboratory results indicated as detected are those results that are reported by the laboratory above their MRL, which is the minimum concentration of an analyte that the laboratory can routinely identify and quantify above the method detection limit (MDL). The MDL is statistically derived and represents a “best case” sensitivity. The MDL is lower than the MRL and has inherently higher associated uncertainty. For dioxins/furans that were not detected, one-half the MRL was used as the concentration to compare to screening guidelines.

3.2 Tissue Samples

A total of ten shellfish tissue samples were analyzed for dioxins and furans, including one laboratory duplicate sample and one field duplicate sample. Dioxin TEQ concentrations were calculated in two ways; one by summing the TEQ concentrations only for the detected congeners; and one by summing all the TEQ concentrations, using one half the method detection limit for all non-detected congeners.

For the purpose of evaluating potential human health risks, the USEPA typically recommends using half the detection limit to represent potential exposure concentrations for non-detected chemicals. Dioxin TEQs calculated using this method were compared to the risk-based concentrations (RBCs) for fish tissue developed by USEPA, discussed in above in Section 3.1. The TEQ concentrations for all ten samples exceeded the RBC of 0.021 nanograms per kilogram (ng/kg or “parts per trillion”). Total TEQ concentrations ranged from 0.061 ng/kg to 0.13 ng/kg, with a mean concentration of 0.084 ng/kg, or about four times the RBC value.

It is also useful to evaluate the dioxin TEQs based only on the detected congeners (i.e., assuming that concentrations of non-detected congeners are zero) to determine if there are patterns in the distribution of dioxins in shellfish collected from different areas. Dioxin TEQs

based on only the detected dioxin and furan congeners ranged from zero to 0.078 ng/kg with a mean concentration of 0.012 ng/kg. The highest detected concentrations were found in samples located in the northwest portion of the study area. When the dioxin concentrations were calculated using this approach, two samples exceeded the USEPA RBC value of 0.021 ng/kg, and four samples exceeded a more subsistence-based RBC of 0.0021 ng/kg.

3.3 Soil Samples

One composite soil sample was collected from the Culture Camp area and analyzed for dioxins and furans. All 17 of the dioxin and furan congeners with toxicity equivalence factors were detected in the sample. The total dioxin TEQ concentration calculated for the sample was 62.6 ng/kg or more than 14 times the soil RBC value of 4.3 ng/kg. The soil sample was also analyzed for a variety of herbicides and pentachlorophenol.

In an effort to in identify the potential source of dioxins detected at the Culture Camp, a "congener profile" of the soil sample was developed and compared to profiles for common human-caused sources of dioxins compiled by USEPA. Sources of dioxins are broadly classified as combustion and incineration sources or chemical manufacturing and processing sources, and each source typically results in the release of certain mixtures of dioxins and furans. These mixtures can be translated into what are termed 'congener profiles' that represent the distribution of dioxin and furan congeners present in the mixture. A congener profile may serve as a signature of the types of dioxins and furans associated with particular environmental sources of these compounds. Common congener profiles that have been compiled by the USEPA include profiles for municipal, medical, and hazardous waste incineration; cement kilns burning and not burning hazardous waste; industrial oil-fired boilers; industrial coal and wood combustors; unleaded fuel combustion in vehicles; diesel fuel combustion in trucks; secondary aluminum smelters; secondary lead smelters; sewage sludge incineration; bleached chlorine paper pulp; technical pentachlorophenol; and 2,4-D salts and esters (Cleverly et al., 1997).

The congener profile developed for the composite soil sample was compared visually to profiles published by the USEPA.

In addition to dioxins and furans, the soil sample was analyzed for nine herbicides using EPA Method 8151A. No herbicides were detected in the sample, and all method detection limits were well below the USEPA RBC values for residential soils. The laboratory analysis found 280 µg/kg of pentachlorophenol present in the soil.

4.0 SUMMARY AND RECOMMENDATIONS

4.1 Summary and Conclusions of Analytical Results

During June 2010, 10 shellfish tissue samples collected from eight locations within the Ankau Saltchucks were analyzed for dioxins and furans. One composite soil sample was collected from within the Culture Camp area adjacent to the Ankau Saltchucks, and was analyzed for dioxins and furans and herbicides.

4.1.1 Shellfish Samples

Dioxin and furan congeners were detected in eight of the 10 shellfish tissue samples.

In all tissue samples, most dioxin and furan congeners were either not detected, or were detected just above the analytical detection limits.

Dioxin concentrations in shellfish tissue were calculated using two different methods; first by calculating a toxicity equivalence (TEQ) concentration for each sample assuming a concentration equal to one half the method detection limit for any non-detected congeners, and second by calculating a TEQ assuming a concentration of zero for non-detected congeners.

When total dioxin TEQ concentrations were calculated assuming a concentration equal to one half the method detection limit for non-detected congeners:

- All ten samples exceeded the risk-based concentration (RBC) established by the USEPA.
- All concentrations were similar, with the maximum concentration about twice as high as the minimum concentration.
- There were no obvious correlations between dioxin concentrations and sample location or shellfish species.

When total dioxin TEQ concentrations were calculated, assuming a concentration of zero for non-detected congeners:

- Two samples exceeded the RBC established by USEPA.

- Four samples exceeded a more protective RBC, more reflective of a subsistence consumption rate.

- Samples in the north and west of the study area typically had higher dioxin concentrations than samples in the south and east.

- The crab sample collected in the northwest portion of the study area had the highest detected dioxin concentration.

4.1.2 Soil Samples

All 17 of the dioxin and furan congeners with toxicity equivalence factors (TEFs) were present in the soil sample.

No herbicides were detected in the sample, and method detection limits were adequately low to determine if any of the herbicides included in the analysis were present above RBC values for residential soils. The laboratory analysis found 280 µg/kg of pentachlorophenol present in the soil.

The total dioxin TEQ concentration of 62.6 ng/kg is more than 14 times higher than the RBC value for residential soils.

The results of the soil dioxin sampling confirmed previous sample results that indicated elevated dioxin concentrations are present in the vicinity of the Culture Camp.

A dioxin “congener profile” was developed for the soil sample by calculating the relative percent of each congener contained in the sample.

The profile developed for the soil sample was visually compared to a number of dioxin source profiles compiled by the USEPA.

Based on a visual comparison, the soil sample profile most resembled the source profile for pentachlorophenol. The next closest visual match for the soil profile was the source profile for diesel exhaust.

While the congener profile developed for the soil sample represents the distribution of dioxin and furan congeners detected in soils within an area of the Culture Camp, it is unclear how well a single sample may represent a pattern that can be tied to a specific source. It is possible that the source of dioxins may be pentachlorophenol (PCP), as dioxins are a well-known contaminant of PCP, and PCP has been detected at former military sites surrounding the Ankau

Saltchucks. The presence of pentachlorophenol in the soil supports YTTs assertion that the dioxins are related to military activities in the area and not from burning at the Yakutat dump.

4.2 Recommendations for Future Work

Based on the results of the shellfish tissue and soil sampling, the following actions are recommended:

4.2.1 Shellfish

The majority of dioxin and furan congeners detected in shellfish tissue samples were present at levels only slightly above current analytical detection limits. To better understand the potential for health risks to shellfish consumers, and to determine if the higher detected concentrations in the northwest portion of the study area may represent dioxin distinct source areas, more extensive shellfish tissue sampling and analysis should be completed.

To help determine whether dioxin concentrations in shellfish in the Ankau Saltchucks represent localized or more regional dioxin sources, areas determined to best represent “natural background” conditions should be selected, and shellfish samples should be collected in these unaffected areas.

To more accurately assess potential human health risks, actual shellfish harvest and consumption patterns should be evaluated.

4.2.2 Soils

Analysis of the composite soil sample from the Culture Camp area confirmed the results of previous sampling that had identified elevated concentrations of dioxins and furans in site soils. However, it is difficult to draw defensible conclusions based on a single sample. More extensive soil sampling should be conducted to define the extent of dioxin contamination in and around the Culture Camp.

While a congener profile was developed based on the distribution of dioxin and furan congeners detected in the soil sample, it is unclear how well a single sample may represent a pattern that can be tied to a specific source. More extensive soil sampling for dioxins and furans would provide a more robust basis for developing a representative dioxin profile. In addition to more extensive soil sampling, further investigation of potential dioxin sources should be conducted.

