Tribal Association for Solid Waste and Emergency Response:

Tribal Hazardous Sites 2004 Report

Researched and Compiled by

Zender Environmental Science and Planning Services

Tribal Hazardous Sites 2004 Report

Developed by

Zender Environmental Science and Planning Services

For

Tribal Association for Solid Waste and Emergency Response

TASWER

TRIBAL ASSOCIATION FOR SOLID WASTE & EMERGENCY RESPONSE

With Funding from the United States Environmental Protection Agency

August 2004

Table of Contents

Section	Page
TASWER Hazardous Waste Sites Project Introduction	1
Overview Picture	1
Project Components	2
Nation-wide survey	2
Identifying Hazardous Sites: Tribal Hazardous Site Registry	3
Problem Background	3
What is hazardous?	7
Where can a THSR site be?	8
GIS Mapping Layer	8
How much risk do THSR sites pose?	9
Did the THSR survey add any sites to the THSR?	11
Did the THSR survey effort delete any sites from the THSR?	11
Did the survey aid the site identification process in any other way	11
How does TIMS fit in with this effort?	11
What else did we find out about the THSR sites?	11
THSR Site Characteristics	12
Role of Intangible Risks	13
What makes us think *we* can describe y*our* Tribe's risks?	13
What did we find?	13
Do Hazardous Sites Impact Subsistence Practices?	14
Do Hazardous Sites Impact Other Traditional Activities?	15
Does Changing A Tradition Matter As Long As It Is Still Performed?	16
How Much Does Tradition Matter?	17
Assessing Contaminant Exposure and Risk to Tribes	19
Other Tribal-Oriented Risk Assessment Software	19
Overview of General Human Health Risk Assessment	21
What is Different About Risk Assessment for Tribes?	21
Hazard Identification	23
Exposure Assessment	24
Dose-Response Assessment	24
Risk Characterization	24
How NAERAM Works	24
Cultural Activities Addressed in NAERAM	25
The NAERAM Architecture: Input Questionnaires	27
How does NAERAM model all the risks that your Tribe faces?	27
How About an Example?	28
Biogeographic Areas	28
Cumulative Short-Term Health Risks	29

Why Did We Perform This Study? 29
What is a Relative Risk? 29
What Hazardous Site Factors Increase Tribal Health Risks? 29
What Symptoms Did We Look At? 30
What Did We "Adjust" For? 30
What Risks To Short-Term Health Did We Find? 30
Other Important Results 32
What Does All of This Mean? 34
Developing a National Policy to Address Hazardous Sites on Tribal Lands Based on Tribal Priorities 35
Size doesn't matter 35
Site Type 35
What Types of Sites Did Tribes Tell Us They Were Concerned About? 36
Contaminant of Concern 36
Site Jurisdiction, and Responsible and Affected Party Identity 37
Media Contamination 38
Whether a Traditional Activity is Impacted 38
Contaminant Risk Exposure 39
Additional Tribal Concerns 39
Summary Of Tribal Priorities And A General Model 41
Using NAERAM to Measure Tangible Risk 42
Using Short-Term Health Risks to Measure Tangible Risks 42
Using Proxies to Measure Tangible Risk 43
Measuring Intangible Risks 44
Lumping the Two to Get a Tribal Priority Number 45
Summary of site priority considerations 47
Closing Issues 48
Survey Response 48
Policy Treatment Of Aboriginal, Customary Use, & Treaty-Use Lands 49
Conclusions 51
Future Research and Project Follow-up Efforts 53
Development of a THSR 53
THSR Survey 54
NAERAM Suggested Modifications 55
NAERAM Software Development 55
Future Risk Model and Model Software Development 56
Appendix A - THSR Survey Profile A-1
Appendix B - Screen printouts of the THSR Database and Map B-1
Appendix C - THSR Regional Tables C-1
Appendix D - Empirical Study Questionnaires D-1
Appendix E - Relative Health Risk Study: Technical Discussion E-1
Appendix F - Summary of Results Pictorial F-1

TASWER Hazardous Waste Sites Project

The purpose of this one-year project was to assess the overall national situation of hazardous wastes sites on, or next to, Tribal Lands, and to describe the risks to Tribes that the sites pose:

How many sites are there?

Over 15,000 hazardous sites and facilities that present potential risks to Tribal lifestyles were identified[1].

979 of these sites are Superfund sites

582 are hazardous waste facilities

1,104 are open dumps

7,884 are mines

4,075 are Leaky Underground Storage Tanks

320 are Formerly Used Defense sites

At least 33 are Brownfields

88 are newly identified sites or site groups from this project.

Do they affect Tribal lifestyles?

Yes, 57% of responding Tribes have changed their subsistence activities due to concerns about a hazardous site[2].

And 52% of responding Tribes have changed other cultural/traditional activities, such as performing ceremonies, making baskets and other art/tools, and making traditional medicine, because of their concerns about a site.

How is subsistence affected?

43% of Tribes changed *where* they hunt, fish, and gather foods

27% changed *how often* they performed these activities

34% changed *how much* traditional food they ate

39% changed *what types* of traditional food they ate

30% of Tribes have had a subsistence activity *stop altogether.*

How are other activities affected?

40% of Tribes changed *where* their traditional lifestyle activities take place

28% of Tribes changed *how often* they performed their traditions

27% changed *the way* their traditional activities are done

26% of responding Tribes have watched at least one traditional activity *stop altogether.*

---

[1] Site numbers and types are derived from compilation of a number of federal databases, website lists, and Tribal survey responses, as described in the following section.

[2] Responding Tribes refers to Tribes that responded with concern over a site(s) to the "THSR survey" developed and distributed for this project. See Appendix A for response rates,and representation discussion.

Project Components The above summary was derived from data resulting from the Project's five main component efforts:

- Identification of hazardous waste sites on Tribal Lands, or of Tribal concern, through the **T**ribal **H**azardous **S**ites **R**egistry (THSR) database and GIS mapping.
- Description of the intangible risks associated with those sites, as defined by Tribes.
- Development of the **N**ative **A**merican **E**xposure and **R**isk **A**ssessment **M**odel (NAERAM), a technically-defensible exposure and risk assessment model that addresses Tribal lifestyle activities, and evaluates physical exposure risks to individual site contaminants.
- Evaluation of cumulative short-term health risks associated with select hazardous sites.
- Exploration of a National Policy on Addressing Hazardous Sites of Concern to Tribes.

Each component will be discussed in its own Main Section, followed by a discussion of Issues and Future Research.

Nation-wide Survey Note that all federally-recognized Tribes were surveyed to provide a portion of the data for this Project, including the descriptive statistics cited above. A response rate of 20.5 percent was achieved[3], with approximate proportional geographic representation, thus providing a basis for identifying general trends, issues, and circumstances present in the full population of Tribes[4]. The survey instrument used, referred to as the "THSR Survey" in this Report, is provided in Appendix A, together with a general description of Survey development, solicitation efforts, and response rates. Along with the Survey, Tribes were provided draft lists of CERCLIS and RCRA_Info sites identified to be within their borders, with a request to confirm or add sites they considered hazardous, and cross out sites about which they were not concerned.

Tribal Voices: Descriptions of THSR Survey sites

- The odor from the farm spans many miles; the ammonia makes it hard to breathe for nearby residents; the flies are out of control in the late summer.
- There is also the Old BIA Fuel Depot…To this day whenever its rainy season or heavy rainfall oil sheen is seen at the lake below the school.
- The site needs to be "cleaned" up. Too much garbage all over the hillside because the garbage is not enclosed in. A recycling system would be great for our village.
- This is a former DOD Loran Station used for radio wave triangulation by seagoing vessels… Transformers were used and these were filled with PCB laden oil….
- As you land in [here] in an airplane to the North, the covered-closed Dump is to your left side of the south end of the airport. It is just 100 feet north of the closest HUD house in that subdivision.
- Tailings were left approximately 20 feet from the …River-which is the only drainage to [the] lake system. [the state] came … because they were informed of mercury tailings near [a] resort…
- The site is the location of traditional/cultural activities. It is visible from the road and is in an open trench along the … River.
- We have dealt with illegal dumping on the…Reservation ever since I came on board 6 years ago. We have successfully picked up around 10 sites. One site…has continued to be a problem
- There is a concern that pesticides and other harmful substances were disposed of at the site. The dump was used by residential, Tribal, (IHS) and (BIA) for approximately 12-15 years
- All contaminants are derived from the manufacture of wood pulp…Dioxins/Furans, PCBs...PAHs.

[3] Surveys were submitted for 115 Tribes for a return rate of 20.5%. Another 5 Tribes did not submit surveys, but responded they had sites or areas of concern that they wished noted, even though they could not fill out survey.

[4] Standard confidence interval calculations with corrections for finite populations reveal an error rate of ± 8% at the 95% level of confidence. Zar, Jerrold in Biostatistical Analysis 3rd ed Prentice Hall, upper saddle river, NJ, 1996.

Identifying Hazardous Sites: Tribal Hazardous Site Registry

This component of the project consisted of developing a database of hazardous sites of concern to Tribes, and a map(s) that delineates a number of site characteristics through use of different symbol and color patterns. We refer to the database (and its associated map(s) that may be generated) as the "**T**ribal **H**azardous **S**ite **R**egistry" (THSR) hereafter. THSR is provided on compact disc with the final report package. A companion user's manual describing features, quality control, source information, etc., is included as a separate package enclosure as well.

Problem Background There are a number of federal databases that contain hazardous site information. For Tribes' purposes, there are several problems with these databases, including:

- They were not designed to record which sites were on Tribal Lands or which Tribe's land the sites were on,
- They include only sites meeting the *federal definition* of a hazardous waste site,
- They don't tell you which of these sites Tribes consider hazardous, or why,
- They have inconsistent format and quality control, and can not be compiled together easily,
- Several are not incorporated into GIS software for mapping purposes,
- They do not link useful Tribe and site information readily available from other sources, such as contaminant data and active Tribal websites, so that the user is left on their own to search through databases and websites, expending valuable staff time,
- They are not generally designed to be user-friendly.

These problems were addressed by creating a user-friendly database in Filemaker Pro 6.0, and an associated GIS map in ARCView 8.3, that contain only sites of Tribal interest and are geared towards Tribes' purposes. The database pulls site information from:

- **Federal databases:** FUDS[5], IHS Open Dump Inventory[6], CERCLIS[7], RCRA_Info[8], MAS[9]
- **Websites:** EPA funded Tribal Brownfield projects[10], State LUST[11], ENVIROFACTS[12]
- **American Indian Environmental Office** (AIEO)[13]

---

[5] Current Feb 2004. FUDS is the USACE database of "Formerly Used Defense Sites". FUDS sites generally coincide with NAETS sites, the Department of Defense database that allows access only to individual Tribal records, with that Tribe's approval, but contains more detailed site information than FUDS.

[6] Latest published IHS Inventory (1998). Available at: http://www.dsfc.ihs.gov/Documents/Appendix%20D%20Open%20Dumps%201998.doc

[7] CERCLIS pull Jan 2004, for all "Tribal interest" flags, including TL, TC, TI, IL, TR, NN. See THSR method field, or CERCLIS manual, for more marker description. CERCLIS is the EPA database of Superfund sites.

[8] 12/2003 data pull from RCRA_Info database. Note that EPA OSW is updating and correcting Tribal RCRA_Info with new data from Tribes. At that time, all *RCRA_Info sites listed in THSR should be deleted* and replaced with the new data. RCRA_INFO is the EPA database of hazardous waste/materials facilities.

[9] Causey, J. Douglas , 1998, Minerals Availability System (MAS/MILS database): U. S. Geological Survey, Denver, CO. Available at http://tin.er.usgs.gov/metadata/masmils.faq.html . Zender redigitized and pulled mines on, or within approximately 5 miles of, Tribal lands.

[10] Brownfield sites were compiled by conducting a state by state search of the Brownfields listed at http://www.epa.gov/brownfields/ and manually inserting sites located on Tribal Lands. The resulting list is a subset of all sites meeting Brownfield criteria on Tribal Lands, in that the list represents only those sites that have been addressed for Brownfield projects.

[11] LUST sites were compiled from state websites at http://www.epa.gov/swerust1/states/stateurl.htm . These sites were identified by either having the same zip code as a Tribe, or by coordinates that came within 2 miles of a Tribe (see the Location Method field in THSR). Note, in the case of large zipcode areas, several of these sites may not be on, or close to, Tribal lands. LUST is the acronym for Leaky Underground Storage Tanks.

[12] ENVIROFACTS search Jan 2004 for AK sites, all sites located in Native Villages were added. June 2004 for lower-48 sites, all sites which share zip codes with Tribes were added. It should be noted a total of 222 sites were added in Alaska and Lower-48.

- **University of Tulsa**[14]
- **National Tribal Environmental Council** (NTEC)[15]
- **Tribally submitted site surveys:** The previously mentioned THSR Survey[16]

The advantages of THSR are:

- It is easy to look up sites by Tribe.
- It has consistent quality control, including source identification and federally standardized Tribal names and identifier codes so that sites are not mistakenly entered twice or not entered at all.
- It uses the latest available GIS mapping layer to identify which sites are on Tribal Lands[17].
- It uses Tribal definitions of a hazardous waste site, but still allows users to see which sites federal agencies currently define as hazardous, and which sites are listed on the various federal databases (see next subsection).
- Through the THSR survey effort, Tribes were provided the opportunity to add, change information on, or delete sites based on whether they feel sites are hazardous and whether they want the site listed (i.e. privacy concerns).
- It contains THSR survey information on intangible and qualitative risks for the sites specific to Tribes and Tribal lifestyles. So the database formalizes these risk concerns in a way that can be used to provide supportive statistical documentation in developing responsible federal policies on addressing Tribal hazardous sites nationwide.
- It contains a Bio-Geographic Area (BGA) layer for the user to view Tribes and sites-- not in EPA Regions of State groupings, but in groups defined by geography, watershed use, and shared Native American cultural characteristics.
- It contains a basic site priority classification scheme that can be used by Tribes and agencies to begin to understand the issue of addressing hazardous sites concerning Tribes, in a methodical way.
- The Tribal records contain demographic information.
- The database is programmed with a number of useful features, including: 1) Links to site contaminant sampling when available from CERCLIS or ASTDR, with links to information about the contaminants found, 2) Updated links to over 400 Tribes' websites[18], 3) Webpage site descriptions, 4) Links to THSR surveys for those sites for which Tribes submitted surveys, 5) Site pictures where available, and 6) Links to Brownfield documentation, 7) Additional email, post, and phone comments from Tribes for sites for which Tribes expressed concern, 8) a Bio-Geographic Area (BGA) map layer for the user to view Tribes, not in EPA Regions, but into present-day broad-based cultural and geographic Tribal similarities, that emanate primarily from the major watersheds and mountain ranges that long ago were primary determinants of Tribal lifestyles, and remain so today (see NAERAM Section below for more details on BGA development).

Examples of THSR database screens are reproduced on the next two pages. See Appendix B for additional screen formats, as well as examples of map layouts.

---

[13] Nine additional CERCLIS sites were added from information provided by EPA AIEO.

[14] An additional 213 sites were identified by University of Tulsa under the same Grant number as the Zender one-year Project. These sites were not possible to classify further into other categories for a variety of reasons. See THSR for more detail.

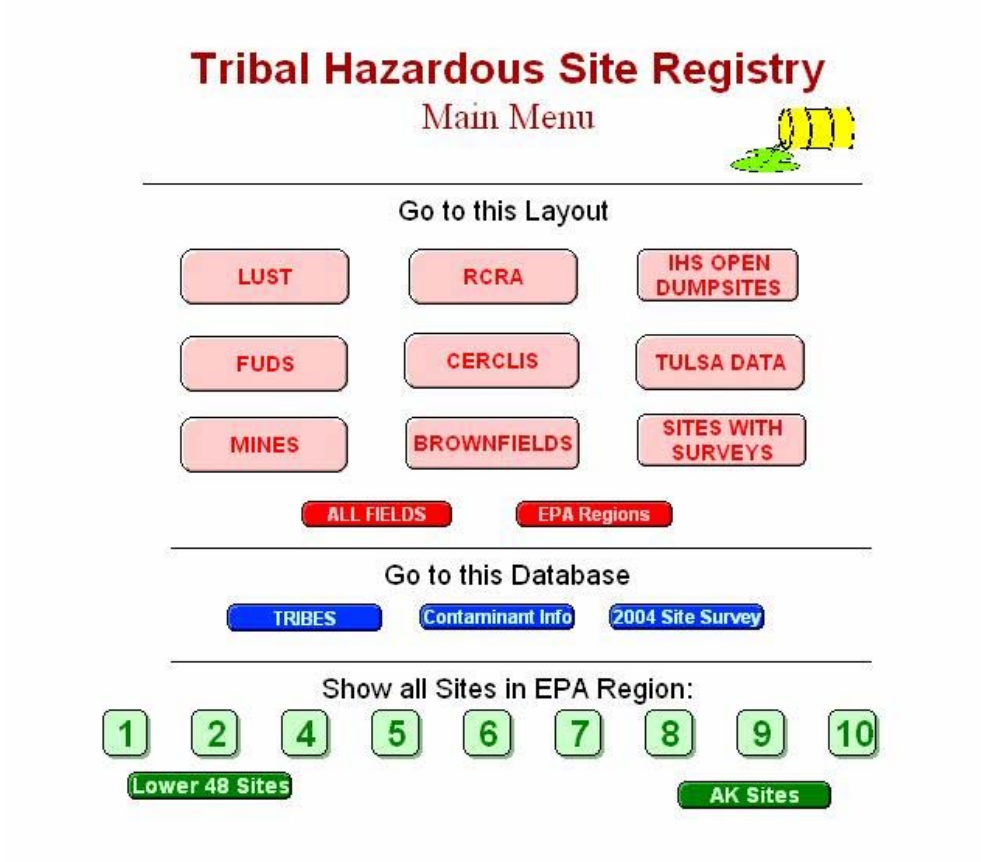
[15] Five CERCLIS/NPL sites were added from information supplied by NTEC.

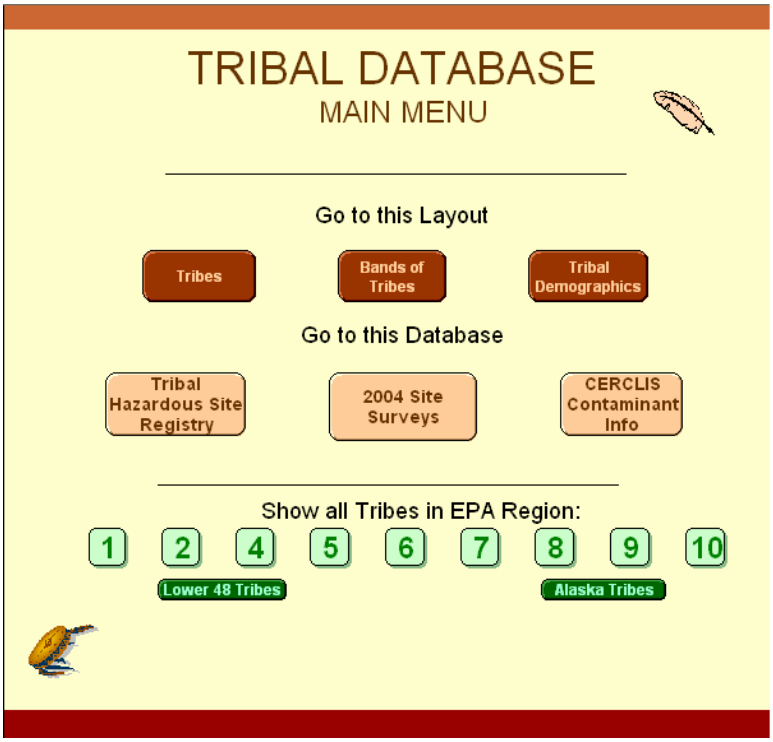
[16] The THSR survey was approved under federal Information Collection Request No: 2059.0, OMB Control No: 2050-0189. The survey is provided in Appendix A, and has also been programmed in ACCESS for query ease.