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FIGURES

YAKUTAT TLINGIT TRIBE

Ankau Saltchucks
Site Investigation Report

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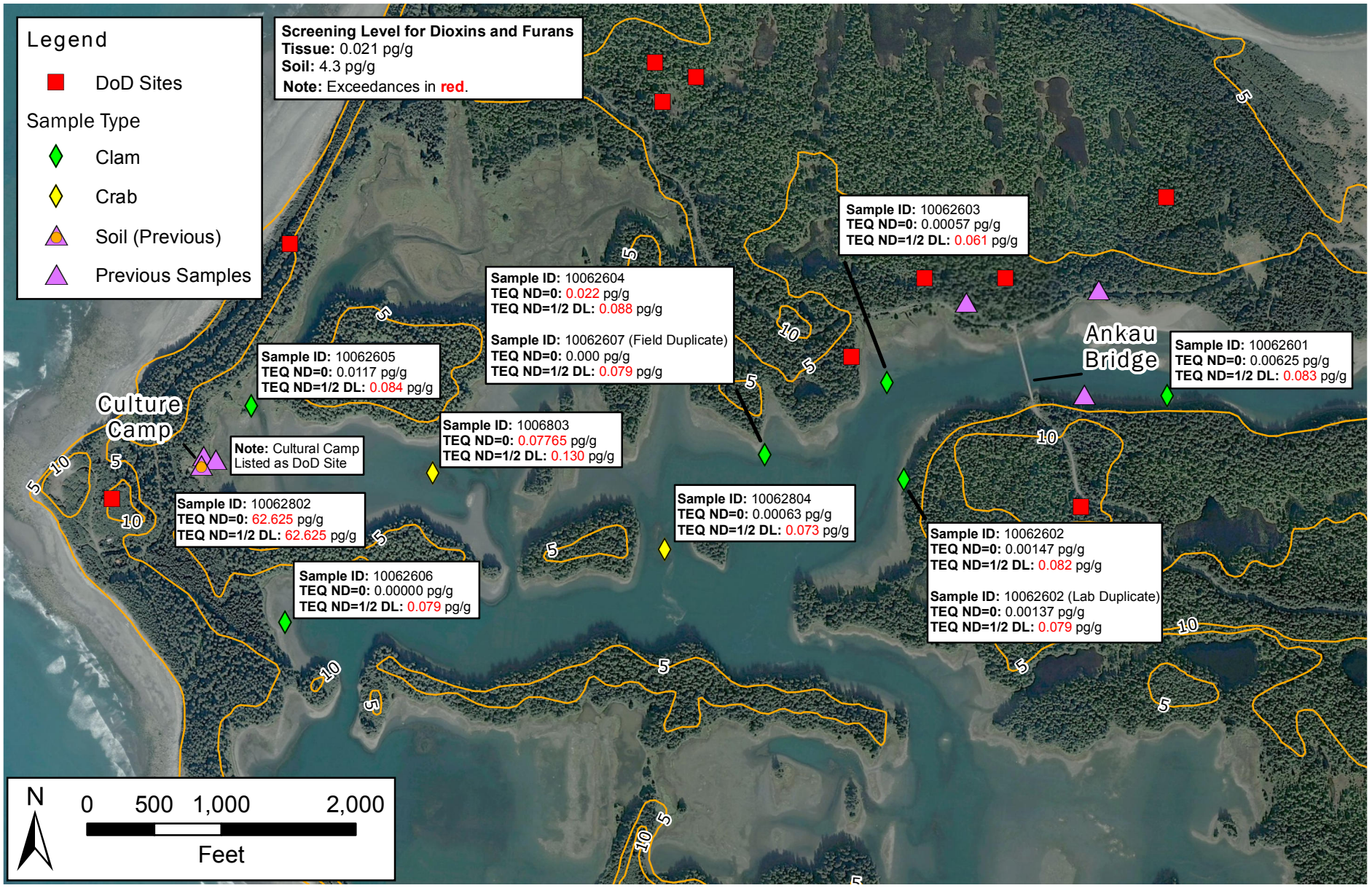
Site Location Map

File Path: J:\255 Yakutat Tlingit Tribe\255C2 YTT TRP 09\GIS\ankau_SIRR\figure_1_final.mxd



YAKUTAT TLINGIT TRIBE

Ankau Saltchucks Site Investigation Report

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Ankau Saltchucks Sample Results

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TABLES

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Table 1. Sample Identification, Description, Coordinates, and Analyses Performed

Sample Number	Media	Date	Time	Note	Location	Latitude	Longitude	Dioxin	Herbicides	PCP
10062601	tissue	6/26/2010	8:00	Horse Clam	east of Ankua Bridge	-139.818304°	59.545496°	X		
10062602	tissue	6/26/2010	8:45	Butter Clam	southwest of Ankua Bridge, south shore	-139.828518°	59.543296°	X		
10062603	tissue	6/26/2010	9:15	Butter Clam	west of Ankua Bridge, northshore	-139.82955°	59.545248°	X		
10062604	tissue	6/26/2010	9:30	Butter Clam	southwest of Ankua Bridge, north shore	-139.834167°	59.543553°	X		
10062605	tissue	6/26/2010	11:00	Softshell Clam	east of Culture Camp	-139.854866°	59.543581°	X		
10062606	tissue	6/26/2010	12:00	Softshell Clam	southeast of Culture Camp	-139.852716°	59.539245°	X		
10062607	tissue	6/26/2010	9:00	Butter Clam	field duplicate 10062604	-139.834167°	59.543553°	X		
10062803	tissue	6/28/2010	19:30	Dungeness Crab	Culture Camp	-139.847368°	59.542548°	X		
10062804	tissue	6/28/2010	20:00	Dungeness Crab	Ankau Bridge	-139.837823°	59.541437°	X		
10062802	soil	6/28/2010	15:00	Upland soils	Culture Camp	-139.856638°	59.542276°	X	X	X

PCP - pentachlorophenol

Table 2. Tissue and Soil Analytical Results Compared to Screening Levels for Dioxins and Furans

Matrix		Tissue (pg/g)			Tissue (pg/g)			Tissue (pg/g)		
Screening Level*		0.021 (pg/g)			0.021 (pg/g)			0.021 (pg/g)		
Analyte	Sample ID:	10062601			10062602			10062602 (Lab Duplicate)		
	Laboratory ID:	L14960-1 R			L14960-2 R (A)			WG33826-103 (DUP L14960-2)		
	Date Collected:	6/26/2010			6/26/2010			6/26/2010		
	TEF	**Concentration**	**TEQ ND=0**	**TEQ ND=1/2 DL**	**Concentration**	**TEQ ND=0**	**TEQ ND=1/2 DL**	**Concentration**	**TEQ ND=0**	**TEQ ND=1/2 DL**
2,3,7,8-TCDD	1	0.0498 u	0.00000	0.025	0.0496 u	0.00000	0.025	0.0494 u	0.00000	0.025
1,2,3,7,8-PECDD	1	0.0498 u	0.00000	0.025	0.0496 u	0.00000	0.025	0.0494 u	0.00000	0.025
1,2,3,4,7,8-HXCDD	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0499 u	0.00000	0.002
1,2,3,6,7,8-HXCDD	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0499 u	0.00000	0.002
1,2,3,7,8,9-HXCDD	0.1	*0.054* j	0.00540	0.005	0.05 u	0.00000	0.002	0.0499 u	0.00000	0.002
1,2,3,4,6,7,8-HPCDD	0.01	0.115 uj	0.00000	0.001	0.094 uj	0.00000	0.000	*0.127* j	0.00127	0.001
OCDD	0.0003	0.803 uj	0.00000	0.000	0.343 uj	0.00000	0.000	*0.23* j	0.00007	0.000
Furans										
2,3,7,8-TCDF	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0494 u	0.00000	0.002
1,2,3,7,8-PECDF	0.03	0.0498 u	0.00000	0.001	0.0496 u	0.00000	0.001	0.0494 u	0.00000	0.001
2,3,4,7,8-PECDF	0.3	0.0498 u	0.00000	0.007	0.066 uj	0.00000	0.010	0.0494 u	0.00000	0.007
1,2,3,4,7,8-HXCDF	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0494 u	0.00000	0.002
1,2,3,6,7,8-HXCDF	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0494 u	0.00000	0.002
1,2,3,4,7,8-HXCDF	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0494 u	0.00000	0.002
1,2,3,6,7,8-HXCDF	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0494 u	0.00000	0.002
1,2,3,7,8,9-HXCDF	0.1	0.0498 u	0.00000	0.002	0.0496 u	0.00000	0.002	0.0494 u	0.00000	0.002
2,3,4,6,7,8-HXCDF	0.1	0.052 uj	0.00000	0.003	0.0496 u	0.00000	0.002	0.0494 u	0.00000	0.002
1,2,3,4,6,7,8-HPCDF	0.01	*0.085* j	0.00085	0.001	*0.086* j	0.00086	0.001	0.0494 u	0.00000	0.000
1,2,3,4,7,8,9-HPCDF	0.01	0.0719 u	0.00000	0.000	*0.061* j	0.00061	0.001	0.0494 u	0.00000	0.000
OCDF	0.0003	0.138 uj	0.00000	0.000	0.098 uj	0.00000	0.000	*0.088* j	0.00003	0.000
Total			0.00625	**0.083**		0.00147	**0.082**		0.00137	**0.079**

Notes:

*U.S. Environmental Protection Agency, Region 3 (USEPA, 2009)
ID - Identification
pg/g - picogram per gram
TEF - Toxicity Equivalence Factor
TEQ ND=0 - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value of zero.
TEQ ND=1/2 DL - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value equal to one-half the method detection limit.
Detected concentrations are italicized.
Concentrations appearing in **bold** exceed the screening level.
j = The detected value is an estimated quantity.
u = The analyte was not detected above the method reporting limit.
uj = The nondetected value is an estimated quantity.

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Table 2. Tissue and Soil Analytical Results Compared to Screening Levels for Dioxins and Furans

Matrix		Tissue (pg/g)				Tissue (pg/g)				Tissue (pg/g)			
Screening Level*		0.021 (pg/g)				0.021 (pg/g)				0.021 (pg/g)			
Analyte	Sample ID:	10062603				10062604				10062605			
	Laboratory ID:	L14960-3				L14960-4				L14960-5			
	Date Collected:	6/26/2010				6/26/2010				6/26/2010			
	TEF	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**
2,3,7,8-TCDD	1	0.0566	u	0.00000	0.028	0.0457	u	0.00000	0.023	0.0488	u	0.00000	0.024
1,2,3,7,8-PECDD	1	0.0337	u	0.00000	0.017	*0.0457*	j	0.00000	0.023	0.0488	u	0.00000	0.024
1,2,3,4,7,8-HXCDD	0.1	0.0424	u	0.00000	0.002	*0.093*	j	0.0093	0.009	0.0488	u	0.00000	0.002
1,2,3,6,7,8-HXCDD	0.1	0.0379	u	0.00000	0.002	*0.057*	j	0.0057	0.006	0.0488	u	0.00000	0.002
1,2,3,7,8,9-HXCDD	0.1	0.0406	u	0.00000	0.002	0.0469	u	0.00000	0.002	*0.052*	j	0.00520	0.005
1,2,3,4,6,7,8-HPCDD	0.01	0.107	u	0.00000	0.001	0.133	uj	0.00000	0.001	0.095	uj	0.00000	0.000
OCDD	0.0003	0.273	uj	0.00000	0.000	0.361	uj	0.00000	0.000	0.727	uj	0.00000	0.000
Furans													
2,3,7,8-TCDF	0.1	0.0154	u	0.00000	0.001	0.0457	u	0.00000	0.002	0.0488	u	0.00000	0.002
1,2,3,7,8-PECDF	0.03	*0.019*	j	0.00057	0.001	0.0457	u	0.00000	0.001	0.0488	u	0.00000	0.001
2,3,4,7,8-PECDF	0.3	0.0161	u	0.00000	0.002	0.0457	u	0.00000	0.007	0.0488	u	0.00000	0.007
1,2,3,4,7,8-HXCDF	0.1	0.0253	u	0.00000	0.001	0.0457	u	0.00000	0.002	0.0488	u	0.00000	0.002
1,2,3,6,7,8-HXCDF	0.1	0.0228	u	0.00000	0.001	0.0457	u	0.00000	0.002	0.0488	u	0.00000	0.002
1,2,3,7,8,9-HXCDF	0.1	0.0295	u	0.00000	0.001	*0.07*	j	0.007	0.007	0.0488	u	0.00000	0.002
2,3,4,6,7,8-HXCDF	0.1	0.0202	u	0.00000	0.001	0.0457	u	0.00000	0.002	*0.065*	j	0.00650	0.007
1,2,3,4,6,7,8-HPCDF	0.01	0.0466	u	0.00000	0.000	0.0457	u	0.00000	0.000	0.0488	u	0.00000	0.000
1,2,3,4,7,8,9-HPCDF	0.01	0.0466	u	0.00000	0.000	0.0457	u	0.00000	0.000	0.0488	u	0.00000	0.000
OCDF	0.0003	0.0484	u	0.00000	0.000	0.089	uj	0.00000	0.000	0.095	uj	0.00000	0.000
Total				0.00057	**0.061**			**0.022**	**0.088**			0.0117	**0.084**

Notes:

*U.S. Environmental Protection Agency, Region 3 (USEPA, 2009)
ID - Identification
pg/g - picogram per gram
TEF - Toxicity Equivalence Factor
TEQ ND=0 - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value of zero.
TEQ ND=1/2 DL - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value equal to one-half the method detection limit.
Detected concentrations are italicized.
Concentrations appearing in **bold** exceed the screening level.
j = The detected value is an estimated quantity.
u = The compound was not detected above the method reporting limit.
uj = The nondetected value is an estimated quantity.

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Table 2. Tissue and Soil Analytical Results Compared to Screening Levels for Dioxins and Furans

Matrix		Tissue (pg/g)				Tissue (pg/g)				Tissue (pg/g)			
Screening Level*		0.021 (pg/g)				0.021 (pg/g)				0.021 (pg/g)			
Analyte	Sample ID:	10062606				10062607 (Field Duplicate of 10062604)				10062803			
	Laboratory ID:	L14960-6 i				L14960-7				L14960-8			
	Date Collected:	6/26/2010				6/26/2010				6/28/2010			
	TEF	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**
2,3,7,8-TCDD	1	0.0497	u	0.00000	0.025	0.0497	u	0.00000	0.025	*0.076*	j	0.076	0.076
1,2,3,7,8-PECDD	1	0.0497	u	0.00000	0.025	0.0497	u	0.00000	0.025	0.0492	u	0.00000	0.025
1,2,3,4,7,8-HXCDD	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,6,7,8-HXCDD	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,7,8,9-HXCDD	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,4,6,7,8-HPCDD	0.01	0.098	uj	0.00000	0.000	0.088	uj	0.00000	0.000	0.078	uj	0.00000	0.000
OCDD	0.0003	0.408	uj	0.00000	0.000	0.507	uj	0.00000	0.000	0.366	uj	0.00000	0.000
Furans													
2,3,7,8-TCDF	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,7,8-PECDF	0.03	0.0497	u	0.00000	0.001	0.0497	u	0.00000	0.001	*0.055*	j	0.00165	0.002
2,3,4,7,8-PECDF	0.3	0.0497	u	0.00000	0.007	0.0497	u	0.00000	0.007	0.0492	u	0.00000	0.007
1,2,3,4,7,8-HXCDF	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,6,7,8-HXCDF	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,4,7,8-HXCDF	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,6,7,8-HXCDF	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,7,8,9-HXCDF	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
2,3,4,6,7,8-HXCDF	0.1	0.0497	u	0.00000	0.002	0.0497	u	0.00000	0.002	0.0492	u	0.00000	0.002
1,2,3,4,6,7,8-HPCDF	0.01	0.0497	u	0.00000	0.000	0.0497	u	0.00000	0.000	0.0558	u	0.00000	0.000
1,2,3,4,7,8,9-HPCDF	0.01	0.0497	u	0.00000	0.000	0.0497	u	0.00000	0.000	0.0558	u	0.00000	0.000
OCDF	0.0003	0.0497	u	0.00000	0.000	0.119	uj	0.00000	0.000	0.097	uj	0.00000	0.000
Total				0.00000	**0.079**			0.00000	**0.079**			**0.07765**	**0.130**

Notes:

*U.S. Environmental Protection Agency, Region 3 (USEPA, 2009)
ID - Identification
pg/g - picogram per gram
TEF - Toxicity Equivalence Factor
TEQ ND=0 - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value of zero.
TEQ ND=1/2 DL - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value equal to one-half the method detection limit.
Detected concentrations are italicized.
Concentrations appearing in **bold** exceed the screening level.
j = The detected value is an estimated quantity.
u = The compound was not detected above the method reporting limit.
uj = The nondetected value is an estimated quantity.