[17] Primarily AIEO updates, AILESP mapping programs compiled together. See THSR documentation for details.

[18] Note, EPA AIEO's dynamic database system includes website links, but well over 300 of these were inactive.

THSR Design Layout Examples





CERCLIS With Contaminant Information

EPA REGION 10 EPA ID AK6210022426 SITE_ID 1001146

TRIBAL ID

Site Name

Listed Tribe

Show all Records

Go to THSR Database

Go to Tribal Database

Link to Contaminants

Go the "link layout to activate table.

Go to Link Layout

Go to Table Layout

Go to related record in Site Database

Go to related record in Tribes Database

AK6210

F47

SITES WITH SURVEYS

Find All Sites With Survey Info

Go to Main Menu

Record Number 115285 EPA ID Data Source Tribal Notification

Tribal ID Code Other ID # Survey Key 119

EPA REGION 10 Tribe Name

To view form as a table, select "View" and then view as table

Site Name OLD STATE SCHOOL SITE County

Address Latitude 62.6930556

Longitude -160.259444

City State AK Zip Location method Tribe Survey

Was this Site on the List Sent out to Tribes? No, site added from survey

Was a Survey filled out about this site Yes

Tribe's Response about Site New

*Note a response of "New" means new to database, not the Tribe

Priority Site of Concern, Confirmed by Tribe

On Reservation

If the cells below this comment is full, there is a related record in the corresponding database.

Go to Record in Survey Database 119

Go to Record in Tribes Database

Go to Record in Contaminant Database

E Link Double click on the photo to activate and then you can scan down and see all photos. Click outside the picture to return to FileMaker

Photographs of Old School site - Alaska

In compiling the THSR, a question begged to be asked first:

What is hazardous? At the outset, it was decided that this Project would *leave the definition of a hazardous site to the Tribes themselves:*

> Please identify all active or abandoned sites and facilities on or near your Reservation (or other Tribal/Village lands) that your Tribe/Village considers to be *hazardous*. Please include only those sites that are known, or suspected, to pose *significant risks* to the Tribal community and/or its traditional practices.
>
> *-Header paragraph for THSR Survey, underline added for emphasis*

> Are you wondering whether your site fits a "hazardous waste site"? If your Tribe feels it is a hazardous site - then to us, it is a hazardous waste site.
>
> *- Excerpt from THSR Survey mass email solicitation*

This decision was based primarily on the following:

1. **IHS Open Dump Inventory history:** The initial under-recording of open dumps in the federally-mandated IHS Inventory is well-documented[19]. Tribes were so dissatisfied with the process, it had to be repeated, at great expense. Besides relying on agency staff rather than the Tribes to identify where and how many sites there were, a rather conservative (but inherently fuzzy) delineation was made as to what constituted an open dump (i.e. generally larger and obtrusive). Many Tribes and other entities feel the inventory number is still low. By leaving to the Tribes what constitutes a hazardous site, *the aim was to capture, up front, the full universe of sites that Tribes believe should be listed.*

2. **GIS database:** Use of a GIS database facilitates this "user-defined site" approach because of its layering function. For those unfamiliar with GIS capabilities, note that different classes of sites can be easily accessed, reported, and viewed separately with the click of a mouse. Thus, for this Project, a single database of hazardous sites was compiled "under one roof", so to speak, while keeping "new" Tribal-defined sites separate from federally-recognized sites. *In this way, decisions by Tribes and agencies regarding the future use of THSR could be made in their due course of time.*

3. **Subjective federal definition anyway**: A third underlying consideration was that, the federal definition of "hazardous" is limited in scope and arbitrary in its quantification. Wastes are considered to be "hazardous" if they meet definitions of ignitability, corrosivity, reactivity, or toxicity. And "hazardous waste sites" are generally inferred to mean sites with RCRA Subtitle C hazardous wastes or materials, and not household hazardous wastes[20]. Yet, inarguably, an open dump in regular use by a community, particularly in an area where no household hazardous waste programs are in place (e.g. over 80% of rural Alaska Tribes), could contain household hazardous wastes in cumulative quantities meeting small quantity generator status[21].

   Further, physical health risks through disease transmission and injury are altogether precluded. In hindsight, selection of the term "hazardous" by the federal government in compiling RCRA was perhaps an imperfect choice. Because it is difficult to argue the point with:

   - An Alaska Native that their honeybucket dump was not "hazardous";

---

[19] Zender, L. *Solid waste management on Indian Reservations: Limitations of conventional solid waste management engineering* Doctoral dissertation, Department of Civil & Environmental Engineering, University of California, Davis, 1999.

[20] Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6992k

[21] Small quantity generator status Household hazardous waste generation has been estimated at approximately one-half to 1 percent of total municipal waste generation (Tchobanoglous, G., H. Theisen, S. Vigil*, Integrated Solid Waste Management: Engineering principles and management issues*, McGraw-Hill Inc, 1993). At a 5 lb per capita average generation rate, a community of 150 people would generate approximately 100 kg of hazardous waste each month, equivalent to small quantity generator status, using 0.75 % of total wastes as an estimate.

- A lower-48 Tribal member that it was safe (i.e. "not hazardous") for their children to play around diabetic needles, loose garbage, rusty nails, subsiding ground, or open refrigerators;
- An elder that eating fish or drinking water from an oil-sheened stream, draining from junked cars, would not sicken them (i.e. again, "not hazardous").

We are not being trite here. Miscommunication can cause much organizational 'grief' and wasted effort in Federal-Tribal waste policy issues[22]. The latter scenario raises a third category of risks that is left out from the federal working definition: *Intangible risks*. Intangible risks are those for which there is no direct physical measurement. Yet, as will be discussed further below in the "Intangible Risk" and "Developing a National Policy" Main Sections, they *do* impact Tribes significantly. *Thus, by allowing Tribes to define "hazardous" for the THSR, we were provided a glimpse into what constitutes "risk" to Tribes.*

Where can a THSR site be? The issue of whether to include Tribally-submitted sites that are outside Reservation/Village boundaries was simple to decide for much of the same reasons as above. Because Tribal Reservation and Village borders were subjectively delineated in the first place[23], including only sites within federally-recognized Tribal borders would effect a purely subjective delineation of sites considered hazardous to Tribes.

Thus, in broad terms, a THSR site is:

> **A site that poses a significant risk to a Tribe's well-being, a Tribal lifestyle, a Tribal member's health, or a Tribe's environment, irrespective of jurisdictional borders…**

In practice, the large bulk of sites listed in the THSR are within Tribal or Village borders. For all but a handful, the remainder are just outside borders, where a number of exposure pathways present physical contamination risks to the Tribe inside their borders. Of the 84 sites in the THSR Survey that lower-48 Tribes submitted jurisdictional information for, 65 percent were on-Reservation, and at least another 10 were associated with some level of federally-recognized Tribal jurisdiction, such as allotments[24]. Only 14 percent were cited to be off-Reservation *and* not related to any level of Tribal jurisdiction.

The location issue is a complex one in terms of future endeavors to address Tribal hazardous sites, as it involves considerations of: 1) GIS mapping layer capabilities[25], and 2) Jurisdictional issues, including the treatment of aboriginal and Treaty hunting and fishing lands. The technical GIS problem is discussed below, and both general issues will be discussed in greater detail in the Closing Issues Main Section.

GIS Mapping Layer In THSR, computer software is used to lay Tribal borders over a site map. This generates a digital map that shows whether sites are inside or outside Tribal boundaries, and/or which Tribe the sites are associated with. But to be precise about where the sites are, there are at least basic two elements needed, and for THSR (as well as for any site database), neither is fully obtainable:

1) The exact physical location of the site, and
2) The exact depiction of Tribal borders.

---

[22] See Zender, *Solid waste mngmt. on Indian Res.: Limitations of conventional SWM engr.*, Supra note 18.

[23] Anyone interested in Federal (or State)-Tribal dynamics in any field of discipline would do well to verse themselves in the history of Indian Tribes, Reservations, Treaty making (and breaking), etc. For the lay reader and scholar alike, our favorite is Nabokov, P. (ed), *Native American testimony: A chronicle of Indian-white relations from prophecy to the present*, 1492-1992, Penguin Books, New York, 1991.

[24] 2.3% of the 84 sites with THSR jurisdiction data (Question #1) were outside trust lands, 2.2% were allotments, 4.8% were treaty hunting and fishing lands. Seventeen percent fell into the "other" land type category.

[25] As an example, for the THSR as a whole, the type of site that is most likely to be off-reservation is a LUST, because those sites were matched with Tribes only by matching zip codes. Unless a reservation has its own zip code, a significant portion of the LUSTs listed for a Tribe are likely to be off-reservation.

Let us look at the first element, identifying an exact physical location:

THSR sites are generally associated with:

- GIS coordinates (e.g. 47 N 156 E),
- An address, or
- No definitive or specific site location information.

Sites with *GIS coordinates* can be placed exactly. The only error is the uncertainty with the measure itself -- the resolution and correct use of the GPS unit and, especially for larger sites, the problematic use of a single coordinate to depict an areal dimension. With *addresses*, there are two problems: 1) Whether the address is correct, and 2) How accurate the program is that is used to translate the address to GIS coordinates. Then, some THSR sites are not associated with a *specific location* at all. For example, a Tribe might submit a site, but exclude its ground-truth whereabouts, either because they don't have the coordinates, or due to proprietary or legal concern. Or, as in the case with the THSR LUST sites, address data extracted from other sources might be limited to a zip code only. In this case again, a zip code-based mapping program will place the site in the zip code area, but with no further resolution. As a result of all of these conditions, the site location in THSR is associated with a varying degree of uncertainty[26].

Then there is the second element needed for THSR site locations to be digitally precise-- Tribal border delineation.

A built-in uncertainty is associated with the computer program that draws the Tribal borders. Partly because Tribal Land borders are so complex, and to this day still in flux, and partly because GIS tool development by agencies is relatively new, an accurate program to digitize Tribal borders has not been developed. Beyond the problem of where the Tribal Land borders physically are, the resolution of a border "layer" on digital GIS map is not perfect. It is a very technical subject, but the borders are mathematically estimated. So on the digital map, the digital border is only a fuzzy approximation of the real, physical border. Thus, hazardous sites that are near the border might register digitally as being outside a Reservation when they are really inside, and vice versa. To adjust for this problem, THSR includes sites within 1 to 5 km of the border, where practical. Note that a federal government inter-agency group is working on a standardized and technologically advanced GIS program for Tribal Lands[27] that should be available in the next few years. At this point, that mapping program can be (and should be) substituted for what is being used currently in THSR.

How much risk do THSR sites pose? We don't know. The scope of this Report was to provide first a methodical look at hazardous sites of concern to Tribes. But assessing risk for all of the sites will require a lot of work, and is also a complicated issue. Risk can be defined in many ways. And our position is the people that are affected should decide how they wish to define it. The risk of a site is not just from how much contamination is there, or how much physical exposure people might have. We look at risk in several ways here, and develop a risk assessment model for Tribes to assess the contaminant risks at their sites of concern. Reading the report will provide a good grasp of the many risk issues involved. And to provide a sense about the *relative* level of risk, below are some numbers CERCLIS, IHS, and FUDS sites, broken into relative priority levels.

[26] Note, sites without specific addresses are not incorporated into the THSR map, for obvious reasons.

[27] Federal Interagency GIS Working Group, GIS Indian Lands Subcommittee, refer to AIEO for details.

Superfund sites Ranked by a Relative Priority Scheme Based on NPL[1] Status

Status	Number of THSR Sites	Percent of each Status Type
Currently on the final NPL	29	3.0%
Site is part of NPL site	41	4.2%
Proposal for NPL	2	0.2%
Pre-proposal site	2	0.2%
Deleted from the final NPL	5	0.5%
Removed from proposed NPL	1	0.1%
Not valid site or incident	59	6.0%
Not on the NPL	588	60.2%
Other (unknown)	249	25.5%
Total	**976**	**100.0%**

[1] National Priority List

Formerly Used Defense Sites (FUDS) in THSR Based on Whether Hazard Found

Hazard Found?	Number of Sites	Percent of total
Yes	117	36.6%
No	196	61.3%
Other (unknown)	7	2.2%
Total	**320**	**100.0%**

Indian Health Service Open Dumps in THSR by SDS Category

Threat	Number of Sites	Percent of total
High	141	14.7%
Medium	443	46.3%
Low	469	49.0%
Other (unknown)	45	4.7%
Total	**957**	**100%**

Is there any kind of "first cut" priority scheme for all of the sites together?

Priority	Sites	Composition
Site of concern (on THSR draft list), confirmed of concern by Tribe	133	0.9%
Site confirmed by Tribe	47	0.3%
Site not confirmed by Tribe, although Tribe responded*	39	0.3%
Site not confirmed by Tribe, ranked as 'high risk' by Agencies	322	2.1%
Site not confirmed by Tribe, ranked as 'medium risk' by Agencies	449	2.9%
Site not confirmed by Tribe, not ranked or ranked as 'low risk' by Agencies	14,232	93.2%
Site confirmed as no concern to Tribe	56	0.4%
Total	**15,278**	**100%**

* Note that Tribal responses indicated that they may have information on these sites to relay in the future. Thirty-six of the sites in the group "Site not confirmed by Tribe, not ranked or ranked as low risk by Agencies" were on site lists sent to Tribes, and while these Tribe's responded about other sites listed, there was no indication that they had any information or knowledge about these sites.

Did the THSR Survey add any sites to the THSR? Yes. Out of a total 183 surveys, *88 were "new" sites*[28]. Of those, 40% were from Alaska. The remaining 95 surveys on 'already-federally-recognized' sites provide valuable new information concerning these sites, including a broader range of risk characteristics that encompass intangible risks.

Did the THSR survey effort delete any sites from THSR? Yes. Sixteen Tribes asked us to delete a total of 56 sites from the draft list we sent them[29]. These sites are flagged in THSR as being of "no Tribal concern". Note that the draft lists did not contain sites from FUDS, LUST, IHS, MAS, or Brownfield data[30].

Did the THSR survey aid the site identification process in any other way? The Survey didn't, but remember the site list we mentioned that accompanied the THSR survey? Our intensive follow-up effort to solicit Tribal responses to the survey included providing Tribes their site list again, and requesting that they confirm the listed sites. Thus, we are able to state that the *site list verification process adds a significant reliability element to the THSR*. In our analysis of Tribal response rates, we found indications that many Tribes did not respond -- because they agreed with the draft CERCLIS and RCRA_INFO site list that we sent[31]. This response behavior is supported by health survey response studies where people are more likely to respond when they feel they have a "stake in the outcome"[32].

How does TIMS fit in with this effort? This Project collaborated with the very promising new Tribal Information Management System (TIMS) developed by AIEO. As a result, much of the quality control work, such as corrected Tribal identifier codes and names and updated Tribal website links, will be transferable directly to TIMS. And because all THSR data is sourced and meets federal standards of quality control, useful THSR information that is not considered proprietary will be integrated into TIMS in the future. Tribes won't need to provide the same site information twice.

What else did we find out about the THSR sites? We gave a sneak preview of the general site classification breakdown at the beginning of report. Those interested in detailed information about the sites can use THSR directly to pull up the statistics in which they are interested. For the rest of us less-ambitious folks, please see Appendix C and the next page….

---

[28] One of these was a CERCLIS site, one a FUDS, one Department of Energy site, and seven others were associated with ID numbers, but the source was unknown (possibly a State ID system). Of the rest, the timeframe of the Project did not allow us to confirm positively whether sites were registered elsewhere, duplicates of another THSR site, or sites that have never been registered.

[29] Nine CERCLIS sites, 24 RCRA_INFO sites, and 15 University of Tulsa sites were deleted from Lower 48, and 2 CERCLIS list sites, 5 CERCLIS (ENVIROFACTS) sites, and 1 Tulsa survey site from Alaska were deleted. Note, no RCRA_INFO sites were identified for Alaska. These sites are still accessible in the database so that agencies will know to remove from their lists, and it has not been confirmed that they are not associated with another Tribe.

[30] They contained only CERCLIS sites from the Jan 2004 pull and from University of Tulsa efforts, and the RCRA_INFO Dec 2003 pull.

[31] Our site list verification effort was random within each EPA region in its solicitation of Tribes. So one would expect that Tribes *without* sites would respond at a rate at least as great as Tribes *with* sites, all else equal, given the fact that Tribes without sites would not need to fill out a full survey. But in fact, Tribes that were sent empty draft lists (i.e. no sites) and indeed had no sites, responded (i.e. confirmed no sites) at a substantially lower rate than Tribes that wanted to change their list or information – i.e. add a site or fill out a survey for one or more of their sites-- 8.6% compared with over 40%. This circumstance supports a general tendency that Tribes without sites did not feel compelled to verify this fact, as we already "had it right" for them. *And* while we asked that Tribes fill out surveys for all of the sites they had concern about -- only 33% of the sites (i.e. 60 sites) described in the surveys were sites from Tribes' draft lists. A full 67% were new. *Tribes felt compelled to fill out surveys when they had something to say – i.e. to disagree with our draft site list.* Conversely, we can say that the proportion of non-responding Tribes whose lists were right, is likely significantly higher than the proportion of non-respondents whose site lists were wrong.

[32] See for example, Gordis, Leon. In Epidemiology; *More on causal inference: bias, confounding, and interaction.* W.B. Saunders Company, Philadelphia, 1996. People with the condition being studied (i.e. here, hazardous sites) are more likely to respond than those without.

THSR Site Characteristics

Is the number of sites different for each EPA region?

Yes, each region had very different site numbers:

Region:	1	2	4	5	6	7	8	9, Ex. NN*	NN*	10, ex. AK	AK
Sites:	345	165	233	1,309	1,230	102	2,079	4855	1246	2,499	1,216

*NN=Navajo Nation

Do different Regions deal with different site types?

Yes, **Region 1** had only one IHS site, and 80% of their sites were LUST sites,

but only 17 % of **Region 2**'s sites are LUSTs.
At 34%, Region 2 had the highest proportion of their sites as RCRA facilities, but at 5%, not very many of their sites were Superfund sites.

At less than 3%, just 6 sites, an even smaller portion of **Region 4**'s sites were Superfund. Like Region 1, the most common site type there were LUSTs, comprising 42% of their sites. But at 32%, or 75 sites, Region 4 also had a sizeable portion of Mine (MAS) sites.

Just 1.1% of **Region 5** sites were CERCLIS types, the lowest portion of CERCLIS sites of all the Regions. But at 69%, Region 5 had the 2nd highest portion of LUST site.

Although they comprised only 14% of **Region 6**'s sites, at 166, Region 6 had the second highest number of Superfund sites. But, at 59 %, the most common site type was a mine.

Like Regions 1, 4, 5, and Alaska, the most common site type in **Region 7** was a LUST. But, at 28% of their sites, Region 7 also had the highest proportion of IHS sites

With a full 77 % of their sites being mines, **Region 8** had the highest proportion of that type, and at less than 1%, the lowest proportion of RCRA facilities except Alaska.

Region 9, had the highest number of RCRA sites by far, as well as the highest number of IHS sites, at 319. But with or without Navajo Nation, the biggest share of sites in **Region 9** are mines, at about 57% in either case.

Likewise, at 1,300 in number, the bulk **of Region 10** sites are mines, *excluding Alaska.* And at 175, Region 10, without Alaska, has the second highest number of CERCLIS sites.

Alaska was the only region with no RCRA sites. But at 143 and 151 respectively, it has a relatively high number of Superfund and IHS sites.

Can we say anything about how many sites a Tribe might have?