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Table 2. Tissue and Soil Analytical Results Compared to Screening Levels for Dioxins and Furans

Matrix		Tissue (pg/g)				Soil (pg/g)			
Screening Level*		0.021 (pg/g)				4.3			
Analyte	Sample ID:	10062804				10062802			
	Laboratory ID:	L14960-9				L14960-10 R			
	Date Collected:	6/28/2010				6/28/2010			
	TEF	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**	**Concentration**		**TEQ ND=0**	**TEQ ND=1/2 DL**
2,3,7,8-TCDD	1	0.0462	u	0.00000	0.023	*1.01*		1.01	1.01
1,2,3,7,8-PECDD	1	0.0462	u	0.00000	0.023	*6.01*		6.01	6.01
1,2,3,4,7,8-HXCDD	0.1	0.0462	u	0.00000	0.002	*11.9*		1.19	1.19
1,2,3,6,7,8-HXCDD	0.1	0.0462	u	0.00000	0.002	*44.2*		4.42	4.42
1,2,3,7,8,9-HXCDD	0.1	0.0462	u	0.00000	0.002	*39.7*		3.97	3.97
1,2,3,4,6,7,8-HPCDD	0.01	0.0462	u	0.00000	0.000	*2,970*		29.7	29.7
OCDD	0.0003	0.224	uj	0.00000	0.000	*33,900*		10.17	10.17
Furans									
2,3,7,8-TCDF	0.1	0.0462	u	0.00000	0.002	*5.83*		0.583	0.583
1,2,3,7,8-PECDF	0.03	0.0462	u	0.00000	0.001	*2.33*		0.0699	0.0699
2,3,4,7,8-PECDF	0.3	0.0462	u	0.00000	0.007	*4.03*		1.209	1.209
1,2,3,4,7,8-HXCDF	0.1	0.0462	u	0.00000	0.002	*16.7*		1.67	1.67
1,2,3,6,7,8-HXCDF	0.1	0.0462	u	0.00000	0.002	*8.15*		0.815	0.815
1,2,3,7,8,9-HXCDF	0.1	0.0462	u	0.00000	0.002	*0.404*	j	0.04	0.04
2,3,4,6,7,8-HXCDF	0.1	0.0462	u	0.00000	0.002	*5.23*		0.523	0.523
1,2,3,4,6,7,8-HPCDF	0.01	*0.063*	j	0.00063	0.001	*106*		1.06	1.06
1,2,3,4,7,8,9-HPCDF	0.01	0.0462	u	0.00000	0.000	*10.4*		0.104	0.104
OCDF	0.0003	0.0462	u	0.00000	0.000	*268*		0.08	0.08
Total				0.00063	**0.073**			**62.625**	**62.625**

Notes:

*U.S. Environmental Protection Agency, Region 3 (USEPA, 2009)
ID - Identification
pg/g - picogram per gram
TEF - Toxicity Equivalence Factor
TEQ ND=0 - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value of zero.
TEQ ND=1/2 DL - Toxicity Equivalent for non-detects TEF-modified concentration assumed to be a value equal to one-half the method detection limit.
Detected concentrations are italicized.
Concentrations appearing in **bold** exceed the screening level.
j = The detected value is an estimated quantity.
u = The compound was not detected above the method reporting limit.
uj = The nondetected value is an estimated quantity.

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Table 3. Soil Analytical Results Compared to Screening Levels for Herbicides and Pentachlorophenol

Sample ID:	10062802			
Laboratory ID:	RC99A			
Date Collected:	6/28/2010			
Analyte	**CAS Number**	**Results (µg/kg)**		**Screening Levels* (mg/kg)**
Dalapon	75-99-0	38	U	1,800
Dicamba	62610-39-3	19	U	1,800
MCPA	94-75-6	9,400	U	-
Dichlorprop	7547-66-2	38	U	-
2,4-D	94-75-7	38	U	690
MCPP	94-65-2	NA		-
Silvex	93-72-1	9.4	U	-
2,4,5-T	93-76-5	9.4	U	610
2,4-DB	94-80-4	190	U	-
Dinoseb	89396-94-1	19	U	61
Laboratory ID:	SJ13			
Pentachlorophenol	87-86-5	280		890

Notes:

* U.S. EPA Regional Screening Levels, December 2009

\- not available

NA - not analyzed for

U - analyte was not detected above the method reporting limit

APPENDIX A
REVIEW OF DIOXIN DATA FOR THE YAKUTAT AREA

T E C H N I C A L M E M O R A N D U M

Date: July 7, 2009

To: Alex James (Program Manager) and Bert Adams (General Manager)
Yakutat Tlingit Tribe

From: Bill Beckley (Senior Environmental Scientist)
RIDOLFI Inc.

Subject: **Review of Dioxin Data for the Yakutat Area**

INTRODUCTION

During 2003, 2004, and 2006, samples of soil, surface water, sediment, and shellfish tissue were collected within the Ankau Saltchucks area west of Yakutat. Of the contaminants of concern detected in these samples, dioxins have been of greatest concern to the Yakutat Tlingit Tribe and their community. This technical memorandum summarizes our evaluation and interpretation of these dioxin data and offers recommendations to further assess the risk and determine the source and extent of this dioxin contamination.

As more information becomes available regarding the nature and extent of these contaminants and the potential risk to people, the Yakutat Tlingit Tribe will take action to increase community awareness of potential impacts related to dioxins in the environment. This information will also guide future sampling efforts and other actions needed to address dioxin contamination within the usual and accustomed lands of the Yakutat Tlingit Tribe.

The data reviewed for this evaluation were collected for and summarized in reports prepared for the U.S. Army Corps of Engineers ("Corps") and the Yakutat Tlingit Tribe (YTT or "Tribe") in conjunction with investigations of the former Yakutat Air Force Base and Ocean Cape Radio Relay Station facilities (CCTHITA, 2004; ENSR, 2003; Shannon & Wilson, 2006).

BACKGROUND

Dioxins

The term 'dioxins' refers to a group of chemical compounds that share certain chemical structures and biological characteristics. More than 200 of these compounds exist, and are members of closely related chemical families known as polychlorinated dioxins and furans. Sometimes the term dioxin is also used to refer to the most toxic and most well studied of the dioxin compounds, 2,3,7,8-TCDD.

Dioxins are not created intentionally, but are produced inadvertently by a number of human activities. They are formed as unintentional by-products of certain types of industrial and manufacturing processes, and by industrial, municipal, and domestic incineration and combustion. Dioxins are also formed during the chlorine bleaching process used by pulp and paper mills, and they occur as a contaminant in the manufacturing process of certain chlorinated pesticides (ATSDR, 1998). The World Health Organization (WHO) has determined that dioxins are a human carcinogen. Dioxins are also believed to cause adverse effects to the endocrine, immune, and reproductive systems.

Calculating Dioxin Concentrations

Although dioxins and furans are structurally-related, they each have different properties and varying levels of toxicity. In the environment, dioxins are almost always found as mixtures, rather than as single compounds. To determine the toxicity and evaluate the risks of complex mixtures of dioxins and furans, scientists use a shorthand method for comparing the toxicity of different types or mixtures of dioxins to the toxicity of 2,3,7,8- TCDD, the most toxic dioxin compound. This method is called the "Toxicity Equivalence" or TEQ. A total of 17 dioxin and furan compounds have been determined to have similar types of toxic effects, and each of these 17 has been assigned a factor, known as a "Toxicity Equivalence Factor", or TEF, that expresses how toxic it is in comparison to 2,3,7,8-TCDD. For example, a dioxin compound that is only half as toxic as 2,3,7,8- TCDD would have a TEF of 0.5. When dioxin samples are sent to a laboratory for analysis, the concentrations of these 17 dioxins and furans are typically reported.

To calculate a single concentration for a mixture of dioxins and furans, the concentration of each individual compound is multiplied by its TEF to convert the concentration to an equivalent concentration of 2,3,7,8-TCDD. The equivalent concentrations are then summed to represent a total TEQ concentration for the entire sample. Concentrations of dioxins are typically reported in units of nanograms per kilogram (ng/kg) or as parts per trillion (ppt). All the total TEQ values calculated for this evaluation were calculated using the most recent (2005) TEF values recommended by the World Health Organization.

Analytical Detection Limits

Because dioxin mixtures can pose risks to human health at extremely low levels, it is critical that analytical detection limits are sufficiently low to determine if dioxins may be present at levels of concern. If there is a possibility that dioxins are present at a location, but they are not detected in a sample, we cannot be certain that they are not present. All we can be certain of is that if they are present, their concentration is somewhere between zero and the detection limit. To account for this uncertainty, it is common practice when evaluating risks to assume that if a chemical is not detected, it may be there at a concentration of half the detection limit. In our evaluation of the dioxin data, we have calculated dioxin concentrations using two methods: (1) calculating a total TEQ for each sample using only the dioxin concentrations that were detected and (2) calculating a total TEQ assuming that the dioxin compounds not detected were present at half the

detection limit. Using these two methods allows us to evaluate the level of uncertainty in our measurements.

SCREENING LEVELS

To evaluate the potential human health risks related to exposure to dioxins in soils, sediments, and shellfish, dioxin results were screened against risk-based concentrations developed by the Environmental Protection Agency (USEPA, 2009). For this screening, we have compared total dioxin TEQs based only on detected concentrations to screening levels. For further discussion of detection limits and uncertainty, see the Summary and Recommendations section below.

Soil

Concentrations detected in soil were compared to risk-based concentrations (RBCs) developed by EPA Region 3. The RBCs represent an increased cancer risk of "one in a million" (abbreviated as "1 x 10^{-6}") for a residential exposure scenario, which assumes a person could be exposed to contaminants in soil 350 days per year for 30 years (six years as a child, and 24 years as an adult). The RBC for dioxins in residential soil is 4.3 parts per trillion (ppt) TEQ.

Sediment

RBCs for screening human health risks from sediment have not been developed. To evaluate risks from direct contact and ingestion of contaminated sediments, sediment dioxin concentrations were compared to the residential soil RBC. The potential for sediment uptake into fish and shellfish tissue was evaluated qualitatively.

Shellfish Tissue

Concentrations detected in shellfish tissue were compared to the EPA Region 3 RBC for edible fish tissue. The tissue RBC, like all RBCs for cancer-causing chemicals, represents an increased cancer risk of one in a million, and assumes that a person may be exposed to contaminants from the ingestion of fish or shellfish tissue at a rate of 54 grams per day (about seven servings per month) for 30 years. While these assumptions underestimate the potential exposure for a subsistence fisher, the RBC value was used as an initial screen to determine what next steps were appropriate. The RBC for fish tissue is 0.021 ppt TEQ.

RESULTS

The results discussed in the following sections are displayed in Table 1, and graphically displayed on Figure 1. In Table 1, the dioxin TEQ concentrations are displayed in two ways: first as total detected concentrations (assuming non-detected compounds are equal to zero, denoted as "ND=0"), and second as total TEQ concentrations assuming non-detected compounds are present at a concentration of one-half of the detection limit (denoted as "ND=1/2 DL"). The comparison to screening levels in the following sections is based on detected concentrations only.

While three surface water samples were also collected and analyzed for dioxins, they are not discussed below, since no dioxins were detected in surface water. Dioxins are typically found attached to sediments or organic materials, and not in the water column. Dioxins are referred as hydrophobic ("water fearing") and lipophilic ("fat loving") compounds.

Soil

A total of 22 soil samples were collected from 19 separate sampling locations (three samples were duplicates), including two sites on Khantaak Island, identified as background, one site related to the Ocean Cape facility, and 16 sites in the vicinity of the Culture Camp.

Of the 22 soil sample results, three exceeded the EPA RBC value of 4.3 ppt, including one duplicate sample. The samples that exceeded the screening level were collected from two locations in the Culture Camp area, and the concentrations were 10.4, 10.8, and 22.5 ppt TEQ. The remaining samples were all below 1.5 ppt TEQ, and the average concentration of all samples was 2.3 ppt TEQ. The two samples from Khantaak Island had concentrations of 0.002 and 0.059 ppt TEQ.

Sediment

Three sediment samples were collected from three intertidal locations immediately east of and adjacent to the Culture Camp. Detected concentrations in the sediment samples were very low in comparison to the adjacent soil samples, and only one of the 17 dioxin compounds was detected in any of the sediment samples. No dioxins were detected in one of the three sediment samples. The average concentration for the three sediment samples was 0.005 ppt TEQ. This value is well below the soil screening level (4.3 ppt TEQ), which addresses exposure through ingestion and direct contact with sediment. However, dioxins in sediment may be concentrated in fish and shellfish feeding in the sediments, so this screening does not address the potential for sediments to pose risks through uptake through the food chain.

Tissue

Five shellfish samples were collected from three separate areas, including one clam sample from an area adjacent to the Culture Camp; one clam, one cockle, and one mussel sample from the area around Ankau Bridge; and one mussel sample from the Ocean Cape area, identified as a background sample. With the exception of the background sample, all tissue samples exceeded the screening level for tissue of 0.021 ppt TEQ. The average sample concentration (excluding background) was 0.81 ppt TEQ, or about 40 times the screening level. The highest concentration was found in the clam sample from the Culture Camp area, with a concentration of 2.5 ppt TEQ, or more than 100 times the screening level. The Ocean Cape mussel sample had a concentration of 0.008 ppt TEQ.

DIOXIN SOURCE IDENTIFICATION

While dioxins are almost always found as mixtures in the environment, the relative proportion of the individual dioxin compounds that make up a mixture is highly dependent on the source of the dioxins. For example, different sources of dioxins such as waste incineration, or pulp mill effluent, or chlorinated pesticides all have a different "fingerprint" that is specific to that type of source. The EPA and others have developed a number of "source profiles" that represent the typical proportions of dioxin compounds found in mixtures associated with different types of dioxin sources. In some cases, it is possible to identify the potential source of dioxin contamination by comparing the proportion of different dioxins in a sample with these source profiles.

As part of our evaluation, we reviewed the dioxin patterns associated with the soil, sediment, and tissue samples to see if there was a consistent pattern in the samples, and, if so, if that pattern was similar to a specific dioxin source profile. Unfortunately, too few of the dioxin compounds were detected in the samples to produce a reliable pattern. Based on our review of the laboratory data, it appears likely that analytical detection limits were not sufficiently low to detect the presence of other dioxin compounds.

SUMMARY AND RECOMMENDATIONS

At the request of the Yakutat Tlingit Tribe, Ridolfi compiled and evaluated existing dioxin data collected within the usual and accustomed lands of the Yakutat Tlingit Tribe.

The data reviewed for this evaluation were collected for and summarized in reports prepared for the U.S. Army Corps of Engineers and the Yakutat Tlingit Tribe related to the former Yakutat Air Force Base and Ocean Cape Radio Relay Station facilities.

As a preliminary method for evaluating the potential for human health risk, sample concentrations were compared to risk-based concentrations (RBCs) developed by the U.S. Environmental Protection Agency.

Summary

The following summarizes our evaluation of the data:

- Samples were collected and analyzed for dioxins in a variety of environmental media, including soil, water, sediment, and shellfish tissue, although the number of samples and the areal coverage of the samples are low.

- Twenty-two soil samples were collected from 19 separate sampling locations, including two background locations. Soil samples from two locations within the Culture Camp area exceeded a residential soil screening level of 4.3 ppt TEQ, including one sample that

was approximately five times the screening level. The average concentration for all soil samples was approximately 2.3 ppt TEQ, or about one-half the screening level.

- Three sediment samples were collected from an area adjacent to the Culture Camp area. The average concentration in sediment was 0.005 ppt TEQ. Even considering the uncertainty related to analytical detection limits, sediment concentrations were below the residential soil screening level.

- Three water samples were collected co-located with the three sediment samples. No dioxins were detected in any of the surface water samples.

- Five shellfish samples were collected from three separate areas, including one sample identified as a background sample. With the exception of the background sample, all shellfish samples exceeded the tissue screening level of 0.021 ppt TEQ. The average tissue concentration, excluding background, was approximately 40 times higher than the screening level. The highest tissue concentration, from the clam sample collected near the Culture Camp area, was more than 100 times higher than the screening level.

- The level of uncertainty in sample concentrations, based on the difference between treating non-detected concentrations as either zero (ND=0) or half the detection limit (ND=1/2/DL) was the highest for the three sediment samples. The average sediment concentration (total TEQ) assuming half the detection limit for non-detected compounds was more than 500 times higher than the concentration assuming non-detected compounds had a concentration of zero.