Yes, most Tribes[33] that have any sites are likely to have between 17 and 59 sites,
With 1 to 5 IHS sites
With 0 to 2 FUDS
And 0 to 4 Superfund sites
And 0 to 23 LUSTs.

[33] Within one standard deviation of mean, approximately 68% of Tribes. See Appendix C for details.

Role of Intangible Risks

Conventional site risk assessment looks at the physical contamination risk from various chemical or material substances at a site. But most Tribes are holistic-oriented, meaning that Tribal well-being, on an individual and Tribal basis, is impacted by a variety of site circumstances that may not depend on the *amount* of the chemical there, but they do depend on the real, or perceived, *presence* of the chemical there (regardless of quantity).

An important part of this one-year Project was to formally document the existence and general extent of these types of "intangible" risks. Intangible risks may include direct loss of cultural resources, sacredness, well-being, ecosystem habitats, and/or aesthetics.

The level of contamination that generates each type of intangible risk can differ greatly. Contamination that is well within EPA established "safe" levels may not produce any significant number risks. But contamination *at any level* may produce very significant non-number risks to individuals and Tribes. There are well over 500 Tribes with unique cultures and site circumstances. While each Tribe knows what intangible site risks they individually face, at the national policy level, this type of information has not been compiled or recorded before-- at least not in a way that can be analyzed for how important intangible risks, what their nature is, and if they vary substantially by different regions.

We consider our Project as a first draft for a nationwide assessment that policy makers and Tribes can use to place the issue of intangible risks in its proper overall context. The federal government allocates resources based on the best available information concerning measured need and expected results. Thus, by providing structured descriptive statistics for discussion, the issue of intangible risks from hazardous sites can begin to be addressed through western institutional means. This project should not affect how agencies will work in the future with individual Tribes on their intangible risks. It aims simply to provide a justification for agency personnel to be able to spend resources in addressing intangible risk issues *at all*. In short, "Uncle Sam" wants numbers, and one of the purposes of this project is to give him some.

The intangible risk information we have compiled is based on:

- General types of Tribal cultural activities from literature, internet, and interview sources that we have grouped into large-scale Tribal regions,
- The THSR Survey responses for Tribal lifestyles and Tribal-identified risks,
- Detailed interviews from the short-term health risk study component, described in the next main section,
- Additional data from a Zender-sponsored questionnaire study.

What makes us think *we* can describe y*our* Tribe's risks? We did not attempt to characterize any Tribe's individual risks. For many Tribes, some or all of the risks are highly personal, proprietary, and/or inexpressible or unutterable[34]. In fact, in the THSR Survey, one-third of respondents declined to describe completely how their traditional practices had been impacted (see "Decline to specify" entries in Tables below). Each Tribe is the only entity that can adequately describe the risks presented to their Tribe. Our aim is to document the extent, type, and importance of these risks on a Nation-wide level.

What did we find? The THSR survey contained a number of questions relating to traditional practices. Analysis of the results paints an overall picture of a *wide range of traditional activities*

[34] In one focus interview conducted for THSR Survey development purposes, a participant described questions concerning their subsistence practices as akin to asking a stranger "How much money do you make?" or "Were you intimate with someone yesterday?". When asked if subsistence was similar to spirituality, the participant, "Yes, but more. It is everything." The participant would not provide further details about subsistence impacts.

being practiced throughout Indian Country (including Alaska)[35]. While Tribes vary in their adoption and use of "Western" lifestyles, it is apparent from our study here that traditions can persist in the face of hazardous sites, regardless of a Tribe's circumstances.

Why? Because Tribes value their traditions and traditional lifestyles. It is well documented in the literature that for most Tribal cultures, past is seen more as present. But "present" is what is affecting the Tribe now, and "present" determines well-being[36]. With past as present, time is a circle, not a line arbitrarily marked. And to keep the circle unbroken – to keep the Tribe's well-being -- past traditions must be present. Elders must continue to teach those traditions, and the Tribe must continue practicing them. Traditional activities are not simply activities – they are a way for the Tribe, as a Tribe, to persist, and *thus a way for the Tribal community to practice, and keep, well-being.* But results from the THSR Survey indicate that traditional activities *are* being impacted by concerns about site pollution.

Do Hazardous Sites Impact Subsistence Practices? *Yes:*

	Concerns about the site have *changed subsistence* activities: *Tribes chose:*		
	"Not at all" for 20.5% of sites:	**"Somewhat" for 27.4% of sites:**	**"A lot" for 31.5 % of sites:**
***How* have site concerns been changed due to the concerns?**	For the above sites, subsistence was *still changed* in these ways:	For the above sites, Subsistence was changed in these ways:	For the above sites, Subsistence was changed in these ways:	***Total percent of sites that have impacted subsistence in by each way listed:***
Where activities are performed:	For {3.3%} of these sites.	50.0%	For {93.5%} of these sites	**78%**
How often they are performed:	0.0%	12.5%	73.9%	**33.6%**
How they are performed:	0.0%	12.5%	69.6%	**31.9%**
Type of food obtained:	0.0%	47.5%	87.0%	**50.9%**
Amount of food consumed:	0.0%	27.5%	82.6%	**42.2%**
An activity can no longer be performed:	**3.3%**	**17.5%**	**78.3%**	**37.9%**
Another way:	0.0%	10.0%	21.7%	**12.1%**
Decline to specify:	10.0%	5.0%	67.4%	**31.0%**
Total portion of all sites that have affected subsistence practices in some way: 78%				

[35] The formal federal government definition of "Indian Country" currently does not include Alaska Native Villages. We use a second, broader definition of "Indian Country" here.

[36] Concerning Native American culture of time, see "The ceremonial motion of Indian time", in Allen, P., The sacred hoop, recovering the feminine in American Indian traditions, Beacon Press, Boston, 1986., and time orientation differences from an academic perspective: Parsons, T., The social system, The social system, Free Press, Glencoe, IL, 1951.

Do Hazardous Sites Impact Other Traditional Activities? *Yes:*

	Concerns about the site have *changed traditional activities* other than subsistence: *Tribes chose:*			
	"Not at all" for 21.9% of sites:	**"Somewhat" for 23.3% of sites:**	**"A lot" for 30.8 % of sites:**	
***How* have traditional activities been changed due to the site concerns?**	For the above sites, *traditional activities* was *still changed* in these ways:	For the above sites, *traditional activities* was changed in these ways:	For the above sites, *traditional activities* was changed in these ways:	***Total percent of sites that have impacted traditional activities in the way listed:***
Where activities are performed:	For {6.3%} of these sites.	52.9%	For {88.9%} of these sites	**54.1%**
How often they are performed:	0.0%	17.6%	73.3%	**35.1%**
How they are performed:	3.1%	14.7%	75.6%	**36.0%**
Less socializing due to fewer participants:	0.0%	14.7%	68.9%	**32.4%**
An activity can no longer be performed:	**0.0%**	**8.8%**	**77.8%**	**34.2%**
Another way:	6.3%	5.9%	8.9%	**7.2%**
Decline to specify:	6.3%	20.6%	68.9%	**36.0%**
Total portion of all sites that have affected other traditional practices in some way: 74%				

Thus, these activities are being lost – not just by stopping the tradition altogether, but losing the way they are performed, the socializing that the activities provided (by fewer members practicing), the connection to the places where they once were performed, and the prominent daily role that the activities played.

But loss of traditions for Tribes is documented to often lead to a wide range of risks to individual and community: physical, spiritual, and emotional well-being. This is particularly true for holistically-oriented cultures such as those of most Tribes[37].

[37] Native American scholars have produced a compendium of documentation concerning this circumstance in general. For explicit treatise, see for example, Anders, G. "Social and economic consequences of Federal Indian policy", in Well, R.(ed), Native American resurgence and renewal: A reader and bibliography, The Scarecrow Press, Inc. Metuchen, N.J. 1994, and Lester, D., Suicide in American Indians, Nova Sci. Pub., New York, 1997. Note, a mass cultural-loss empirical experiment has been performed several times with Tribes. See in general, documentation of the U.S. Allotment Act of 1987 and Termination Act of 1953. These two Federal Indian policies, designed largely for socio-cultural and economic assimilation respectively, both resulted in universally acclaimed failure, largely associated with Tribes' loss of traditions as a key factor, which in turn propelled societal illnesses. See in general, Nabokov, P. (ed.), Native American testimony: A chronicle of Indian-White relations from prophecy to the present, 1492 – 1992, Penguin Books, New "York, 1991.

That keeping traditions is important is also borne out by the THSR Survey analysis. Look at the 4th column in the two Tables above (i.e. "a lot" of impact). High percentages of these sites changed traditional practices in all ways across the board. Such a result could be expected from the relative level of impact stated (i.e. "a lot"). But what is interesting are the responses concerning sites that had changed practices "somewhat". For subsistence, only where it took place and what foods were consumed were changed—in line perhaps with taking precautions at what might be quite contaminated sites. But concerns about these same sites-- that were enough for people to go elsewhere to fish and hunt- did not really affect how often, how much, how, or *whether,* subsistence was performed. Similarly, with other traditional activities, only *where* these activities were performed was changed by a substantial number of sites (i.e. 52.9%). But even though these sites might be enough to stop people from practicing there, people's concerns did not stop the way, how often, or whether these traditions were performed. *Traditions persist*.

The results of a simple empirical study (separate from this Project) that the authors carried out also support this interpretation. The study was intended to serve as a cursory means to begin to identify: 1) Important Tribal values that relate to hazardous site risk situations, and 2) Whether these values differ from conventional western risk perceptions.

The answer is keeping traditions and yes. Just previous to this Project, we developed a questionnaire with a set of value choices relating to hazardous waste sites, and paid for 17 Tribal respondents at a Tribal environmental conference to complete it. Tribes from 5 Regions took part. We then took the same set of questions and adapted them to represent parallel situations for a conventional Western-oriented community. For example, we replaced the word "elders" with "senior citizens". Instead of a Tribe losing its traditions, we described a rural farming community losing theirs. We then had 21 Caucasian respondents, with Western-oriented backgrounds who reside in several States, fill out this 2nd questionnaire. Both questionnaires may be viewed in Appendix D. Here are the interesting results:

Does Changing A Tradition Matter As Long As It Is Still Performed?[1]

For Tribes, *Yes:*

Answer selected:	**Tribal Group**	**Non-Tribal Group**
Doesn't really matter	12%	33%
Matters some	0%	48%
Yes matters a lot	41%	19%
Extremely important	35%	0%

Note for scientists: **Fishers exact test P value = 0.026%**

[1] Citation of this study and Table should read: Zender, L., S. Gilbreath, S., S. Sebalo, W. Leeman, A. Erbeck, "How much does tradition matter? Comparison of Tribal versus Non-Tribal values in the context of waste site pollution", www.zender-engr.net, July 2004.

How Much Does Tradition Matter? A Comparison Of Tribal And Non-Tribal Responses In The Context Of Waste Site Pollution[1]

Approximate description of tradeoff, with key terms, values bolded[4]:	Tribal Group[2] Which is your highest concern?	Non-Tribal Which is your highest concern?	The "low-down": Is there a significant difference in what groups valued? *Compared to non-Tribal group*, Tribal group valued :	P value: 'Chance that the difference could be random':
Few **elders'** berry–picking **tradition** w/ *possible* physical exposure. *Versus* Many **non-elders** with *definite* significant **physical exposure.**	35% 47%	14% 86%	Elders/traditions *Over* Non-elders, having low exposure risks	5.81%
Losing **elders /traditional knowledge/traditions.** *Versus* Several **non-elders** having **short-term health effects.**	59% 24%	10% 90%	Elders/traditions *Over* Having good short-term health	0.02%
Losing **elders /traditional knowledge/traditions** *Versus* Pollution of a **sacred** site, with **intangible impact** only	53% 24%	14% 86%	Tradition/knowledge *Over* Intangible risk -free sacred site	0.11%
Non-members polluting/**jurisdiction** issue/**intangible impact.** *Versus* **Tribal members,** regular **physical exposure**, nearby open dump.	35% 35%	29% 71%	Sovereignty/community *Over* No physical exposure risks for community members	21.83%
Small dump with **low risks** near where **elders** gather *Versus* **Kids** playing at abandoned building with **high risks**	18% 53%	33% 67%	*No significant difference*	*61.63%*
Intangible pollution, but **loss of tradition** *Versus* **Physical pollution and cancer risk**, but **tradition continues**	47% 24%	14% 86%	Tradition *Over* Physical pollution, cancer risks	0.21%

[1] Citation of this study and Table should read: Zender, L., S. Gilbreath, S., S. Sebalo, W. Leeman, A. Erbeck, "How much does tradition matter? Comparison of Tribal versus Non-Tribal values in the context of waste site pollution", www.zender-engr.net, July 2004.

[2] Note percentages do not add up to 100% in Tribal Group because some respondents declined to answer some questions.

[3] Fishers exact test P value expressed in percent.

[4] Results are best appreciated by reading the full text of the tradeoff scenarios. The reader is encouraged to refer to Appendix D in this study for full questions, or access the study at www.zender-engr.net .

Note, this test did not test which group values a contaminant-free environment, or other single value-concept, more. It compares scenarios with sets of values. The tradeoffs were devised to underscore key value differences in the context of hazardous site risk. In the first row, more of the Tribal group selected the 2nd scenario as being worrisome. This makes sense, given the higher number of people exposed and level of risk. Tribes *are* very concerned about physical exposure and risk. But the ratio of the Tribal group response was significantly different – i.e. much more slanted towards the first option than that of the non-Tribal group. In other words, given a straightforward choice of equal exposure for an equal number of people, the response of the Tribal Group could be predicted to be nearly 100% for more concern with elders. But the Non-Tribal Group's response could be expected not to be. Note, the Tribal group tended to be much more evenly split, compared with the non-Tribal Group for all tradeoffs, with the exception of the 5th, where no inferences can be drawn. A summary of traditional practices and intangible risks identified to be relevant to Tribal hazardous waste sites is provided on the next page.

In at least 91% of Tribes, some number of Tribal members practice traditional activities[38]:

While activities differed, Tribes in the Lower-48, as a group, listed nearly the same numbers and proportions of traditional activities as Alaska Native Villages[39].

Of course, these practices differed among regions.

The top three activities in Alaska are:

94% of Tribes listed hunting and fishing

66% of Tribes listed gathering and everyday use of plants

68% of Tribes listed smoke houses

In the Lower-48, the most prevalent activities are:

68% of Tribes listed hunting and fishing

63% listed powwow activities

with a tie at 56 % for:
Ceremonies with smoke (fire, sage, etc), Gathering/using of plants, and Farming and growing

But about 58% of hazardous sites impact subsistence practices substantially, with concerns from 80% those sites changing where Tribes hunt and fish. Similar, but slightly lower numbers, are true for other traditional activities.

These are high numbers. But what is striking is that traditional activities continue even at sites that are significantly contaminated:

71 % of Tribes reported that traditional activities take place on, or next to, the site of concern

58% of Tribes reported members consume fish, game, plants contaminated by a site

33% of Tribes reported that at least some Tribal members continue to drink *untreated* water from streams with site drainage, (i.e. traditional drinking of water)

Traditional activities were conducted in, or next to, water contaminated by 68% of reported sites.

***Why?* Because Tribes value their traditions and traditional lifestyles:**

Compared to non-Tribal communities, Tribes appear to be less likely to trade off their traditions in exchange for tangible physical benefits such as contaminant-free foods and environment, and short- and long-term health[40].

And traditional activities can be affected in ways that don't depend on physical contamination:

Even when traditional activities took place away from the site and site- contaminated water, 58% of Tribes *still felt these activities were impacted by the sites.*

In one related study, even if a tradition continues to be performed at the same level, *how* it is performed mattered greatly to 76% of Tribal members— compared to only 20% for non-Tribal people[41].

For about one-third of sites, Tribes reported traditional activities being impacted-- not by decreasing in frequency or changing location, but by how the activities were performed and the sociability they provided.

---

[38] Includes three AK Tribes who were known to practice traditional activities, but did not answer questions. The number is conservative because of some portion of remaining Tribes who did not mark traditional activities likely conduct them, but it was not possible to confirm that activities took place.

[39] The proportion and number of Tribal members practicing the activities was not examined, but is expected to differ considerably among regions and individual Tribes.

[40] See Intangible Risk Section description of unpublished Zender Environmental study, or www.zender-engr.net .

[41] See Table on previous page. Fishers exact test P value = 0.026. A group of 17 Tribal environmental representatives from 5 EPA regions, 25 to 65, and a group of 21 Caucasian persons in living in 4 EPA regions, took a set of parallel questions intended to elicit familiarity with subject matter and values discussed. For example, "elder" was replaced by "senior citizen".

Assessing Contaminant Exposure and Risk to Tribes from Hazardous Sites: NAERAM 2004

A central issue in addressing hazardous site risks to Tribes is that exposure and risk assessment models that contain exposure scenarios for Tribal lifestyles have been notably absent. Tribes desiring to model exposure and risk have had to use generic models developed for Non-Native American populations, which do not address traditional practices and cultural/lifestyle activities. The **N**ative **A**merican **E**xposure and **R**isk **A**ssessment **M**odel (NAERAM) has been developed by Zender Environmental in response to this notable deficit. Tribes interested in determining technically accurate exposure and risk values, that explicitly include the additional exposure pathways presented by practicing traditional activities, may now use NAERAM to do so.

We refer readers interested in using and applying NAERAM to the NAERAM 2004 Technical Documentation that accompanies this Report. Once familiar with this document, readers will find it helpful to use the step-by-step NAERAM Tutorial to get started. Once NAERAM is installed, the Tutorial can be accessed from the model software.

Note that because NAERAM is based on approved EPA guidelines, all equations, default values, and terms cited within the NAERAM documentation, and all references and documents used, contain the most up-to-date, EPA-approved information on the subject of exposure and risk assessment. Thus, *NAERAM is a technically-defensible risk assessment model.* While users unused to western science risk assessment may find that using NAERAM is initially challenging, it is straightforward in its design, and may be easily used by Tribes to learn more about how risk assessment works. In short, NAERAM represents a significant achievement and tool for Tribal risk assessment, and modelers will find that it greatly facilitates exposure and risk assessment for Native Americans exposed to chemicals from hazardous waste sites.

Other Tribal-Oriented Risk Assessment Software

It bears mentioning that another, EPA-funded quantitative risk assessment model, "Tribal LifeLine" will soon be available to Tribes. Tribal LifeLine is a comprehensive, population-based freeware model, developed from The Lifeline Group's™ well-vetted Lifeline model, used by states and agencies to model pesticide exposure. Because NAERAM and Tribal LifeLine have been developed for different purposes, the two programs are quite different, and should not be viewed by Tribes as "competing models". To assist Tribes in deciding which model best meets their current needs, we describe several comparative features in the context of usage for determining hazardous site exposure risk.

NAERAM is *individual*-based. It requires specific exposure information provided by the user[42]. Tribes interesting in calculating what risks the *individuals* in the community have for developing cancer, or being exposed to chemicals at deleterious effect levels, should use NAERAM.

And, Tribal Lifeline is *population*-based. Tribal Lifeline generates statistical distributions that simulate how exposure and risk may manifest in an entire population of interest. States use complex population-based models like Lifeline to set various criteria and

[42] Let us use the example of applying bug spray in the backyard. Assuming that activity produces an exposure for 1 in 1000 individuals, one might need to run a population-based model 1,000 times (or more) for that individual exposure to show itself in the results. In NAERAM, a Tribe would input specific exposure values for the individual they were interested in modeling. NAERAM then outputs the cancer or non-cancer risk for that person from using the bug spray.

regulations. Tribes may find Tribal Lifeline useful in doing the same, but should be aware of the disadvantages[43].

2. *NAERAM addresses all traditional activities that have been identified for Tribes* (see below for categories and Model documentation for full list). Tribes interested in examining their members' total exposure and risk to a chemical through the variety of their traditional practices, will find NAERAM very useful.