- The three tissue samples collected near Ankau Bridge exceeded screening levels by a factor of 10. No co-located sediment samples or adjacent soil samples were collected from this area.

- Analytical detection limits were not low enough to provide sufficient data to determine the potential source of the dioxins based on a review of the dioxin source profiles.

Recommendations

Based on the limited sampling considered in this evaluation, the greatest risk to members of the Yakutat Tlingit Tribe appears to be through the consumption of shellfish, particularly from the area of the Ankau Saltchucks. Shellfish tissue collected from this area ranged from about 10 to more than 100 times higher than human health-based screening levels. In relation to other media sampled, including soil, sediment, and surface water, the shellfish samples appear to have disproportionately high dioxin concentrations. This may be due to several factors, including the existence of other upland source areas that are contributing contaminants to the Saltchucks, or the inadequacy of analytical detection limits for sediments. It is possible that sufficient concentrations in sediments are present to account for the elevated tissue concentrations through long-term processes such as sediment uptake and bioaccumulation through the food chain.

However, the existing information is not sufficient to determine specifically what is causing the elevated tissue concentrations. For this reason, we recommend the following:

- Further efforts to identify and sample potential upland source areas.
- Additional more extensive sediment sampling with improved (lower) analytical detection limits.
- More extensive shellfish sampling in the Ankau Saltchucks, with lower analytical detection limits.
- More extensive shellfish sampling in other areas to determine if elevated tissue concentrations are localized or wide-spread.
- Detailed evaluation of potential contaminant migration pathways from upland areas to surface waters and sediments.
- Preliminary evaluation of fish and shellfish consumption rates and patterns to assist in the further evaluation of human health risks.

We believe these recommendations are warranted by the existing dioxin data and are necessary next steps in identifying and addressing potential sources of risk to the Yakutat Tlingit Tribe.

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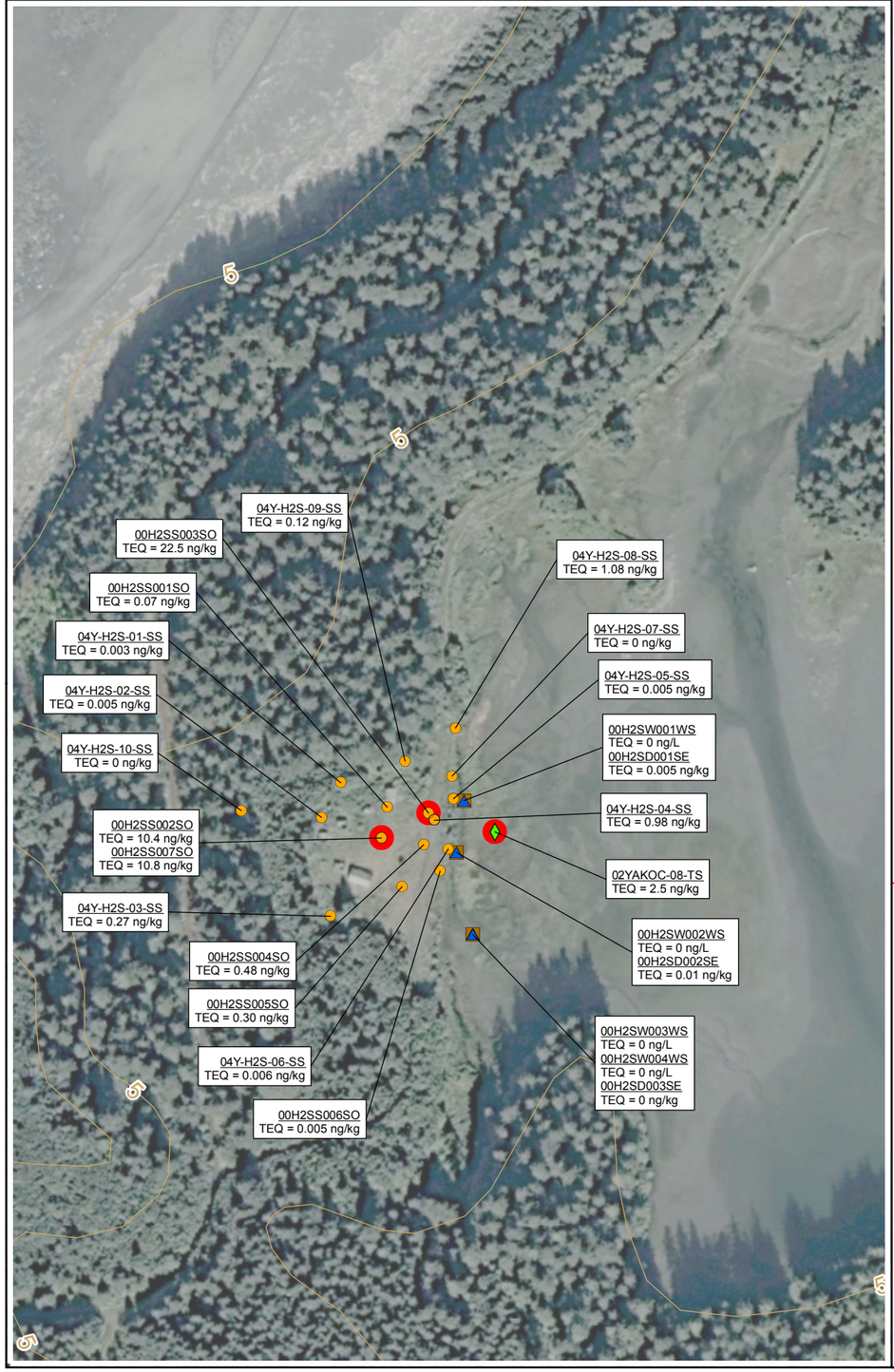
Table 1. Sample Concentrations as Total Dioxin TEQ (ppt)

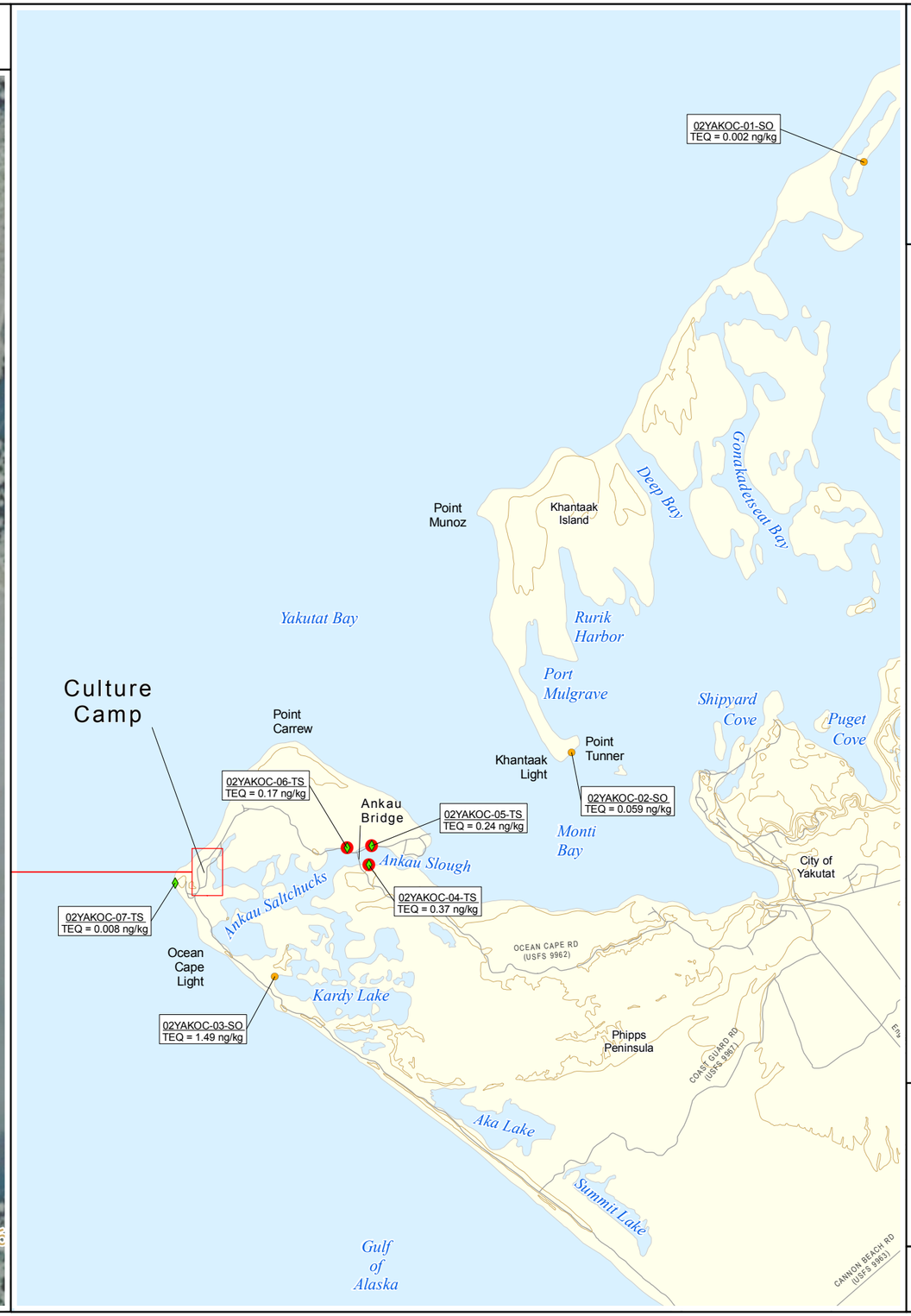
Sample ID	Total Dioxin TEQ, ND=0	Total Dioxin TEQ, ND=1/2DL
Soil	***Soil Screening Level = 4.3***	***Soil Screening Level = 4.3***
02YAKOC-01-SO[1]	0.002	0.69
02YAKOC-02-SO[1]	0.059	1.51
02YAKOC-03-SO	1.49	2.63
04Y-H2S-01-SS	0.003	0.32
04Y-H2S-02-SS	0.005	0.31
04Y-H2S-03-SS	0.27	0.61
04Y-H2S-04-SS	0.98	1.89
04Y-H2S-11-SS	0.93	1.73
04Y-H2S-12-SS	0.85	1.13
04Y-H2S-05-SS	0.005	0.53
04Y-H2S-06-SS	0.006	0.31
04Y-H2S-07-SS	0	0.65
04Y-H2S-08-SS	1.08	2.18
04Y-H2S-09-SS	0.12	0.84
04Y-H2S-10-SS	0	0.69
00H2SS001SO	0.07	1.68
00H2SS002SO	**10.4**	**11.9**
00H2SS007SO	**10.8**	**11.3**
00H2SS003SO	**22.5**	**23.2**
00H2SS004SO	0.48	0.82
00H2SS005SO	0.30	1.80
00H2SS006SO	0.005	1.41
Sediment	***Soil Screening Level = 4.3***	***Soil Screening Level = 4.3***
00H2SD001SE	0.005	2.41
00H2SD002SE	0.01	3.68
00H2SD003SE	0	2.05
Shellfish Tissue	***Tissue Screening Level = 0.021***	***Tissue Screening Level = 0.021***
02YAKOC-04-TS	**0.37**	**2.04**
02YAKOC-05-TS	**0.24**	**2.32**
02YAKOC-06-TS	**0.17**	**3.51**
02YAKOC-07-TS[1]	0.008	**1.75**
02YAKOC-08-TS	**2.5**	**4.06**

[1] Sample Identified as Background.
"ND=0" means non-detected concentrations are assumed to be zero.
"ND=1/2DL" means non-detected concentrations are assumed to be one-half the detection limit.
Bold indicates sample exceeds screening level.

Culture Camp Dioxin Sample Locations

0 200 Feet





Legend

Contour

Sample Location

- Tissue
- Soil
- Water
- Sediment
- Samples Exceeding Screening Level

Screening Levels

Soil	- 4.3 ng/kg
Tissue	- 0.021 ng/kg

Notes:

- -Water and Sediment samples are co-located
- -TEQ was calculated using a value of 0 for nondetections
- -Image Source Microsoft 2009
- -ng/kg, nanogram per kilogram
- -ng/L, nanogram per Liter

0 1 Mile

N

Dioxin Sample Locations

Yakutat Tribal Response Program

July 2009

RIDOLFI Inc.

File Path: J:\255 Yakutat\255C YTT TRP\GIS\Mapfile\dioxin_map\figure_01_dioxin.mxd

APPENDIX B
COMPLETED FIELD FORMS

Field Record for Shellfish

Species (Latin or common name): Horse Clam

Sample Number: 10062601 Sampling Date: 6/26/10

Collector Name(s): A. James, D. James, J. Klushkan, K. Foster Start Time: 750 AM Stop Time: 820 AM

Location/Site: Map Clam 6, 1000' east Bridges, shore Water Body Name: Ankau Saltchuck

GPS Coordinates: LAT: 59° 32.730'
LONG: 139° 49.098'

Location Marked on Map: ✓ *(check when completed)*

Photos: (yes) / no) Photo Numbers: 1-3 4(starfish)

Count: 7 Collection Method: Shovel to loosen, Collected with gloved hand, rinsed in saltwater, 3" dia hole

Notes: *(unusual odors at collection site, stained soils, discolored animals, abnormalities)*

Checked by: K Foster Date: 6/28/10

Field Record for Shellfish

Species (Latin or common name): Butter Clams

Sample Number: 10062602 Sampling Date: 6/26/10

Collector Name(s): A. James, D. James, J. Klushkan, K Foster Start Time: 840 A

Stop Time: 855 A

Location/Site: map Clam 4 1200 SW Bridge, southshore Water Body Name: Ankau Saltchuck

GPS Coordinates: LAT: 59° 32.598'

LONG: 139° 49.711'

Location Marked on Map: ✓ *(check when completed)*

Photos: (yes) / no) Photo Numbers: 5-10 (Photo 5 inside pack erased)

Count: 32 Collection Method: shovel to loosen, collect w/ gloved hands, Rinsed saltwater, 2.5' dia hole

Notes: *(unusual odors at collection site, stained soils, discolored animals, abnormalities)*

Collected sufficient number for duplicate sample numbered 10062607

Checked by: K Foster Date: 6/28/10

Field Record for Shellfish

Species (Latin or common name): Butter Clam

Sample Number: 10062603 Sampling Date: 6/26/10

Collector Name(s): A. James

Start Time: 9A

Stop Time: 915A

Location/Site: map clam 5 Water Body Name: Antau Saltchuck
1000' West Bridge, Northshore

GPS Coordinates: LAT: 59° 32.715'
LONG: 139° 49.773'

Location Marked on Map: ✓ *(check when completed)*

Photos: (yes) / no) Photo Numbers: 11-12

Count: 18 Collection Method: shovel to loosen, collected w/ gloved hand, Rinsed saltwater, 1' dia hole

Notes: *(unusual odors at collection site, stained soils, discolored animals, abnormalities)*

Checked by: K Foster Date: 6/28/10

Field Record for Shellfish

Species (Latin or common name): Butter clam

Sample Number: 100626004 Sampling Date: 6/26/10

Collector Name(s): ~~map~~ A James, D James, J Klushkan, K Foster Start Time: 9:20 A

Stop Time: 9:50 A

Location/Site: map clam 3 2000' SW Bridge, Northshore Water Body Name: Ankau Saltchuck

GPS Coordinates: LAT: 59° 32.613' LONG: 139° 50.050' GPS location B/E holes

Location Marked on Map: ✓ *(check when completed)*

Photos: (yes) / no) Photo Numbers: 13-20 (4 K4, 21 K7) (includes panorama of saltchuck)

Count: 14 Collection Method: shovel to loosen, collected w/ gloved hand

3 holes - 2' dia each, 12' circumf.