   And, *Tribal Lifeline currently addresses traditional food use and use of sweat lodges.* Tribes interested in other activities will not be able to use Lifeline to address them.

3. *NAERAM relies on Tribes inputting their specific exposure parameters*. This allows Tribes to retain proprietary information.

   And, *Tribal Lifeline internally accesses comprehensive data banks of exposure information.* Data was obtained primarily from two Tribal populations, one in Alaska and one in Montana. For example, it contains recipes, food contact rates, and activity levels for Tribal members. Thus, Tribes can automatically get a detailed simulation of a subsistence-based diet. Unfortunately, food diet data has only been entered for sub-regions, so that most Tribes cannot use Lifeline to model their specific subsistence foods. Tribes are able to enter their own information. However, due to Lifeline's more complex architecture (and purpose), entering it is not as straightforward as using NAERAM.

4. *NAERAM was developed to model exposure and risk to Tribes from chemicals at hazardous waste sites, but can be used to model any type of chemical exposure resulting from any activity due to its simple design[44].*

   And, because LifeLine was originally developed for pesticide exposure and risk, the activities built into the architecture are based on a typical individual's 24-hour activity patterns that may result in pesticide exposure. Individual activities and their resulting exposures cannot be picked and chosen from at will because LifeLine was developed to be a population-based model.

In summary, we developed NAERAM as an individual-based risk model because, from the findings in this report, it seems apparent that Tribes *are* interested in risks to individuals, particularly because many traditional practices are carried out by a subset of members. For example, NAERAM can be used to determine the risk to five elders who pick their berries at a particular contaminated site. Population-based models are not designed for this purpose[45]. Further, Tribes are interested in all of their traditional practices, of which there are many nationwide. NAERAM provides Tribes an opportunity to assess the exposures and risks from the full set of Tribal lifestyle activities that members practice. While exposure parameters specific to Native Americans would be very useful in future versions of NAERAM, a primary feature of NAERAM is its simplicity and quick run-time. Tribes may use the software on any computer with a Windows operating system. And, while NAERAM will only output accurate Tribally-specific results with Tribally-specific data, it

[43] In deciding whether to use a population or individual-based model, it is important for Tribes to realize they *run the risk that the modeled exposure will not manifest itself* in their community profile. That is because most cancer risks are relatively small numbers, and most Tribes are small populations. Statistically speaking, a cancer risk of 1 in 10,000 may not show up for a community of 200 people. In other words, the chance of at least one person getting cancer in a city of 100,000 people is larger than for someone getting cancer in a town of 200. Yet, all of those 200 people still are at the same risk as the 1 million people in the large city.

[44] Providing that the activity in question results in one of the three major exposure pathways, inhalation, ingestion, or dermal absorption. Subcutaneous injection, intraperitoneal injection, etc., were not considered to be viable exposure pathways for chemicals in the environment.

[45] Let us use the example of applying bug spray in the backyard. Assuming that activity produces a cancer risk for 1 in 1000 individuals, one might need to run a population-based model 1,000 times (or more) for that cancer risk to show itself in the results. In NAERAM, a Tribe would input specific exposure values for the individual they were interested in modeling. NAERAM then outputs the cancer risk for that person from using the bug spray.

provides up-to-date default data that Tribes may use to derive best risk estimates in the absence of some, or all data. Finally, even without Tribally-specific data:

- NAERAM is ideal for use as a tool to examine how different exposure parameters affect end risk values.
- For Tribes concerned with comparative exposure risks for several sites, NAERAM can be used look at relative risk values for each site
- It can serve as a key learning tool for Tribal staff wishing to expand their knowledge base to the risk assessment field.
- And, used correctly, it can provide Tribal decision makers insight into the types of actions they can take, or advise members to take, to minimize their exposure risks as much as possible.

In this Section of the main Report body, we provide a brief description of how NAERAM works to provide the lay reader a sense of its capabilities, and finish by describing our work in characterizing Tribal biogeographic areas. With 'a picture being worth a thousand words', a screen print of NAERAM is provided on the next page.

Overview of General Human Health Risk Assessment

Human health risk assessment may be performed for a variety of contexts, or exposure scenarios, such as risk to farmers from a certain chemical found in a pesticide spray, etc. While the general exposure pathway equations are the same, each exposure scenario is associated with specific required input information. NAERAM addresses risks from hazardous waste sites, and thus adopts the approach that has been developed by EPA for human health risk at Superfund sites[46]. The process of assessing human health risks includes four steps:

(1) **Hazard identification** Review scientific literature to identify any potential health problems that a chemical can cause.

(2) **Dose-response assessment** Estimate how much of the chemical it would take to cause health effects that could lead to illnesses (derived from epidemiological and non-human animal toxicology experiments).

(3) **Exposure assessment** Determine the amount, duration, and pattern of exposure to the chemical[47].

(4) **Risk characterization** Assess the risk for the chemical to cause cancer or other health problems in the general population[48].

What is Different About Risk Assessment for Tribes?

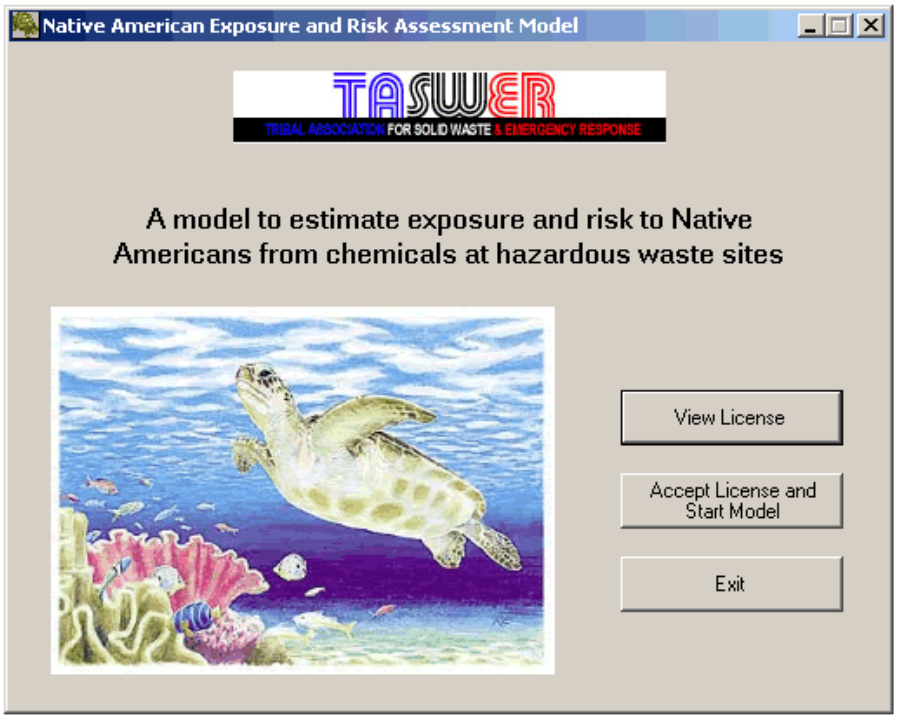
Modeling exposure and risk to Tribes from chemical exposures at or near hazardous waste sites in Indian Country differs from conventional risk assessment mostly with respect to exposure

[46] Refer to Tools for Human Health Risk Assessment and Risk Assessment Guidance for Superfund (RAGS) Part A for more detailed information, online at: http://www.epa.gov/oerrpage/superfund/programs/risk/toolthh.htm#hazard http://www.epa.gov/superfund/programs/risk/ragsa/index.htm

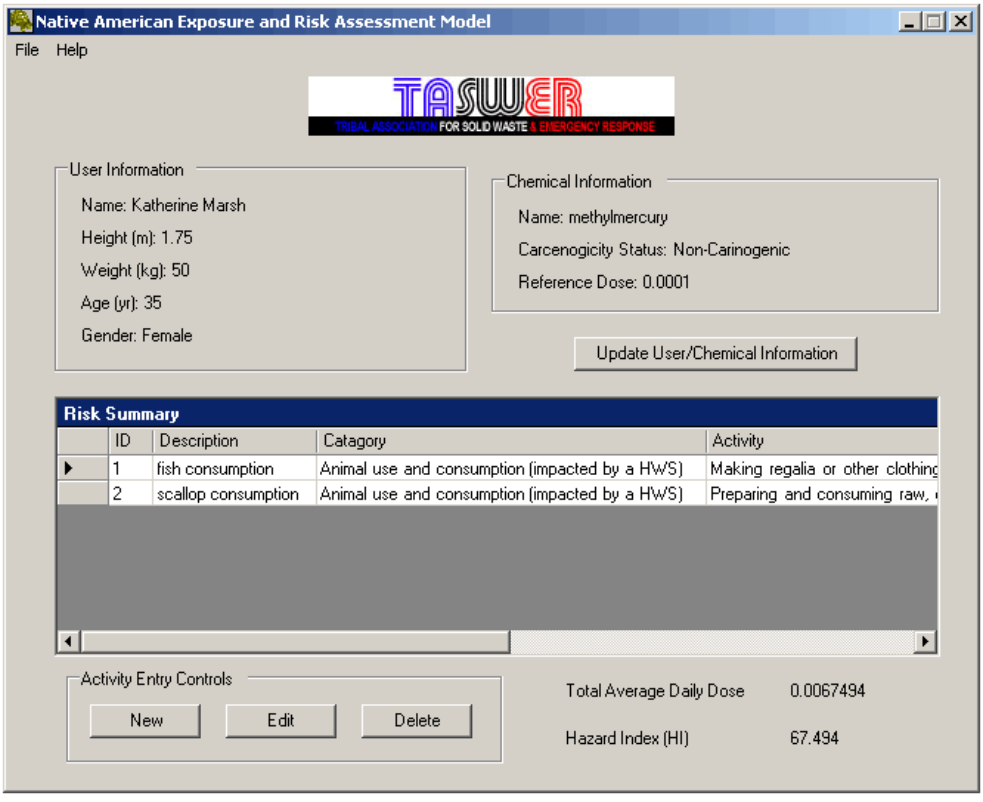
[47] Refer to "Exposure Factors Handbook" (USEPA, 1997) for more detailed information, online at: http://www.epa.gov/ncea/exposfac.htm

[48] Refer to "Risk Characterization Handbook" (USEPA, 2000) for more detailed information, online at: http://epa.gov/osa/spc/htm/rchandbk.pdf

NAERAM Front Page



Example of NAERAM Results Page



assessment. To correctly model exposure and risk to Tribal members, Tribal lifestyle activities that present additional exposure scenarios or different exposure parameters first must be incorporated. NAERAM does this.

Hazard Identification To provide tractability, available contaminant data from the following sources were enumerated and grouped by Biogeographic Area ("BGA", see the end of the Section):

- CERCLIS site records with flagged "Tribal Interest" fields
- THSR Surveys that provided specific sampling information

Unfortunately, for the majority of hazardous waste sites in Indian Country (including Alaska) comprehensive contaminant monitoring has not been performed, or has not been reported in a publicly accessible vehicle.

Exposure Assessment Self-reported lifestyle activity data collected from THSR surveys, conference interviews, and health study participant questionnaires were used to define present-day activities that may put Tribes at risk from chemical exposures at or near hazardous waste sites in Indian Country. We provide full detail of activities in the NAERAM Technical Documentation. What types of activities did Tribes report they practice?

Some Traditional Activities Practiced by THSR Survey Tribes

Traditional Activity[1]	Total	AK	Lower-48
Hunting and fishing	81.8%	93.6%	68.3%
Gathering and everyday use of plants or plant materials (in food, teas, to smoke, etc.)	65.9%	74.5%	56.1%
Smoke house	52.3%	68.1%	34.1%
Ceremonial or powwow activities such as dancing, games, consumption of ceremonial/medicinal plants, teas	51.1%	40.4%	63.4%
Ceremonial or art using feathers or skins or bones	48.9%	51.1%	46.3%
Ceremonial or other tool making not from animals (e.g. wood or stone carvings)	44.3%	40.4%	48.8%
Basket making, other weaving	44.3%	42.6%	46.3%
Building/carving of canoes, sweat lodges, other structures.	44.3%	48.9%	39.0%
Using hides, oils, bones, antlers, etc. for regular-use tools or clothes	39.8%	46.8%	31.7%
Farming/growing	39.8%	25.5%	56.1%
Bathing/sweat lodge use	37.5%	36.2%	39.0%
Other	37.0%	32.6%	42.9%
Ceremonies with smoke (from fire, sage, etc.)	34.1%	14.9%	56.1%
Traditional games	29.5%	31.9%	26.8%
Regular use of traditional pottery (made from local clays, etc.)	15.9%	4.3%	29.3%
Making pottery	14.8%	4.3%	26.8%
Mean (Average percent of Tribes practicing any one of the traditions)	**45.4%**	**43.7%**	**47.4%**
Median (Half of the Traditions are practiced by more than the Median percent of Tribes, half of the traditions are practiced by less)	**42.0%**	**40.4%**	**44.6%**

[1] Irrespective of whether the practices are associated with a site. Tribes submitting survey to confirm no sites were requested to respond to the question concerning traditional practices carried out by at least some Tribal members.

Dose-Response Assessment. This portion of the risk assessment process *may be different for Tribes than for the general population* if it can be shown that metabolic/detoxification tendencies exist which result in dose-related responses that are significantly different from those of the non-Native American population. Some differences could possibly result from genetic makeup, dietary differences, medical problems or background exposure levels different from those of the general population. In the absence of other reliable data, NAERAM users are encouraged to use default dose-response relationships for the general U.S. population. Qualified Tribal risk assessors who feel confidant that there are unique issues resulting in more, or less, chemical sensitivity than the general population can vary the health reference levels associated with chemicals of interest.[49]

Risk Characterization It is our position that risk characterization be left up to Tribes, to choose what they consider to be "acceptable" vs. "unacceptable" risks to health and culture, and to communicate these risks to Tribe members. Any health advisories (or other changes in Tribal lifestyles that reduce exposure and risk to chemicals of concern) should be decided by Tribes to protect their own best interests—*regardless of whether the decisions result in preserving traditional ways* that result in chemical exposures, and/*or in advisories* that recommend avoiding certain areas/foods/activities.

NAERAM was developed so that Tribes themselves could characterize risks within their own subpopulations using a general model in which proprietary exposure/activity information and contaminant data can be input as it becomes available. Individuals are modeled rather than whole populations, and it is up to the Tribe to decide whether they want to model the most at-risk individuals (e.g., a child, nursing mother, or infirm individual), the average Tribe member, or any number of different people of different age groups in different states of health.

How NAERAM Works

Exposure to chemicals can occur by three different routes:

- **Inhalation** (for example, sweat lodge vapor and smoke from dump fires)
- **Ingestion** (*direct*, such as eating food or drinking water, *and indirect*, such as hand-to-mouth exposure)
- **Dermal contact** (direct handling or deposition of chemicals on skin, touching contaminating surfaces, back and forth transfer of chemicals to and from surfaces)

Exposure and dose are distinct. Exposure is the amount of a chemical entering the body via inhalation, dermal absorption, or ingestion. The full amount of a chemical that one is exposed to will not actually end up being delivered to target organs. For example, some of what is inhaled will be exhaled and not delivered to the blood by the lungs (lung clearance); additionally, some of the chemical may be removed by the airways (if it is sorbed to a particle) or otherwise metabolized by cells in the lungs instead of being absorbed into the bloodstream. Similarly, a chemical that is applied to the skin generally won't be fully absorbed by the skin, and a chemical that is ingested may not be completely absorbed and metabolized. These processes are technically complex, and generally not linear. Readers who are interested in "science", in addition to the results, can appreciate the complexity of the mathematical equations by scanning the NAERAM Technical Documentation. The automatic computation of the algorithms used, together with the ability of the user to address each of their traditional practices explicitly and clearly, with maximal user control, are the strengths of NAERAM as a risk and exposure software for American Indians, Aleuts, and Eskimos, as well as any sub-populations that practice activities consistent with rural lifestyles and environment-based ceremonial and traditional customs. The algorithms used in NAERAM to model exposure for the various pathways are defined in the Technical Documentation.

[49] See US EPA's Exposure Factors Handbook, 1997, Table 1A-1, online at: http://www.epa.gov/ncea/exposfac.htm

Cultural Activities Addressed in NAERAM

All traditional activities reported by Tribes in their THSR survey, plus those activities which were unreported, but were identified through research to occur in some areas of the lower-48 states and Alaska, are listed below[50]. NAERAM groups these activities into eight "Activity Categories", based on the type of exposure. All of the activities may result in chemical exposure via *dermal contact*, *ingestion* (incidental non-dietary ingestion and hand-to-mouth ingestion), and/or *inhalation* (of volatile chemicals or, more likely, particulate matter generated by burning or dust production, e.g. sanding, grinding).

Category 1) Tribal activities directly related to hazardous waste sites (HWS), involving direct contact with mixed wastes: household, human, and household-hazardous or other chemical wastes

Non-Ceremonial activities:

Subsistence food and water gathering

- Gathering of food (including nuts, berries, mushrooms, other plants, algae, seaweed, etc.)
- Tilling, planting and growing in soil impacted by site
- Hunting, trapping, fishing
- Water collection

Other Gathering

- Gathering of plant/animal/mineral products for artwork, crafts, regalia, etc. (including materials such as reeds, bones, tusks, antlers feathers, stones, clay, etc.)

Trash dumping or burning

- Taking trash or honeybuckets to dispose of at a dump site
- Burning trash at dumpsite or otherwise inhaling smoke from dump fire
- Salvaging through materials at dump site

Recreation

- Game/athletic/other event field
- Seasonal or year-round camp use (fish or other camp)
- Youth camps
- Other children's activities (playing/playground)
- Livestock grazing area
- Rodeo or livestock showing area
- Carnivals/fairs
- Swimming, washing, wading or other contact with water[51]

Other Tribal use area

- Homes, offices, schools, parks/playgrounds, other Tribal buildings (i.e. casino, Elders residences) located at or next to site
- Plant/animal/clothing drying area
- Short-cut to other Tribal hunting/gathering/use sites

Ceremonial activities:

Pow wows, cultural celebrations, other ceremonies

- Dancing
- Games
- Fires
- Burial
- Other use[52]

2) Incidental transport of material offsite

Any activity above that results in transport of contaminated soil, dust, or mixed media, carried on clothing, shoes, equipment, kids, or pets, from a hazardous waste site into an enclosed area (indoors)

- Dirt on clothing, shoes, equipment tracked indoors
- Dirt on kids tracked indoors
- Dirt on pets tracked indoors

3) Preparation and use of plants impacted by HWS (ceremonial and non-ceremonial)

Preparation and use or consumption of plants/wood impacted by site for personal use or sale

- Preparation (including drying) and consumption of gathered plants (including berries, nuts, seeds, flowers, bark, seaweed, algae, etc.) impacted by site for food and medicinal use, for example:
  - Drying/canning/preserving plant products
  - Eating plant products raw or cooked[53]
  - Steeping plants for teas/infusions/medicines

[50] All THSR survey data are presented as reported by Tribes and have not been externally verified.

[51] Note that contact with affected water by sweat lodge use is a separate category.

[52] Note that contact with affected water by sweat lodge use is a separate category.

[53] Note that water use and consumption is a separate category.