Notes: *(unusual odors at collection site, stained soils, discolored animals, abnormalities)*

Checked by: K Foster Date: 6/28/10

Field Record for Shellfish

Species (Latin or common name): Softshell Clam

Sample Number: 10062605 Sampling Date: 6/26/10

Collector Name(s): A. James, D. James, J Klushkan, K Foster Start Time: 10^25 A

Stop Time: 11 A

Location/Site: map clam 1 600' NE culture camp Water Body Name: Ankau Saltchuck

GPS Coordinates: LAT: 59° 32.615'

LONG: 139° 51.292'

Location Marked on Map: ✓ *(check when completed)*

Photos: (yes) / no) Photo Numbers: 22 - 247 KF (28-29 flowers)

Count: 30 Collection Method: shovel to loosen, collected w/ gloved hand, 7 - 2' dia holes over 10' dia area

Notes: *(unusual odors at collection site, stained soils, discolored animals, abnormalities)*

Checked by: K Foster Date: 6/28/10

Field Record for Shellfish

Species (Latin or common name): Softshell Clam

Sample Number: 10062605 Sampling Date: 6/26/10

Collector Name(s): A. James, D. James, J. Klushkan, K. Foster Start Time: 11^40 A

Stop Time: 12^30 p

Location/Site: map clam 2, 1300' SE of Culture Camp Water Body Name: Ankau Salt Chuck

GPS Coordinates: LAT: 59° 32.355'

LONG: 139° 5'.163'

Location Marked on Map: ✓ *(check when completed)*

Photos: (yes) / no) Photo Numbers: ~~29~~ KF ~~30~~ 30-31

Count: 22 Collection Method: shovel to loosen, collected w/ gloved hands, 10 holes over 25' dia area holes 1.5-2

Notes: *(unusual odors at collection site, stained soils, discolored animals, abnormalities)*

Checked by: K Foster Date: 6/28/10

Field Record for Crab

Sample Number: 10062803 Sampling Date: 6/28/10

Collector Name(s): A. James
D. James

Start Time: ~6pm 6/26/10 set pot
Stop Time: 6:30 pm 6/28/10

Location/Site: Culture comp Water Body Name: Ankau Saltchuck

GPS Coordinates: LAT: 59° 32' 33.42" N
LONG: 139° 50' 51.43 W

Location Marked on Map: _____ *(check when completed)*

Photos: (yes) (no) Photo Numbers: of the crabs not location

Collection Method: Crab pot

Animal No.	Body Length	Weight	Sex	Damage from Collection?	Abnormalities
01	7"	2 lb	M	no	missing 1 claw
02	6"	1 lb	M	no	none
03	6.5"	1.5 lb,	M	no	missing 1 claw
04					
05					

Checked by: K Foster Date: 6/30/10

Field Record for Crab

Sample Number: 10062804 Sampling Date: 6/28/10

Collector Name(s): A. James
D. James

Start Time: 6/28/10 6pm
Stop Time: 6/28/10 6:45 pm

Location/Site: Ankau Bridge Water Body Name: Ankau Saltchuck

GPS Coordinates: LAT: 59° 32' 28.94" N
LONG: 139° 50' 13.40" W

Location Marked on Map: X *(check when completed)*

Photos: (yes) / ~~(no)~~ Photo Numbers: _____

Collection Method: Crab pot

Animal No.	Body Length	Weight	Sex	Damage from Collection?	Abnormalities
01	6.75"	1.5 lb.	M	NO	missing 1 claw
02	6.5"	1.3 lb	M	NO	none
03	6.25"	1 lb.	M	NO	~~more~~ small claw
04					
05					

Checked by: K [illegible] Date: 6/30/10

APPENDIX C
DATA QUALITY REVIEW REPORT

ANKAU SALTCHUCKS SITE INVESTIGATION
DATA VALIDATION QA/QC REVIEW

Polychlorinated dibenzodioxins and dibenzofurans analyses were performed by AXYS Analytical Services, Inc., of Sydney, British Columbia, Canada, and herbicides were performed by Analytical Resources, Inc, Tukwila, Washington, in accordance with Ankau Saltchucks Site Investigation Quality Assurance Project Plan (Ridolfi, 2010).

Nine tissue and one soil sample were analyzed for polychlorinated dibenzodioxins and dibenzofurans, and one soil was also analyzed for herbicides. The laboratories provided U.S. EPA CLP style deliverables for all sample delivery groups.

Samples were analyzed and results reported by the laboratory in batch numbers as summarized below:

RC99:

Sample	Date Collected	Matrix
10062802	6/28/10	soil

DPWG34058:

Sample	Date Collected	Matrix
10062601	6/26/10	tissue
10062602	6/26/10	tissue
10062603	6/26/10	tissue
10062604	6/26/10	tissue
10062605	6/26/10	tissue
10062606	6/26/10	tissue
10062607	6/26/10	tissue
10062802	6/28/10	soil
10062803	6/28/10	tissue
10062804	6/28/10	tissue

DIOXINS/FURANS - U.S. EPA Method 1613 Revision B.

Sample Holding Times- ***acceptable***

All samples were handled and delivered to the laboratory according to chain-of-custody procedure. Laboratory data deliverables were complete. The cooler temperature upon laboratory receipt was 0 °C and all samples were kept frozen at -20 C until time of extraction. Maximum holding times for extractables were specified as 30 days/1 year (sample/ extract maximum holding times) for both solids and waters, all extraction and

analytical holding times were met since the samples were frozen until being prepared for analysis.

GC Resolution Criteria – *acceptable*

The separation criteria of ≤25% valley measurement between compounds 2,3,7,8-TCDF and 2,3,4,7-TCDF was met.

Ongoing Precision and Accuracy – *acceptable*

Four ongoing precision and accuracy (OPR) samples were analyzed (two tissue and two solid) with the respective matrix batch. Seventeen compounds and sixteen labeled compounds were analyzed and the percent recoveries were within the laboratory established limits.

Blanks – *acceptable*

Four procedural blanks were analyzed for each analytical group. The blanks contained low levels of target compounds, which were compared to the associated laboratory data. The samples were qualified as 'U' for the following compounds for the indicated samples, due to blank contamination:

Sample 10062601 for 1,2,3,4,6,7,8-HPCDD, OCDD, 2,3,4,6,7,8-HXCDF and OCDF.
Sample 10062602 for 1,2,3,4,6,7,8-HPCDD, OCDD, 2,3,4,7,8-PECDF and OCDF.
Sample 10062603 for OCDD and total Hexa-dioxins.
Sample 10062603 L for 1,2,3,4,6,7,8-HPCDD.
Sample 10062604 for 1,2,3,4,6,7,8-HPCDD, OCDD and OCDF.
Sample 10062606 for 1,2,3,4,6,7,8-HPCDD, OCDD and OCDF.
Sample 10062606 i for 1,2,3,4,6,7,8-HPCDD and OCDD.
Sample 10062607 for 1,2,3,4,6,7,8-HPCDD, OCDD and OCDF.
Sample 10062803 for 1,2,3,4,6,7,8-HPCDD, OCDD and OCDF.
Sample 10062804 for OCDD.

Labeled Compound Performance – *acceptable*

Labeled compound performance was reviewed. The labeled compound recoveries and the ion abundance ratios and RRTs were acceptable.

Laboratory Duplicates – *acceptable*

Duplicate analysis was performed on sample 10062602. All compound relative percent differences were less than 35% with the exception of OCDD which was 39.3%. No qualification was made to the data since the matrix was tissue and the concentrations were less than >10x the reporting limit.

Target Compound Identification and Reporting Limits – *acceptable*

For several samples, a 'K' qualifier was reported by the laboratory which indicates a peak was detected but did not meet the quantification criteria, the result represents the maximum possible concentration. These compounds were additionally qualified as estimated 'J' during data validation to indicate the maximum criteria. Additionally, several compounds were also qualified as 'U' for blank contamination.

HERBICIDES – 8151A

Samples were analyzed for herbicides using EPA method 8151A.

Sample Holding Times- *acceptable*

The soil extraction was performed within 14 days of collection, and all analyses were performed within 40 days of extraction, per the method.

Blank Contamination – *acceptable*

Analytical method blanks were analyzed at for each matrix type per SDG. No analyte responses were reported.

Surrogate Recovery- *acceptable*

Surrogate compounds were added to project samples and laboratory quality control samples prior to analysis to assess analytical performance for the samples. All surrogate recoveries are within specification.

Matrix Spike/Matrix Spike Duplicate Recovery – *acceptable*

A spike pair was not reported with the dataset.

Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples were analyzed per matrix. LCS performance is considered acceptable.

Compound Identification - *acceptable*

No problems were noted with the result forms.

System Performance: The chromatograms were reviewed for baseline shifts, general instrument response and missed peaks. No anomalies were noted.

Overall Assessment: All deliverables required by the project are present and data packages are complete. Recommended sample holding times and conditions were met. Method blanks show trace levels of target compounds which resulted in qualification of associated samples. Compound identification and quantitation is acceptable. Raw data show no indications of system anomalies. The laboratory duplicate criteria were met. The OPR samples recovered in limits. Overall analytical performance is considered acceptable, and data quality is sufficient for project use.

References:

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