- Making and applying poultices, other herbal remedies

- Preparation of gathered plants/wood impacted by site for crafts/artwork/tools/structures, for example:
  - Making of baskets, dyes, regalia, musical instruments (pipes), other instruments (tools, pipes), ropes
  - Carving and assembling figurines, masks, tools, weapons, drums or game pieces (using wood, reeds, twine, bark, seeds/nuts/nutshells)
  - Carving or building structures such as canoes, dwellings, etc.
- Burning of gathered plants/wood impacted by site for fire
  - Smoking or other burning and inhalation of gathered plants (such as those used in smudge sticks)

<u>Growing, preparing, and utilizing or consuming plants that were irrigated with water affected by site</u>

- Harvesting plants grown in impacted water; preparing, and consuming them for food and medicinal use
- Harvesting plants grown in impacted water; preparing them for crafts/artwork/tools/structures

4) Preparation and use of animals impacted by HWS (ceremonial and non-ceremonial)

<u>Preparation and use of gathered animal products impacted by site for personal use or sale</u>

- Preparation of gathered animal products impacted by site for crafts/artwork/tools, for example:
  - Making regalia or other clothing (using shells, feathers, skins, bones, tusks, antlers)
  - Basket making (using shells, feathers, skins, bones, tusks, antlers)
  - Making of drums or game pieces (using shells, feathers, skins, bones, tusks, antlers)
- Carving of bones, tusks, antlers for figurines, pipes, etc.
- Other uses such as carved tools, weapons, etc.

<u>Hunting and fishing for animals that have been impacted by site (including animals collected for food such as shellfish) for personal use or sale</u>

- Hunting/trapping, cleaning/preparing animals that have been impacted by the site for food and medicinal use, for example: Preparing and consuming raw, dried, smoked, cured, or cooked animal tissues
- Hunting/trapping, cleaning/preparing animals that have been impacted by the site for crafts/artwork/tools, for example: Use of hides, oils, bones, tusks, antlers for regalia, carvings, tanning

5) Use of minerals impacted by HWS (ceremonial and non-ceremonial)

<u>Use of rocks gathered from areas impacted by HWS</u>

- Steam baths, fire pits, pounding/grinding, carvings, pigments, decorations, jewelry making

<u>Use of clay gathered from areas impacted by site</u>

- Pottery, figurines, other instruments for personal use or sale

<u>Use of sand gathered from area impacted by site</u>

- Leaching acorn or other meal, building material, other

6) Use of water impacted by HWS (ceremonial and non-ceremonial)

<u>Dietary contact with untreated water source</u>

- Drinking of impacted water
- Consumption of foods and beverages prepared with impacted water

<u>Non-dietary contact with untreated water source</u>

- Contact with impacted water during crop irrigation, food or beverage preparation, craft production, washing, fishing, swimming, or wading

7) Sweat lodge use, bathing and showering with water impacted by HWS (ceremonial and non-ceremonial)

- Sweat lodge use, bathing and showering with impacted water

8) Breastfeeding (breast milk ingestion by infants and young children)

For example, chemical exposure could result from gathering and use of contaminated plants for crafts/artwork/tools. The relevant exposure factors for two such scenarios are described below..

Basket making

- *Using hands to gather and weave components:*

  Dermal contact plus transfer of chemicals from hands to mouth or other surfaces-

  Required Exposure Factors and Other Inputs: Contaminant level on plant, surface area of hands in contact with plant, contact rate, and dermal absorption factor need to be known; contaminant level on plant or surfaces, transfer factor from hand to mouth, hand to mouth activity, attenuation factor (for transfer to and from other surfaces) and gastrointestinal absorption factor need to be known

- *Using hands or mouth to split or tear reeds/plants:*

  Dermal contact plus transfer of chemicals from hands to mouth or other surfaces (same as above)

  Direct Ingestion-
  Required Exposure Factors and Other Inputs: Contaminant level on plant, area of plant placed into mouth, number of times activity performed, and gastrointestinal absorption factor need to be known

Dye making

- *Using hands to gather dye materials:*

  Dermal contact plus transfer of chemicals from hands to mouth or other surfaces (same as above)

- *Preparation of ingredients, including grinding:*

  Dermal contact, transfer of chemicals from hands to mouth or other surfaces (same as above)

  Inhalation-
  Required Exposure Factors and Other Inputs: Contaminant level inhaled, respiration rate, (dependent on activity level, weight, etc.), number of times activity performed, and inhalation absorption factor need to be known.

The NAERAM Architecture: Input Questionnaires NAERAM greatly simplifies the task of a Tribal modeler in accounting for the myriad exposure routes and factors that are associated with each different cultural/traditional practice. It accomplishes this problem by guiding the user through a cascading series of questionnaires that are linked through logical flow based on user input. For a given chemical, the user checks the types of activities that lead to exposure to the chemical, and inputs the necessary values. NAERAM outputs the Total Average Daily Dose and Hazard Index or Cancer Risk.

How does NAERAM model all the risks that your Tribe faces when we don't know about your Tribe's risks? NAERAM contains terms for each of the general cultural activities that have been identified in the Lower-48 and Alaska. Tribes select their particular set of practices when they run NAERAM. To demonstrate how it works, we provide a tutorial with the NAERAM software. For a particular Tribe to use the model to evaluate their exposure risks better, they will need to generate their own Tribally-relevant values. For example, how much fish do their Tribal members eat? What is the level of contamination in that fish? NAERAM default values are taken from the latest EPA guidelines and documentation. When you read the NAERAM Technical Documentation you will see that it includes webpage addresses to link to a number of data sources

that you can use to adjust as closely as possible to fit *your Tribe's* risk scenario. Again, risk assessment is a highly technical process, and the selection of appropriate exposure values from existing data banks, and the collection and analysis of appropriate data within your Tribe, requires a high level of technical expertise. If your Tribe does not have a risk modeler, or you are the risk modeler, but are just starting out, the guidance of an expert is strongly recommended.

How About an Example?

We'll use the example in the tutorial. The Good Heart Tribe is assessing the dangers of methylmercury to their Tribal members that eat bass that are contaminated by a mine site drainage. They decide to look at the average risk to an "average "adult female, with no substantial medical problems. We call her Katherine:

Weight = 120 lbs

Gender = female

Katherine prepares and eats ½ lb of bass every day.

The Tribe enters her consumption and exposure information under "Preparing and consuming raw, dried, smoked, cured, or cooked animal tissue" They fill out the 3 short questionnaires that pop up for them. For example, they enter that she eats about ½ lb per day each day. They also input exposure numbers that have to do with the general way she prepares the fish – they can input that she just touches the fish with half of her hand's available surface (i.e. the front-side), or that all of her hand touches the fish-- during gutting.

The results that NAERAM outputs for a 120 lb female eating bass contaminated with methylmercury are:

Total Average daily dose 0.00656

Hazard Index = 65.994

Biogeographic Areas

Biogeographical Areas (BGAs) are subregions in the lower 48 states and Alaska defined by geography, watershed use, and shared Native American cultural characteristics. BGAs may be used to simplify certain tasks, such as modeling exposure and risk to all Tribes in the lower 48 states and Alaska from chemicals at hazardous waste sites. By breaking a large area (like the lower 48 states or Alaska) into representative subregions (such as BGAs), the problem of erasing all regional variability, which occurs when data are averaged over a large area, is reduced and the given task is more tractable. For example, representative hazardous waste sites and chemicals of interest in Indian Country may be picked for each BGA. Certain Native American exposure scenarios may also be picked for each BGA. Exposure and risk may then be calculated for each BGA, assuming that the waste sites/chemicals and exposure scenarios in each BGA are average representations of the people and their interactions with their environment within each BGA. For a breakdown of BGA's identified in this Project, refer to the NAERAM technical document. BGA's may also be viewed via the THSR map.

Cumulative Short-Term Health Risks Associated With Hazardous Sites

To look at the relative health impacts of hazardous sites on Tribes, we carried out studies with select self-identifying Tribes who were interested in participating. A Tribal representative from each participating community was trained by professional researchers to interview households. The interviews consisted of questions about people's short-term health, and about different habits that they had that placed them near the hazardous site of concern in their community. The total number of households interviewed was 107, representing 502 people. Our purpose was to identify the *relative risks* a site might pose to the short-term physical health of Tribal members. A qualified Zender epidemiologist performed the complex statistical analyses required to generate correct results. If you are interested in the scientific details of the study, please see Appendix E.

Why Did We Perform This Study? We mentioned in the NAERAM Section that conventional risk assessment studies for small populations can fail communities when it comes to establishing specific numbers for site health risks, especially for chronic, complex, and relatively rare diseases like cancers. However, there is a way to quantitatively assess the relative short-term health risks that might be associated with the site. We used such a technique successfully in a Central Council of Tlingit and Haida Indian Tribes of Alaska study in evaluating health risks of open dumps in four Alaska Native Villages. Even though the timeframe was too short to include as many households as we would have liked, we felt it was important to include this health study component here. In this way, we can begin to identify health risks associated with hazardous sites in a quantitative way. We are pleased to say the technique worked in this case as well, and we will describe our results below.

It is important to realize that getting "number results" that are considered significant by western science criteria was possible here because we used a "relative health risk" study looking at total short term health effects from the site overall. This technique does not try to quantify absolute risk values for individual contaminants (which NAERAM does), *and* it does not try to look at long-term health effects, like cancer, that are much more difficult to study and isolate in small populations.

Besides providing number values for health risks associated with a hazardous waste site, our technique here identifies *total* health risks from the site. For many situations, we believe this feature is of great benefit. When individual contaminant risks are evaluated, as in most risk assessment studies, the combined "synergistic" effects can rarely be identified. With our technique, the relative health risks generated actually are the *site* health risks. In fact, there *is* no way to separate out effects from the different contaminants and, in fact, no way to tell what exactly at the site might be linked to increased health risks.

What is a Relative Risk? Here is an example. A characteristic that a group of people shares, like smoking cigarettes, is looked at. Another group of people-- the "control group" – does not have that characteristic (i.e. they are not smokers). Both groups are asked questions about their health, like whether they cough. In our example, the relative risk for the group of smokers is how much more the smokers coughed than the non-smokers. Thus, if the relative risk is 3, smokers coughed three times more often than non-smokers. To be useful, the results have to be adjusted for other factors that might affect why people cough. So for example, the analysis of the data would take into account the people who had a cold or fever.

What Hazardous Site Factors Increase Tribal Health Risks? Previous research has shown that people living near hazardous sites are more likely to have increased chances for a weakened immune system, greater stress and fear about where they were living, and a higher

chance at being affected by hazardous chemicals in the dumps than people who are further away[54].

In our study, there were three factors found that made a difference in how healthy people were:

- Visits to (or within 100 yards of) the site
- Being bothered by odors from the site
- Eating traditional subsistence-based foods (people were healthier if they consumed traditional foods)

This does not mean that other factors are not risky. It only means that we could not find anything with *this* study. For example, we found that people who lived closer to hazardous sites were no more likely to get sick than those who lived further away. However almost every person interviewed lived less than a mile from the site of concern. We may been more likely to find differences in health if we had compared people who live within 1 mile of the site, to people living more than 5 miles from the site.

Also, please note that one indication of exposure through air contamination from a site is to evaluate the wind direction, speed, and path distance relative to someone's house. Because analysis of wind records would be complex, we looked at whether people were bothered by site odors instead. All else equal, people who are bothered by odors will tend to be those people that are in the *path* of the odors (and the air contaminants that cause them). People who live close to the site may not be bothered by odors if the wind usually blows away from them. But people who live farther from the dump *might* be bothered, because the wind blows towards them. So being bothered by odors is one indication that people might be exposed to site contaminants[55].

What Symptoms Did We Look At? We looked at whether people experienced the following symptoms: Skin irritation/rash, dizziness/faintness, fever, stomach upset, vomiting, diarrhea, earache, sore throat, eye irritation, congestion, cough, headache, and numbness/tingling or weakness in arms or legs.

What Did We "Adjust" For? As we mentioned in the smoking example above, to be considered reliable, relative risk studies must account for different factors that could cause people to experience the symptom that is being studied. Our adjustments included race, age, gender, tobacco exposure, diabetes, asthma, allergies, and income. Details are in Appendix E.

What Risks To Short-Term Health Did We Find? In this study the relative risk is estimated by the "odds ratio". Because many people suffered from the symptoms we looked at[56], the odds ratio overestimates the relative risk, but not so much as to make the relative risk useless. The following three graphs show the odds ratios associated with the factors used to predict getting symptoms. The graphs only show odds ratios that were statistically "significant". This means that there was only a small chance (less than 5%) that the results were "just a coincidence".

Let us look at the first graph below. This graph describes the symptoms that were associated with just being at, or near, the hazardous site of concern. You can read the "odds ratio", which is the relative risk, along the vertical line. It is marked into increments of five. So an odds ratio of 2.5

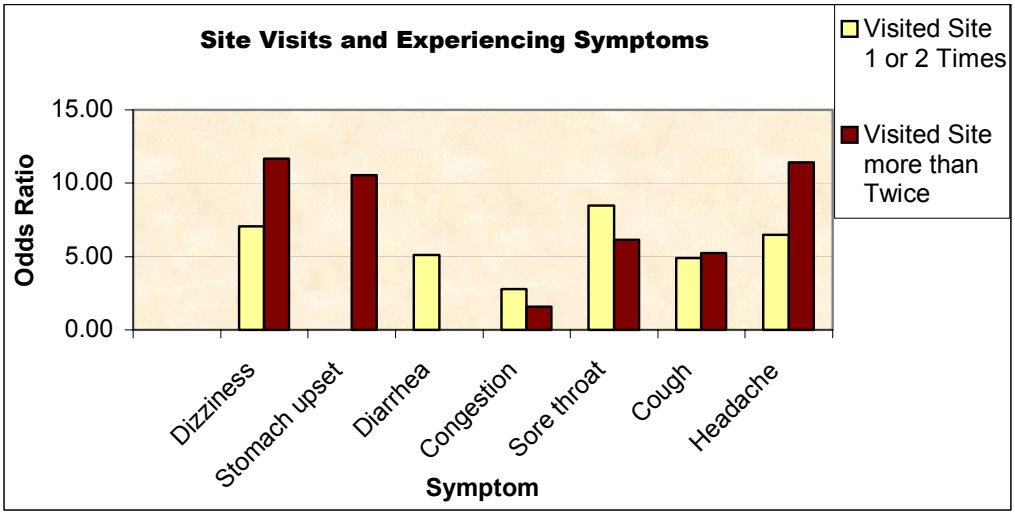
---

[54] Gilbreath, S. *Health Effects Associated with Solid Waste Disposal in Alaska Native Villages*, Doctoral dissertation, in Graduate Group in Epidemiology. University of California, Davis 2004.

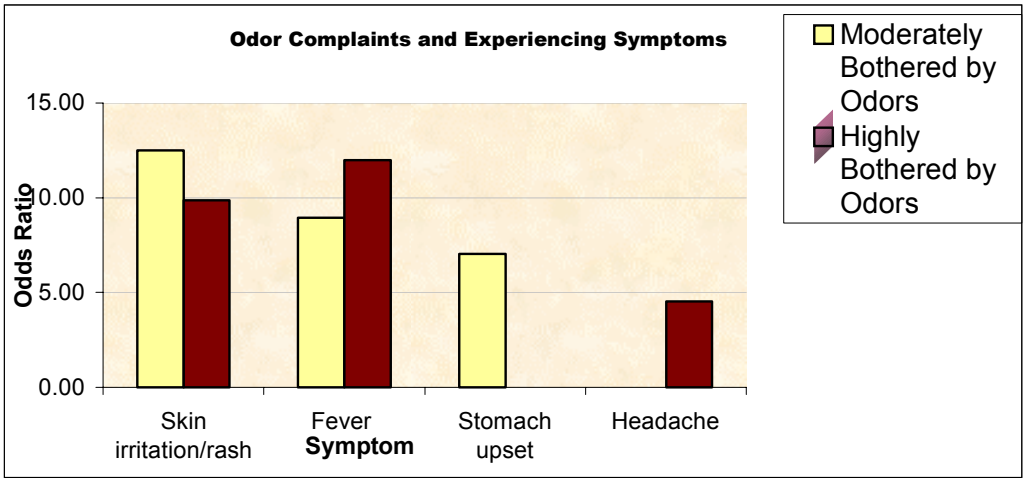
[55] We would like to point out that there are many factors involved with whether people are bothered by site odors, including the quality and characteristics of their sense of smell, concern about the odor source, and smell preferences. So while being bothered by odor does indicate some kind of exposure, it is just an approximate substitute. In some cases it won't be a very good substitute, and in other cases it will be.

[56] Symptom prevalence is included in Appendix E.

would be half way up between the "0.00" and the "5.00". Reading from left to right, the first symptom is "dizziness or faintness". The first vertical bar shows that *people who visited or came within 100 yards of the hazardous site* in their community 1 or 2 times during the previous 10 days were *more than 5 times as likely* to have had feelings of *dizziness or faintness* than those who did not visit near the site. The second higher bar shows that people who visited the site *more than twice* in those 10 days were *more than 10 times as likely* to have had feelings of dizziness or faintness than those who did not visit near the site. The rest of the graph can be read the same way. The symptoms listed in the graphs are the symptoms for which positive results were found. **So just visiting or coming within 100 yards of the hazardous site in their community was associated with experiencing dizziness, stomach upset, diarrhea, congestion, sore throat, cough, and headache.**

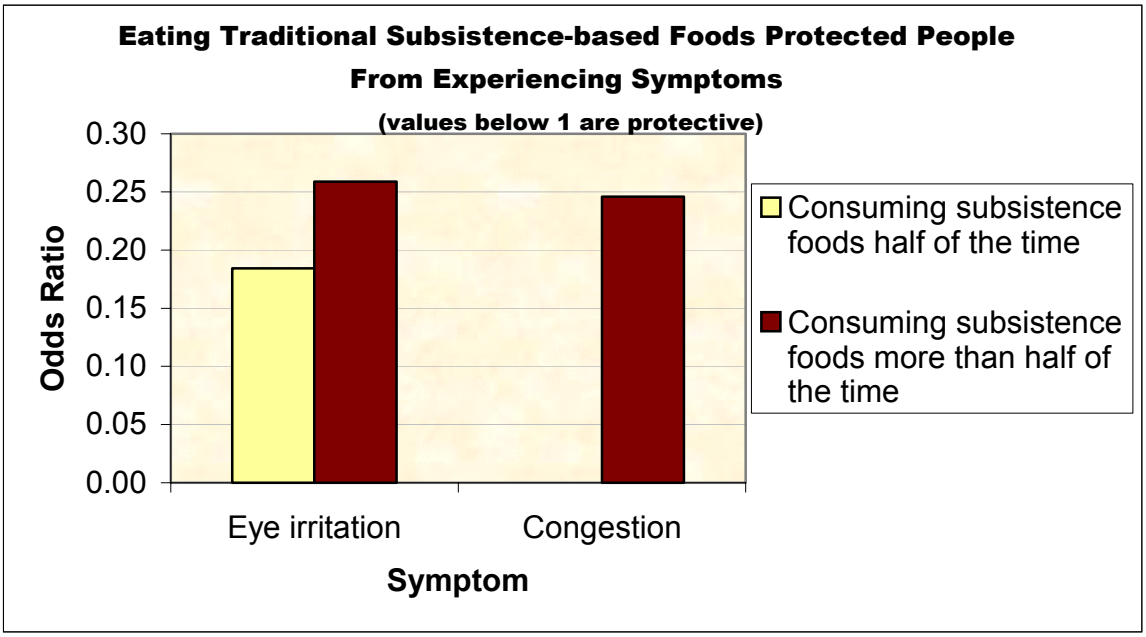


People did not need to be at or next to the site to be at increased risk. The next graph shows that *some symptoms were also positively associated with odor complaints.* People who were moderately and/or very disturbed by odors from the hazardous site were more likely to experience the symptoms listed—*skin irritation, fever, stomach upset, and headache*.



The next graph shows that **eating traditional diets actually helped people to not experience some of the symptoms** listed in the first two graphs. This graph is different than the other two. Odds ratios *smaller* than one indicate that you are *less* likely to get the condition if you engaged in an activity. People who consumed traditional foods at least half of the time were about 4 to 5 times

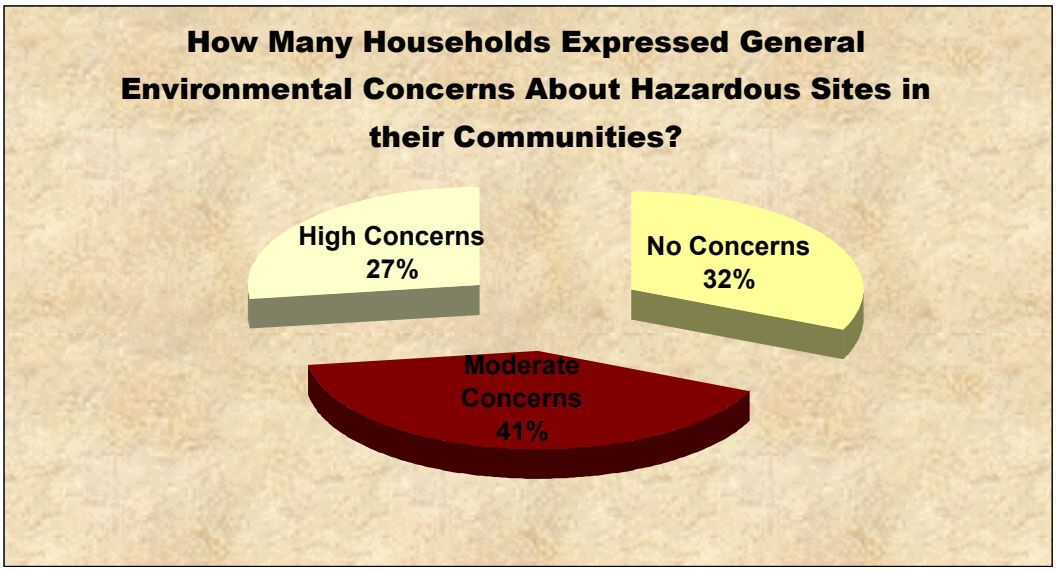
less likely to suffer from eye irritation and congestion than people who consumed traditional foods *less* than half the time. This makes sense, as many studies document general benefits of eating traditional subsistence-based foods. Interestingly, for people in our study, consuming traditional foods about half the time provided just slightly more protection against eye irritation (not anything else) than eating traditional foods most of the time. Many possible explanations exist, like overlapping confidence intervals or a threshold effect. Or people who ate traditional foods most of the time might not have been eating the full *range* of their traditional diet, and possibly missing some nutrients. If that were true, that raises the possibility that the full range of subsistence foods might not be available anymore, or pollution concerns might be curtailing the harvesting of some



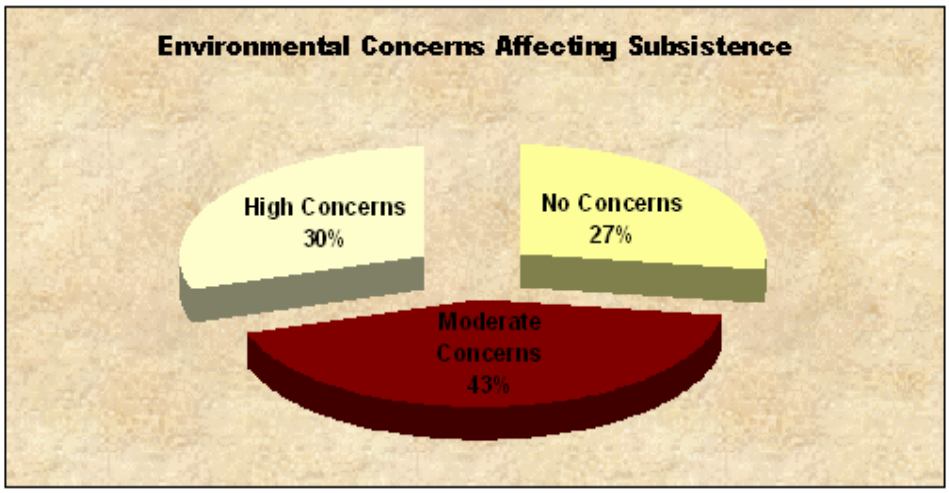
foods. As we have discussed previously in this Report, and will discuss again in the next Main Section, some Tribes did report in the THSR Surveys the circumstance of their subsistence foods being eaten less, or different foods being consumed, because of hazardous site concerns. Still, there is no reason to suspect that as the explanation for the phenomenon anymore than a statistical–based reason. Without more study and data collection, we simply cannot say what the reason is.

Other Important Results One of the unfortunate aspects of the THSR Survey is that the entries only represent what the Tribal staff has determined to be correct. For the technical questions, they are the best people to respond to the Survey, because they are generally the ones handling the issues with their THSR sites. But what about the questions about how concerned the Tribe is, and what activities are being impacted, and how? Are they the best people? We think so. Many staff told us that they consulted not only with their Councils, but also with elders. Our experience in the past has been that Tribal staff are generally quite careful in filling out something that speaks for their Tribe. And the THSR Survey states very clearly that the information will be used for their Tribe. Further, most Tribes are very close-knit and smaller communities, so that how a site is impacting traditional activities, and how concerned Tribal members are about it, relatively speaking, can be general knowledge. Still – we cannot say for certain that the staff or Tribal Council knows precisely how many Tribal members are concerned, or how many have had their activities impacted. So the THSR Survey does not ask for specific numbers, but relative and broad measures.

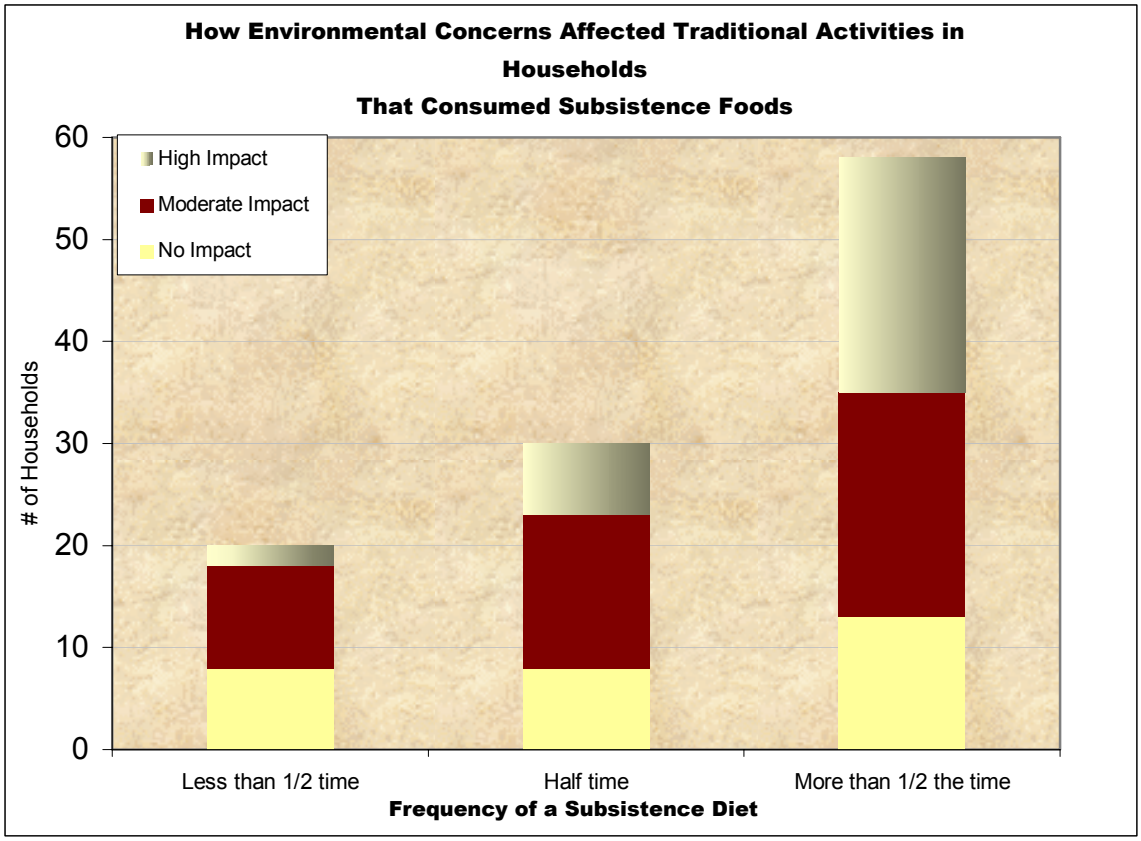
An important aspect of the Short-Term Health Study component was that the staff of the participating Tribes *did* go to individual Tribal members and ask them, in an unbiased manner meeting National Institute of Health Standards, about their concerns, and whether and how their traditional activities were being impacted. In fact, the individual households *did* have substantial concerns and impacts to their traditional activities. About two-thirds of the households reported having at least some concerns related to sites in their communities:



Remember in the Intangible Risk Main Section that about 58 percent of THSR Survey sites affect the subsistence and/or traditional activities of Tribes nationwide? It is interesting that somewhat similar proportions were found in this study component -- where we had many Tribal member households reporting from a very small number of Tribes. *More than two-thirds of households in this health study had altered their traditional activities* at least moderately because of their concerns. And 27% of households had made *no* changes to their traditional activities.



How *much* people's concerns changed traditional activities varied depending on how much of people's diets depended on subsistence foods. The graph below demonstrates that people who ate *more* traditional foods were *more likely* to have changed their traditional activities because of environmental concerns. People who consumed traditional foods *less* often were *less likely* to have changed their traditional practices. We can't say whether that is because they did not partake in many traditional activities anyway, and thus didn't need to change them; or whether people who ate a smaller amount of traditional foods were not as concerned about site pollution, and thus did not see as much need to change their activities. Again, that is another study.



What Does All of This Mean? We have seen positive associations between site exposure and feeling ill before in a Central Council of Tlingit and Haida Indian Tribes of Alaska study of the health effects from open dumps for four Alaska Native Villages[57]. These results add to that evidence that waste sites can have an impact on traditional lifestyles *and* on physical health. The number of households and sites we examined here was too small to make conclusions about the nature of health risks associated with all hazardous sites, or even certain hazardous site types. Still, we were able to provide a quantitative measure of increased risk for experiencing physical health symptoms when visiting or being next to a hazardous waste site. Through a standard western science interview study technique, we also provide documentation that hazardous sites can substantially impact traditional activities. We believe these two outcomes stand of their own accord as important considerations in making decisions about whether, why, how and when, hazardous sites near and in Tribal communities should be addressed.

[57] Zender, L. and S. Sebalo, Guide to closing solid waste disposal sites in Alaska Villages, Central Council of Tlingit and Haida Indian Tribes of Alaska, 2002. See Chapter 3 and Appendix B.

Developing a National Policy to Address Hazardous Sites on Tribal Lands Based on Tribal Priorities

To develop a national policy on addressing Tribal hazardous sites, information concerning at least two fundamental parameters is needed; *Tribal* priorities concerning sites, and Site (physical) contamination risks. We addressed the latter consideration in the NAERAM Section, and will review it below. But identifying Tribal priorities in addressing sites is complex, and with the limited Project scope, we just begin to examine the problem in a structured methodical way.

To start with, we can feel reasonably confident that the large bulk of sites Tribes submitted for the THSR are a priority within those Tribes. Why? Because the Survey took significant time to fill out--in the range of one hour or more. And, in follow-up emails and phone solicitations we asked those Tribes that had more than one site to consider filling out at least the site(s) about which their Tribe was most concerned. Thus, we can examine THSR Survey parameters for trends that might lend themselves to a general priority ranking scheme for use by Tribes and agencies in developing together a national policy on Tribal hazardous sites[58]: Note, in doing so, we provide elements needed for the first (and partially second) phase of three in USEPA and Council on Environmental Quality draft guidance on assessing "cumulative risks"[59]. Parallel to our general discussion in this Section and indeed, the Project approach, of addressing tangible and intangible Tribal risks as equally valid components of an umbrella problem, this framework for a cumulative risk assessment process can include qualitative (i.e. intangible) and quantitative (i.e. tangible) factors. Indeed, while the timeframe for this Project does not allow framing of the problem into a formal cumulative risk process structure, it is hoped that this Project does provide additional motivation and credence to developing and implementing in practice the general concept of weighing both quantitative and qualitative risks, as well as their interactions, in making environmental policy decisions.

Size doesn't matter The 109 THSR Survey sites for which Tribes provided an area estimate ranged in size from 0 to over 40 sq mi., with a mean average of 371 ac. But based on a preliminary statistical analysis, no meaningful Tribal priority information can be obtained from site size *alone*-- half of the sites were under 2 acres, indicating a complex non-linear, if not random, distribution pattern[60]. Note too that the correlation between contaminant plume size and site size (if any) would be monstrous to establish for a variety of technical reasons.

Site Type Site type is another parameter that can play a role in national policy development. As can be seen in the Table below, the most common reported site type was an open dump. However, the priority varied regionally. Combining the open dumps and landfills together, only

---

[58] It is likely a distinction exists in Tribal priorities between new sites for which surveys were submitted, and old sites for which surveys were submitted. As was discussed in the THSR Section, Tribes might tend to submit surveys less often for sites that were on the Draft Site Lists we sent them, because we already "had it right". So it is possible that site characteristics for these sites provide more insight into Tribal priorities. In fact, distinction between the two circumstances was made in the THSR priority scheme, provided in the THSR Section of this Report. Unfortunately, teasing out statistically, or verifying via follow-up, validation of these two separate priority categories was beyond the scope of this Report.

[59] See USEPA, *Framework for Cumulative Risk Assessment (External Review Draft)*, Risk Assessment Forum, Washington, DC, 120 pp., 23 April 2002. Available at http://www.epa.gov/ncea/raf/pdfs/frmwrk_for_cra/Draft_Framework_April23_2002.pdf; Council on Environmental Quality, "Considering cumulative effects under the national environmental policy act. Principles and methods for conducting cumulative impact analysis are identified and reviewed. Available at: http://ceq.eh.doe.gov/nepa/ccenepa/ccenepa.htm

[60] Standard deviation = 2,526 ac

about 15% of reported Lower-48 sites were open dumps or landfills. But 36% of Alaska sites fit that category, likely reflecting the general rural nature of Alaska Villages. Likewise, military sites were high on the Alaska list, but not so in the Lower-48. It is beyond the scope of this study to determine whether this difference can be attributable to the relative *number* of military sites per Alaska Village versus Lower-48, whether Alaska Native Tribes are more *concerned* about Military sites, or whether a number of *other factors* come into play. Not surprisingly again, RCRA facilities were reported far more in the Lower-48 than in, generally more rural, Alaska. Petroleum and wastewater sites were reported at about the same percentage.

What Types of Sites Did Tribes Tell Us They Were Concerned About?

Site description	All Tribes	Lower 48	Alaska
Standard open dump with mixed household & business wastes[1]	15.8%	10.3%	23.7%
Military waste site	11.6%	4.6%	22.0%
Petroleum product only sites (e.g. drums, tanks, spills)	9.6%	9.2%	10.2%
Small facility – likely RCRA	8.9%	13.8%	1.7%
Wastewater-related (e.g. sewage lagoons, leaky sewer pipes)	8.9%	9.2%	8.5%
Mine and/or mining wastes	7.5%	10.3%	3.4%
Authorized Landfill or disposal site[1]	6.2%	2.3%	11.9%
Large facility – probable RCRA	4.8%	6.9%	1.7%
BIA school (inactive)	3.4%	0.0%	8.5%
Agriculture wastes, farm open dumps[2]	2.7%	4.6%	0.0%
Open dump with mostly household wastes	2.1%	3.4%	0.0%
Open dump – mostly business/construction wastes	1.4%	2.3%	0.0%
"Other" type, or type unchecked with insufficient detail	16.4%	21.8%	8.5%
Total	**100%**	**100%**	**100%**

[1] The distinction between authorized landfill, authorized open dump, and unauthorized dump is complex, particularly in Alaska, and caution is needed in developing a policy based on the ratio here. Note that none of the Alaska dumps contain purely business or purely household wastes. This reflects the general situation of a single Village dump where all wastes are channeled. Open dumping by non-members or rogue businesses is rare in Villages, because these two entities are virtually non-existent. But this type of unauthorized open dumping is likely represented in the Lower-48 by the Open dump with mostly household wastes and Open dump with mostly business/construction waste categories. The standard open dump in Lower-48 may be unauthorized or informally authorized, and no distinction is possible.

2 Note – while agriculture/farm sites might sound pastoral to urban dwellers, they generally contain substantially more FIFRA substances (i.e. pesticides, fertilizers, rodenticides, fungicides, etc.) than a "standard" open dump.

Thus, the Site Type provides some insight into Tribal priorities, but a number of complex statistical and logistical questions must be answered before the role of site classification in a Nation-wide policy approach is defined. For example, farming sites were not reported by Alaska Tribes, as only a tiny fraction of Tribes are near Alaska's farming region (yes, there is one!). But that does not mean that farm sites should be assigned a low priority. For Tribes in farming regions, farm sites are a high priority as they are generally associated with significant contamination from pesticides, fertilizers, fungicides, etc. How to treat site type in a general priority scheme is not an impossible question, but to answer it well, a good deal of thought needs to be exercised.

Contaminant of Concern Another parameter that can partly describe where Tribal priorities might lie is the type of contaminant with which Tribes are concerned. Of course, contaminants can be classified in a number of ways: Ecotoxicologically, Visual concern, Fear, Cancer risks, Handling or Treatment Logistics (e.g. Lead-acid batteries can be picked up and moved), or even Educational

need of the community in understanding the "true" risk. In the Table below, a very low level of grouping was performed based on the authors' knowledge of general term connotation. Note, if 'lead' and 'mercury' are combined with the generic 'heavy metals' category, and if the 'released' and 'tank-contained' petroleum hydrocarbon categories are combined together, heavy metals were cited nearly 50 percent more than the 2nd place 'petroleum hydrocarbons' nationally, and in the Lower-48. In Alaska, 'petroleum hydrocarbons' would just edge out 'asbestos' as being the contaminant of greatest concern. But if lead is considered as the primary contaminant of concern in lead-acid batteries (which the authors can verify as generally likely), heavy metals would top Alaska's contaminant list as well.

What Contaminants Did THSR Tribes Have Concern Over?

Combined

Contaminate of concern cited	No. of surveys
Heavy Metals	20
Diesel/Motor Oil	17
Lead	14
Fuel (In Tanks, 55-Gal Drums)	13
Asbestos	12
Garbage/Flying Debris	11
Mercury	10
Dioxins/DDT	9
Lead-Acid Batteries	9
PCBS	8
Solvents	8
Hazardous Wastes,	7
VOC's; Nitrates; Pesticides & Insecticides	*Tied at 6*
Sewer & Human Wastes; Lead Paint; Refrigerants	*Tied at 5*

Lower-48

Contaminate of concern cited	No. of surveys
Heavy Metals	16
Fuel (In Tanks, 55-Gal Drums)	9
Lead	8
Dioxins/ DDT/DDD/DDE	8
Diesel/Motor Oil/ Hydrocarbons	7
VOC's	6
Solvents	6
Nitrates	6
Mercury	6
Pesticide, Insecticide	6
Garbage/Flying Debris	5
PCB's	4
Hazardous Wastes	4
Refrigerants; PAH's; Lead-Acid Batteries	*Tied at 3*

Alaska

Contaminate of concern cited	No. of surveys
Asbestos	11
Diesel/Motor Oil/ Hydrocarbons	10
Lead-Acid Batteries,	6
Garbage, Flying Debris	6
Lead	6
Sewer, Human Wastes	5
PCB's	4
Dioxins, DDT, DDD, DDE	4
Mercury	4
Heavy Metals	4
Lead Paint	4
Fuel (In Tanks, 55-Gal Drums)	4
Hazardous Wastes	3
Solvents; Waste Oil; Refrigerants	*Tied at 2*

Site Jurisdiction, and Responsible and Affected Party Identity The land status breakdown for Lower-48 Tribes responding to the THSR Survey is provided below.

Land Status Types For Lower-48 THSR Survey Sites

Land Status	Off-Reservation	On-Reservation
Trust	2%	40%
Fee	1%	4%
Allotment	1%	3%
Treaty hunting fishing	4%	0%
Disputed	0%	1%
Allotment outside Reservation	1%	1%
Not Tribal related but of concern	12%	2%
Trust outside Reservation	0%	3%
Other	14%	12%

For most Tribes, whether a site is within a Tribe's jurisdiction, whether non-members or non-Tribal businesses are contributing to the site, and whether Tribal members are being affected, likely has an effect on the level of priority a might assign it. Respect and care for elders was discussed briefly in the Intangible Risk Section. It is of note that concerns about elder health and well-being were noted at 37% percent of sites reported. However, Tribal jurisdictional issues, and socio-cultural perspectives on non-member pollution, as regards waste sites are complicated[61]. Whether at a national level Tribes are concerned more about sites with their full or partial jurisdiction (and thus at least partial control), or more concerned with sites that they have little to no recognized or practical authority/influence is not at all clear. Defensible elucidation is possible, but well beyond the scope of this Project. One would expect that, like many Tribal issues, the priority depends on the context of the particular situation. Thus, an analysis of how the role of jurisdiction and authority *can* be treated in developing a Tribal hazardous waste site policy would be complex, and a decision by Tribes on how it *should* be treated, would likely be volatile. Note, because of the ambiguity and unresolved nature of what is considered Tribal land, responses from Alaska Tribes on site land status could not be accurately summarized without detailed statistical analysis and response validation.

Media Contamination While soil was listed most often as the media contaminated in the THSR Survey sites, the numbers are likely not sufficiently different to make any inferences on the type of media contamination with which Tribes are most concerned:

What Was Contaminated?

Media	Percent of sites where media is contaminated
Air	43.8%
Stream	50.0%
Groundwater	52.1%
Soil	66.4%
Other (e.g. "sediment", "fish", "ocean", "dust")	32.9%

Whether a Traditional Activity is Impacted A possible parameter that could be used in developing a national priority scheme would be the type of traditional activity that is affected, or and/or how it is affected.

What Traditional Activities Were Affected By The THSR Survey Sites?

Activity Affected	Percent of THSR Survey sites affecting the activity
Hunting, fishing	70%
Plant harvesting	58%
Ceremonial/spiritual	47%
Traditional art/handicraft	39%
Farming/growing	37%
Bathing/sweat lodge use	36%
Traditional tools or clothes	34%
Decline to specify:	32%

[61] See Zender, *Solid waste mngmt. on Indian Res.: Limitations of conventional SWM engr.*, Supra note 18.

The THSR Survey results do not exclude the *possibility* that some activities are of more urgent priority to protect than others, within a particular Tribe, region, or among all Nations. But from a purely statistical perspective, a much more detailed statistical analysis and verification process than is within the scope of this project is needed to ascertain whether different levels of priority are hidden statistically in the data. For example, 'hunting and fishing' is the activity affected by the greatest number of THSR Survey sites. But it also is the most widely practiced traditional activity, and it makes sense that it would be affected more frequently. It does not necessarily follow that 'hunting and fishing' is a greater priority. Sites were of concern to Tribes for a variety of reasons. A site with hunting and fishing impacted might also be impacting ceremonial/spiritual practices, and the latter impact may be why the Tribe considered the site enough of a concern to submit a survey. And, while the bulk of surveys were almost certainly submitted because the site was of concern, there are any number of site concerns that could have inspired a Tribe to submit one. Some of these reasons likely can be articulated through detailed statistical analysis, and some can not.

But even if a knowledgeable statistical analysis were to point to the existence of Tribal priorities associated with certain practices, or confirm Tribal priorities in the *way* that a site affects a traditional activity (e.g. a higher concern for *how* a tradition is performed than for *where* it is performed), including such a parameter in a national prioritization policy invites a morass of problems. Primarily, on a policy level, inclusion would be difficult to justify without a consensus decision making approach involving all interested Tribes. And the issue certainly presents a wide opportunity for misinterpretation and misuse. Still, based on the findings here, there is a real value in Tribes considering at the National level *whether some element of priority should be given to those hazardous sites where the traditional activity that is being impacted is in imminent threat of being lost* (to the Tribe, Region, or Nations). Reliable and equitable ways to develop priority criteria exist, although certainly the time frame needed to develop and implement policy for such an endeavor would be several years[62].

Contaminant Exposure Risk While it is apparent from the study here that it should not be the sole consideration, contaminant exposure risk *is* needed as a national policy parameter to address Tribal hazardous waste sites. At least 20 percent of sites that Tribes reported in the THSR were not considered to impact traditional activities, and one might expect that a primary concern for a good portion of those sites is physical contamination and exposure risk. Sixty-four percent of the THSR sites elicited Tribal concern that homes, schools, community halls, etc. were too close to the site, site-contaminated streams, or were in the path of smoke/fume release. Such concerns are not about intangible risks to traditions, but about exposure risk in daily universal human activities. Including intangible risks as a legitimate site priority consideration need not detract from the consideration of physical contamination risks. At a national policy level, fortunately, risk exposure has been well studied compared with other possible site priority considerations described above. The level of "acceptable" exposure has been established for a large number of contaminants of concern. And used correctly with the appropriate data, NAERAM provides Tribes and agencies a simple, but technically-defensible means, to determine risk exposure for Tribal members who engage in traditional activities. Thus, NAERAM can be used as a primary tool in the analysis phase of the proposed EPA cumulative risk assessment.

Additional Tribal Concerns Last, central to a defensible priority ranking structure for a national policy on Tribal hazardous sites is assuring that the full range of concerns related to hazardous site risks are considered, if not included. To provide the reader with a *preliminary idea*

[62] Particularly because most Tribal cultures are holistic-based, a sufficient amount of time is necessary in decision making processes that involve priority ranking. The nature of holism is that all things are connected, and, in a sense, equal. It follows that elements introduced into the process by participants may happen at any time, irrespective of the seeming "priority" that an outsider might assign them. Thus, the relative length of time needed to ensure that all of the key elements involved are included (i.e. brought up and considered by participants), may be longer than in working with a mono-western oriented culture group.

of the wide range of concerns that require consideration, we mention a third, simplistic test in the separate Zender study discussed in the Intangible Risk Section. We listed 16 potential concerns based on previous doctoral research. Then we had the groups select their top four concerns. The results are reproduced below.

What Are The Concerns That Tribes Feel Are Most Important?

The instructions were: **Can you check (√) 4 or less items below for what is most important**? We realize many of these issues below are very connected and hope that it is still possible to check the 4 that sound most important to you. It will help us a lot. You are welcome to star (**) really important issues:

Issue	Tribal Group	Non-Tribal Group	Rank of 1st Round choice for this issue	Rank of 2nd Round choice for this issue
Long-term physical health of members – keeping them free of pollution that might cause cancer or serious health problems even if the risk is very, very low.	59%	29%	*1st*	*tied for 5th-9th*
Spiritual / mental health of Tribal members – content with their life	53%	29%	*2nd*	*tied for 5th-9th*
Tribal sovereignty – land jurisdiction issues about the site	47%	43%	*3rd*	*1st*
Keeping land clean	41%	29%	*tied for 4th – 6th*	*tied for 5th-9th*
Subsistence resources – keeping them pollution-free	41%	24%	*tied for 4th – 6th*	*tied for 10th-12th*
Keeping and practicing traditions	41%	38%	*tied for 4th – 6th*	*tied for 2nd*
Elders' health and well-being	35%	24%	*tied for 7th -8th*	*tied for 10th-12th*
People being concerned about environment or health – even if there is nothing wrong.	35%	19%	*tied for 7th -8th*	*13th*
Not having people's bodies be contaminated by pollution from the site – even if the pollution doesn't cause any physical sickness.	24%	29%	*tied for 9th-10th*	*tied for 5th*
Site cleanup even if scientists found that there was nothing wrong with the site and no harmful chemicals.	24%	0%	*tied for 9th-10th*	*tied for last*
Listing site as a CERCLA or other -	18%	0%	*11th*	*tied for last*
Tribal sovereignty – people jurisdiction about the site (e.g. non-member dumping)	6%	33%	*tied for 12th-16th*	*4th*
Self-determination and not needing to rely on local or state agencies.	6%	29%	*tied for 12th-16th*	*tied for 5th*
Finding the site owners or responsible people and having them pay or apologize	6%	14%	*tied for 12th-16th*	*14th*
Contamination of sacred sites	6%	38%	*tied for 12th-16th*	*tied for 2nd*
Short-term physical health of Tribal members – keeping them free from symptoms like coughs, headaches, congestion, nausea	6%	24%	*tied for 12th-16th*	*tied for 10th-12th*

Interestingly, the top two concerns of the Tribal Group highlight the dichotomy discussed several times in this Report – intangible versus tangible risks. Quantifiable cancer risk is ranked almost equally with the intangible factor of spiritual and mental well-being of Tribal members. The results coincide with a holistic perspective on life. But the problem of developing a national policy on Tribal hazardous sites is not made any easier. Note that the ranking of short-term health of Tribal members as last in concern coincides with the test previously described in the Intangible Risk

Section. There, the Tribal Group "chose to tradeoff" short-term health in the interest of elders and traditions[63]. As a basic test, any inferences drawn must be limited.

There was a twist on this test. Rather than adapting these issues to conventional western community terminology for the non-Tribal Group, the non-Tribal Group was given the same instructions and issues, and asked to mark what they thought someone from a present-day Tribe would answer.

We should note that statistically, the difference in the two *sets* of rankings from each group are not considered significant[64]. But *individually*, the fact that a concern such as "contamination of sacred sites", was ranked 2nd by the non-Tribal Group and last by the Tribal Group introduces another facet to developing a national site policy. In conventional western-oriented America, of which the non-Tribal Group is part, the term "sacred sites" arguably precipitates an almost inherent mental association, perhaps partly a hegemonic association with Native Americans (e.g. the "Chief-with-teardrop" anti-litter 1970's public service announcement)[65]. Yet, *in the context of hazardous site tradeoffs and priorities*, pollution of sacred sites may not be the top priority, or even one of the top priorities. Traditions and members' long-term health – being free of pollution -- could in fact be more important, *when and if* a tradeoff must be made. Indeed, it is compelling to note that several of the five issues ranked last in the Tribal Group seem to indicate that misconceptions about Tribal priorities exist, at least with regard to waste sites. If this is the case, such a circumstance only underlines the importance of having full Tribal participation in policy decisions about addressing hazardous sites that impact them.

Summary Of Tribal Priorities And A General Model

Based on the findings provided in this report, intangible risks are certainly a significant factor for a substantial number of Tribes in prioritizing their site risks. Thus, from a rational perspective, these types of risks in some way must be included as a parameter in devising a defensible federal policy for addressing Tribal hazardous sites. We would like to summarize the above discussion and report findings by suggesting a general conceptual model for assessing Nation-wide[66] Tribal priorities in addressing hazardous sites on and near their present-day Lands, Treaty lands, and aboriginal lands-- with which the ties for most Tribes, if not all, will never be fully broken (see the Issues Section below):

Priority = Weighted Intangible Risks + Weighted Tangible Risks

Here, the 'Intangible Risks' include those we discussed in the Intangible Risk Section and just above -- they are wide ranging and can include tradition impact, sovereignty concerns, environmental aesthetic and habitat loss, and societal well-being. The 'Tangible Risks' are essentially the exposure-related risks the site presents. The term 'weighted' refers to identifying relative values for how much each of the two components contribute to the priority. The problem with the above model is that the two parameters do not have the same measure. Tangible risks are directly quantifiable – they are measurable "absolute number" values. Intangible risks are not –

---

[63] As an aside, readers interested in this particular point might consider that, compared to conventional western cultures, in holistic Tribal cultures, short-term health and its symptoms tend to be viewed due less to viruses and environmental ills, and more due to the individual's holistic well-being i.e. factors within their control. Cancer tends to be viewed due to pollution and environmental contamination, and would be viewed as polluting the body.

[64] A paired sample t test was conducted on percentages, with p value = 0.53109 (i.e. "no difference")

[65] See Castile, G. "*Hegemony and symbolism in Indian policy*", in "State and reservation: new perspectives on federal Indian policy", Castile, G. and R. Bee, (eds), Univ. "o f Arizona Press, AZ, 1992, or Zender, L., *supra* note 18 for application to Tribal waste issues.

[66] Here, Nation-wide (capitalized and hyphened) refers to Tribal Nation-wide, i.e. all Tribes.

they are descriptive values. There is no method now, nor in the foreseeable future, to assign *measured values* to concepts and issues. When we say 'measured values', we mean that it would be like using a yardstick to measure someone's mind-- and calculating their traditional values to equal '4 inches'. Fortunately, intangible risks *can* be evaluated in a technically defensible model that *categorizes* the risks clearly, and *assigns* Tribally-determined weights to develop a set of *relative values*[67]. And tangible risks are 'numbers', so that they lend themselves to separation into numerical ranges, from which *relative values also may be assigned*.

Using NAERAM to Measure Tangible Risk Let us examine the Tangible Risk factor in our model. Relative ranking values for exposure risk could be assigned based on threshold effect levels – such as cancer thresholds. For example, Tribes with their scientists could assign a value of "1", where the calculated risk was 100 times less than a threshold; a value of "2"; where the risk was in the range of an effect threshold; and "3", for exposure risks above the threshold[68]. The disadvantage to this method would be that, while the process to devise a National criteria would be fairly straightforward, to assign a site its relative tangible risk value would require Tribes (or agencies or Responsible Parties) to go through the technically difficult step of performing risk exposure assessments on their sites before they could be categorized.

How would Tribes measure their site exposure risks? One answer lies in the Project work here. NAERAM provides a way for Tribes with the appropriate data to evaluate their exposure and risk – including those that result from Tribal lifestyles and traditional practices. NAERAM itself is straightforward to use with the appropriate data. *It is the step before that that would present the logistical and financial obstacle* -- technically sound data collection and analysis can be complex and expensive. And only a fraction of the 15,000 sites in THSR are associated with the type of comprehensive media sampling that is needed[69]. Tribes could decide however, to approach the problem in stages – and address the sites that are of highest concern first, where comprehensive and technically defensible contaminant sampling data might already be available or be planned, and/or missing input data such as traditional foods contamination can be reasonably extrapolated based on that data. Then using NAERAM (or another method) to assess exposure and risk, and assigning the site a relative Tangible Risk value from that, might be workable from a national implementation perspective.

Note however, that beyond contaminant sampling, the issue of available data on Tribal lifestyle risk parameters looms. Traditional foods dietary information and contaminant sampling data is becoming more available, particularly for Alaska Tribes. But contact exposure data for a variety of traditional practices has not been gathered, or it has been collected as Tribal proprietary information, or within a context that is not transferable to similar practices by other Tribes. Thus, to successfully implement a national policy model for addressing hazardous sites that is based partly on site exposure and risks, a national effort would be needed to fill in Tribal lifestyle data gaps so that all Tribes could assess their risks correctly (using NAERAM or some future model) *and* could do so within their financial means.

Unfortunately, because risk assessment can work only for one contaminant at a time, if Tribes were interested in more than one contaminant at a site, the risk exposure for each contaminant

---

[67] Note the specific methodologies used depend on how Tribes would like to frame the problem and outcome, and the level of effort possible, and nature of, any data collection additional to THSR (i.e. development of an optimal analysis plan). There are several general references, such as Landscape Institute with the Institute of Environmental Management and Assessment, *Guidelines for landscape and visual impact assessment.* Publisher, London ; New York : Spoon Press, 2002; Kulkarni, V. S, A *handbook of environment impact assessment*, V. Kulkarni, S. Kaul, R. Trivedy, Publisher: Scientific Publishers (India), c2002. See also CEQ, *Considering cumulative effects, supra* note 54.

[68] To be technically defensible, and to ensure that the ranges and values assigned to them were agreeable to all Tribes, the actual process would be much more involved, but would entail essentially the same idea.

[69] See the NAERAM 2004 Technical Documentation that accompanies this Report.

would need to be calculated separately. However, as regards this issue, a great advantage to converting risk exposure levels to a relative ranking scheme exists. One of the deficits of contaminant risk models is that data for the combined (i.e. synergistic) effects of contaminants is not generally available. The scientist is left to adding up each separate effect and assuming an unknown effect for what the chemicals might "do" together. But with a relative ranking scheme, one could simply assign a higher category level for larger sets of contaminants, perhaps even proportional to the rising level of uncertainty.

Using Short-Term Health Risks to Measure Tangible Risks We should point out that the Tangible Risk factor is simply a term that measures physical risks of the site. The relative health risk technique discussed in the Short-Term Health Risk Section in fact is a way to measure the physical risk of a site. Why can't this technique be used instead of a contaminant risk approach? It can be, in theory. The primary problem here is that this technique is a very contextual test. As we mentioned before, the results only address the full site risks, and exactly what *about* the site that is precipitating those risks cannot be extracted. So, for example, we apply this technique to one Tribe's open dump where we find that people who visit it are 5 times more likely to have stomach upset. But in this particular community, people may be going to the dump and salvaging for spare auto parts, so that their exposure period is much longer than for another community where people just dump their garbage and leave. Or perhaps at the test community, people are walking through a septic field on the way to the dump, and the sewage is causing the stomach ache. The test won't reveal that, unless it is tested for. The relative risk test depends on people's *habits* as regards the site just as much as it does on the site characteristics. So to use short-term relative health risks for a national priority policy is complicated.

In practice, to use the relative health risk technique, a substantial number of Tribal communities, representing the general range of site types and community-site dynamics (i.e. exposure scenarios), would need to participate. Tribal staff would need to be trained correctly to perform unbiased surveys, and the households in the test communities would need to participate. The data from this Project could provide a reasonable basis for sampling design (i.e. how many Tribes, what types of sites and situations). The design analysis might very well point to an overly ambitious Project that requires too many participating Tribes and an unwieldy number of site type/exposure scenarios. We don't know, as such an analysis is beyond the scope of this Report. But assuming an effort was feasible, pooled analyses for the different site types and exposures *might* yield results with sufficiently narrow confidence intervals. With each site type and exposure associated with a set of different quantitative health risks, priority ranking into site scenario categories would be automatic. Each Tribal site nationwide would be then assigned to the best matching site scenario category. For example, an active open dump that was within 5 miles of houses might be assigned a national priority of "3", based on the relative level and number of increased health risks it posed for a set of expected community exposure patterns. All the sites nationwide that fit this description would be ranked then as a "3".

Using Proxies to Measure Tangible Risk Obviously, both methods to measure the Tangible Risk of sites would be logistically quite difficult. As an alternative, the Tangible Risks factor could be a relative value that is assigned based on proxy measures of site exposure risks. A 'proxy measure' is a way to measure an outcome that is difficult to measure. We use proxy measures all the time in our lives. For example, to judge the age of a child, we might look at their height. In the case of IHS, CERCLIS, and FUDS, their site priority categories (provided in the THSR Section) lend themselves to serve as exposure proxies. In fact, they are intended in many ways to serve as measures of site exposure as a matter of design[70].

[70] FUDS sites might be best categorized using NAETS (Native American Environmental Tracking System) data – see https://www.denix.osd.mil/denix/Public/Native/Mitigation/naets.html . However, access to records might be problematic, as this NAETS maintains strict user/security protocols to guard individual Tribal site information.

How would this work? As a simplistic example, IHS sites of high threat could be assigned a score of "3", those with moderate and low threat, a "2" and "1", respectively. One problem with this scheme is that a workable national policy on addressing sites should differentiate the level of site priority sufficiently such that site remediation can be carried out in fundable stages (i.e. only so many sites each year can be addressed). Thus, in practice, a higher level of resolution of physical contamination risks might be needed to work. For example, the SDS point system upon which the IHS threat levels are based, could be reviewed to determine whether a more narrow classification system is technically defensible (e.g. 8 categories, rather than 3). But certainly problems with the SDS system itself, in regards to capturing tangible physical exposure risks of Tribal lifestyles, like Tribal subsistence and plant use, would need to be addressed as well[71]. Tribal lifestyles, and in fact rural lifestyles in general, where residents "live off the land" and thus engender additional exposure through ingesting and using contaminated plants and animals, are not considered in the SDS ranking model. Analogous problems exist with other hazard ranking schemes, although considerable progress is being made in terms of formally incorporating both quantitative human risk assessment and ecological risk assessment of hazardous sites[72] into the CERCLA Program[73], in terms of developing frameworks for cumulative risk assessment where qualitative stressors to a community are recognized[74], and in reviewing methods for qualitative assessment of projects with potential environmental impacts[75].

Certainly, the challenge of incorporating Tribal lifestyle risks fully into a nationally accepted site assessment model is fully solvable. Once worked out, the problem of how to assign values to sites that have not been assessed would need to be addressed. Finally, a technically defensible approach would need to be devised to merge the various site types (e.g. IHS, CERCLIS, FUDS, LUSTs, etc.) into one ranking system. These issues are not intractable, and a number of decision making and game theory models (which could work with traditional consensus) exist to accomplish the task. *If* the obstacles mentioned above were addressed, as well as others that would be identified during the process, reliance on using existing information and threat classification schemes to develop proxy measures for tangible exposure risks would be likely more implementable on a national scale than one that relies on risk assessment for each site[76].

Measuring Intangible Risks How would we measure intangible risks? A number of different methods exist, but they have at least one aspect in common: Tribes will need to be involved heavily at each decision juncture and tradeoff. What will be the nature of such a method?

---

[71] While it includes general relative human activity level near the site, the Sanitation Deficiency System, used to rank solid waste, water, and wastewater projects does not address traditional practices, and inherently assumes that exposure occurs via direct dermal or inhalation routes at the site - not ingestion, or dermal off-site, of contaminated animals and plants, or traditional (untreated, unregulated) drinking water sources.

[72] Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments - Interim Final, June 1997 (OSWER Publication Number 9285.7-25; NTIS Order Number PB97-963211).

[73] EPA Superfund has updated its guidance on risk assessment of include planning and scoping of cumulative risk assessment and ecological risk assessment. See http://www.epa.gov/superfund/programs/risk/rsk_sf1.htm

[74] EPA, *Framework for Cumulative Risk Assessment (External Review Draft)*. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, 120 pp., 23 April 2002. Available at http://www.epa.gov/ncea/raf/pdfs/frmwrk_for_cra/Draft_Framework_April23_2002.pdf. Also National Environmental Justice Advisory Council Cumulative Risks/Impacts Workgroup is finalizing a document on the subject that focuses on under-served populations, including Tribes.

[75] Council on Environmental Quality, "Considering cumulative effects under the national environmental policy act. Principles and methods for conducting cumulative impact analysis are identified and reviewed." Available at: http://ceq.eh.doe.gov/nepa/ccenepa/ccenepa.htm

[76] However, if Tribes were to decide to approach the problem in stages – and address the sites that are of highest concern, where contaminant sampling extensive enough to be useful is likely to have been carried out already, using NAERAM to assess exposure risk, and then to assign the site a relative Tangible Risk factor value from that, might be less-resource intensive.

We cannot posit a defined model here because it is well beyond the Report scope. We have provided a number of possible terms, some insight into the dynamics between their relative values, and some sense of where they might rank overall in comparison to exposure risks. We can say with certainty that *Tribes consider the loss of tradition as a very high priority intangible risk*. We have listed a number of ways that traditions can be impacted. But the scope of the Project does not allow us to proceed further -- to map out general weights, harvest additional data, and statistically analyze associations that could help Tribes further develop the general structure we have discussed here.

Lumping the Two to Get a Tribal Priority Number. *Once both tangible and intangible risk factors are given relative values, they can be weighted and considered together.* For readers unused to conceptual models, a simplified example of what we are suggesting here would be:

> A THSR site of moderate exposure risk threat that is the last area where the right reed plants for making baskets can be found.

On a national level, Tribes might assign the value of "5" on a scale of 1 to 10, to a scenario where a tradition like basket making was being impacted. Then the fact that, if left unaddressed, this site might cause a tradition to be lost to a Tribe, would rank a "10". The total intangible risk might then be '5 + 10 = 15'. A moderate exposure risk site might rank "5". We would add "15" (for the intangible risk) and "5" (for the tangible risk), and the result would be "20". We could go through the same process for each site of interest, and then compare the number values to see which scored the highest. Again*, this is a simplistic example*. In reality, to achieve a consensus-based, equitable solution requires the process be carried out methodically, in a way that can be technically justified. And there are specific, technically defensible methods to assign values for a group or groups of people with divergent viewpoints. These methods have been developed over the past several decades, and a wealth of work has been devoted to adjusting and verifying them so that they can work in complex situations.

Of course, intangible risks and tangible risks are also associated with each other. So rather than adding the risks, the model would fit hazardous site scenarios better if the risks were multiplied together. To be more precise, because the relative level of many intangible risks can depend on the value of the tangible risks, an exponential function might provide the best fit. An exponential function means that, rather than just multiplying once, you multiply more and more times as you get higher and higher.

In other words, from the findings here*, the relationship between tradition loss and contaminant risk does not appear to be at all linear*[77]. Tradition is fundamental to Tribes, and many, if not virtually all, Tribes may tend to avoid losing a tradition at the cost of some physical contamination risk. Thus, as we saw in the Intangible Risk Section, at low and moderate levels of site impact concerns, it appears that Tribal members will continue practicing their traditions, modifying them only as needed. But at high levels of concern, traditions become impacted substantially, and at some point, may stop completely, if only because the animal, plant, water, etc. used or hunted is no longer there. We saw also in the Short-Term Health Risk Section, that traditional activities were impacted more for the participating households that ate traditional foods more. While this report scope does not allow a statistical analysis to determine scientifically that site concerns are correlated with site pollution level, it makes practical sense that at least a moderate correlation exists. Why? Because all else equal, sites that are heavily contaminated would tend more to become Superfund sites, and thus their contamination levels and risks to be more highly publicized and better defined. Note, the phenomenon of Tribes holding onto traditions in the context of

[77] We use the words "does not appear" here because in western science, we cannot reach conclusions without detailed statistical analyses -- in this case, analysis and verification of the THSR Survey data, which is beyond the scope of the report here. However, with the basic analysis in this report, we have some strong indications the results here may be correct.

hazardous sites is not newly discovered here (and is certainly not new to Tribes), but we provide a beginning of structured documentation. In mathematical terms, a conceptual priority model would look like this:

$$\textbf{Priority (scaled)} = (\textbf{Relative Intangible Risk})^{\textbf{Relative Contaminant Exposure Risk}}$$

Scaled priority would convert the final values to a finite range (e.g. 1 to 100). Relative intangible risk would be a summation, of the individual intangible risks or concerns, or more likely a weighted function with some multiplier effects. And of course, each risk term would be weighted by Tribes.

Note, in all of the above discussion, we are formulating a priority model for a *Nation-wide* policy – i.e. a single conceptual model that can be applied to all Tribal hazardous site scenarios at the national level, containing the terms discussed in this section, and possibly others that are identified down the line. Within their Tribe, Tribes themselves are the best judges of which sites are a greater priority to address[78]. For a national policy, whether Tribes and agencies will (or should) choose to pursue more detailed development and valuation of terms and weights, is not the purpose of this report. But the above general structure, and discussion of parameter interactions and dynamics in this Section and the Report entirety, is provided as a starting point for policy discussions in how the various individual risks and concerns interact to produce a 'sense' of Tribal priority for a particular hazardous site. Note, the authors feel that it may be helpful for Tribes and agencies to employ a general "cumulative risk assessment" approach, as a framework in making use of the structure and parameter information provided here.

Finally, on the following page we provide a summary of site priority considerations.…

[78] Within their Tribe, Tribes themselves are the best judges of which sites are a greater priority to address. They may or may not rank sites and other needs explicitly with numbers, and they may or may not use the different terms and general approach discussed here. However, should Tribes desire a model to rank intangible risks within their Tribe, or perhaps even within an Inter-Tribal region where shared values and traditions exist, technically defensible and straightforward methods exist to do so within a relatively short timeframe.

What Do We Know About The Priorities Of Tribes In Addressing Hazardous Sites And Facilities?

Heavy metals, particularly lead and mercury from various sources, were cited to be of greatest concern about 50% more often than petroleum hydrocarbons, the 2nd most frequently listed contaminant.

And Contaminant Concerns Appear to Differ Regionally

In Alaska, the 3rd highest number of concerns was registered for asbestos, and in the Lower 48, it was for dioxins.

What Types of Sites Are of Concern?

We aren't certain, but the site types for which Surveys were most frequently submitted were:

Open dumps at 16% to 19% of Survey sites

Military waste sites at 12%

And Petroleum product-only sites; Sites fitting RCRA small facilities criteria; and sites where wastewater and sewage were of concern at 9% to 10% of Survey sites.

And that varied regionally:

In the Lower-48, the most Surveys were submitted for Small facilities (14%), open dumps (10% to 16%), and mines & mining sites(10%)

In Alaska, the most Surveys were submitted for Village open dumps & landfills (36%), military sites (22%), and then petroleum-only sites (10%).

What Types of Traditional Activities took place on or near Survey sites?

Hunting and fishing	70%
Plant harvesting	58%
Ceremonial/spiritual activities	47%

Traditions Matter, Size Alone Probably Doesn't.

The size of THSR Survey sites varies greatly. Half of sites are less than two acres, but about one-third of sites are over 2,800 acres.

Does Tribal jurisdiction play a role in Tribal Site Priorities?

We don't know for certain. But we do know that Tribes are concerned about lands outside their Reservations and Villages, including customary use and aboriginal lands.

35% of sites for which Tribes submitted surveys were off-Reservation.

The Lower-48 land status types for which Tribes submitted the most surveys were:

On Reservation Trust Lands at 40% of sites

Off Reservation, not Tribal Related, at 12%

And Treaty hunting and Fishing (Off-Reservation) and Fee Lands (On) tied at 4%.

26% of sites were marked as "Other" land status types, and about half of those were on- and half were off-Reservation.

Closing Issues

There are several issues in regards to addressing hazardous sites of Tribal concern that cropped up in the performance of this Project. We mention two below.

Survey Response As should be evident now, the THSR Survey provides a wealth of data for Tribes and policy makers in addressing hazardous sites. At a 20 percent response rate, the effort can be deemed a success[79]. The results can be used to identify prominent and general trends, issues, and circumstance lay out a plan to *begin* policy development. However, to use the Survey numbers for a specific plan for allocating resources to certain site types or priorities would be premature at best. First, through a combination of statistical analysis, research, and Tribal verification, it must be ascertained whether, and where, any Survey results are not representative.

And second, through a parallel solicitation effort, Tribes must be given additional opportunity to respond to the Survey, with the knowledge that the Survey results will be used to develop a national policy (even though individual Tribe's results will not play a role). For example, several Tribes expressed concern that different Tribes define a "hazardous waste site" differently, and thus Tribes who had a more conservative definition would be 'slighted' during resource allocation. As the most prominent example, at least some Tribes define sites corresponding to Subtitle D (RCRA solid wastes) and Subtitle C (RCRA hazardous wastes and materials) definitions. In fact, we made an explicit effort in our Survey solicitation to request Tribes submit any site they had concern over. But we know by ground-truth at least two Tribes responding to the THSR survey had an open dump which is of great concern to them, but they did not register it. We need to know why, and a follow-up survey verification procedure could answer that. Of course, a rational national policy will be focused more on overall resource levels and program allocations, *not* on which specific Tribes will be funded. Thus, inequitable funding would be avoided. However, Tribes must be provided additional opportunity to register *all* of their hazardous sites of concern, particularly in lower-response regions, and statistical analysis must be carried out to confirm representation. Otherwise, the overall level of funding may be underestimated and the allocation to different program aspects (e.g. addressing site type categories) not optimally parsed, if decisions are based solely on extrapolation of this Report's numbers, as stands.

Another circumstance that could result in needed resources to be underestimated in the absence of verified Survey representation is through institutional "under-counting" of sites that are of Tribal interest. For example, some fee land sites in state CERCLA programs are not flagged or treated to be within Tribal borders. It is easy to see how this circumstance can happen, particularly on Reservations where fee land is treated by the Tribe and local county as fully county land for regulatory purposes. While the problem is being addressed today, in practice rectifying it completely will take some time. In the meantime, the number of sites that are actually on Tribal Land may continue to be higher than catalogued in the federal databases. A verified and expanded Survey effort to confirm full representation could partially compensate for this.

With all of the various land status and jurisdiction types that exist Nation-wide, inside and outside Reservation borders, and with the paramount importance of Tribal sovereignty, the issue of which sites are under Tribal control *is* important and deserves to be fully addressed, and redressed. But at this point, the two primary actions to take are either to ground-truth all sites as being within or outside borders (and then painstakingly override the border mapping layer), or simply to be aware of the issue, address it as possible through Survey verification and research, and incorporate an appropriate level of uncertainty when formulating a resource allocation policy.

[79] See Appendix A.

Advantages (and disadvantages –primarily logistical) certainly exist to ground-truthing all sites, as has been done in EPA Region 10 lower-48 States[80], but for the immediate future, these advantages may lie more in a regulatory sphere, rather than policy. Addressing the issue through Survey solicitation, verification and statistical validation (which should happen anyway), and incorporating a resultant statistical uncertainty might suffice for a national policy. Because to Tribes, the priority of their sites *is* what it *is*. With THSR, Tribes are able to note which sites have their concern, and whether they are within and without their borders.

Thus, as long as Tribes have the ability to list their sites of concern, perhaps it shouldn't matter as much to the federal government where exactly the sites are. Perhaps the priority scheme developed for Tribes should be based primarily on what the Tribes prioritize. A national policy would base itself on statistically extrapolated THSR numbers, and as site projects came through the pipeline to the implementation level, land status questions could be clarified. In the end, those sites of concern to the federal government, but not to Tribes, can be addressed via existing federal program policies, primarily such as CERCLA and RCRA.

Policy Treatment Of Aboriginal, Customary Use, And Treaty-Use Lands

Coincident with the idea that Tribal priorities should have prominence in a policy addressing Tribal concerns is the issue in general of including lands where federally-recognized Tribal jurisdiction is limited or absent. Several Tribes -- "landless", with Reservations, and in Alaska -- expressed to us via written, spoken, or email their concerns over lands outside their borders. And concerns were not limited to specific sites where physical exposure pathways to Tribal members from site contamination were established or even possible.

> Do to the fact that the Tribe has lost the land around the area of what this letter was sent to us for, at this time have no information about the surrounding problem of contaminants. It would like to be followed up though do to abiriginal tearitory. Sorry we couldn't provide you with more information. *[sic]*
>
> - *THSR Survey response by Tribe*

> We have more concerns about activities/sites outside the reservation, such as … military bases. …All of these sites are within a 100-mile radius of the reservation.
>
> - *THSR Survey response by Tribe*

Because they pose a type of risk that is legislated to be of concern, non-Tribal sites that pose physical contamination risks to Tribal members, via contaminated waterways or other cross-border pollution (e.g. air, dust) can be assigned a priority via the same general priority classification scheme as those sites within Tribal borders, particularly if they are Treaty lands.[81] Then the procedure in *addressing* non-Tribal sites versus Tribal sites will generally differ according to which entity (namely state, Tribal, federal) has the primary regulatory and enforcement role, and what its associated site remediation mechanisms are like.

But what of aboriginal, ceded, customary use, lands etc. where a physical exposure risk is absent or difficult to prove, and a Tribe's federally recognized borders are miles away? Intangible site

---

[80] Region EPA Region 10 Office of Cross-Media Compliance. Ending in 2004, all reservations, with the possible exception of one pending visit, were visited over a 4-year timeframe to ground-truth, alongside Tribal representatives, all facilities and sites that come under the purview of EPA regulations. A database including GIS coordinates and site characteristics was compiled. The authors were not permitted access to the database to verify Region 10 sites, or compare field features, quality control, and usability.

[81] The reader should know that Tribal versus State versus federal jurisdiction in and over various land types is not all a static fact, and indeed is quite muddled. For a small portion of sites, assigning a site as within Tribal borders or without will bring into play where federal Indian policy stands at the time. See Zender, *Solid waste mngmt. on Indian Res.: Limitations of conventional SWM engr.*, Supra note 18, for discussion as regarding waste sites in particular.

risks still exist, and intangible concerns can and do affect Tribal well-being. Particularly for the many Tribal cultures that recognize the relative nature of space and time[82], whether a site is interior or exterior to the arbitrary boundary line drawn 150 years ago through lands they occupied for 1,000's of years before that, loses meaning in the intangible realm. In that realm at least, those lands *are* Tribal lands, regardless of whether there is desire to reclaim them in the tangible, legal realm.

This is not an obtuse consideration. Based on Project work, past research, and indeed 'common knowledge' within the Tribal sphere, the issue is likely to be brought up time and again in the process of developing a policy to address hazardous sites of Tribal concern. How it should be addressed is unclear, but based on limited feedback from Tribes during this Project, it does make sense to address it explicitly[83].

[82] The relativity of time, after all, is not only a concept prevalent in many Native American cultures, but a basic tenet of the science of physics as well. Hawkings, S. *A brief history of time*, Bantam Books, New York, 1988.

[83] Note we have left that avenue open in THSR by incorporating expressed Tribal concerns over their historical lands into their THSR data record when requested

Conclusions

> Not yet. But if site is contaminated and dumping persists traditional activities will slow or stop all together.
>
> - *A Lower-48 Tribe response to the THSR Survey regarding whether subsistence and other practices have been affected*

This was a wide ranging Project with a number of results, including the two products NAERAM and THSR. What we can say about hazardous sites on Tribal Lands is that it is an issue of concern to Tribes, that there are a large number of sites (over 15,000) that need to be considered as a potential part of the problem, that there are a number of different *types* of sites, and how Tribes define them in some instances is not how the federal government would. Additionally, we can say:

- That Tribes practice traditional activities near and on these sites, and thus, that their traditional lifestyles present additional exposure risks that must be accounted for, *and* that their traditional lifestyles are being impacted situationally, if not through physical contamination as well.
- That Tribal members who choose to continue to, or must continue to, visit or walk next to hazardous waste sites *might* be placing themselves at increased risks for experiencing a number of poor heath symptoms, as we found this to be the case for participating households in our study.

Further, this Project has resulted in the development of two very practical tools to address the general situation of hazardous sites near and on Tribal Lands:

- We provide through THSR a unique and practical database that is truly geared towards Tribe's purposes, and that has been developed with strict adherence to quality control procedures, so that this tool can be relied upon by agencies and Tribes alike to view site characteristics and the full range of risks that Tribes describe.
- We have developed for the first time, through NAERAM, a technically-defensible practical tool for Tribes to assess their quantitative risk and exposure from the full range of traditional activities they practice.

And we provide what we feel is a vivid descriptive summarization of the national situation, as best as it is now known from the Project work (see Appendix F), and a preliminary evaluation of potential parameters and basic structure to begin to plan for development of a national policy to address Tribal hazardous sites.

Thus, this Project provides the rudiments of what Tribes might need to begin to address the problem – identification of Tribal-based stressors and basic interactions, health effects, parameters, a general conceptual model, information to develop a formalized analysis plan as a first phase of cumulative risk assessment, and last, through NAERAM development, full identification of Tribal exposure profiles.

What we cannot provide is a solution, or in fact, even a technically-based identification of the problems(s), other than that the situation engenders the need for a formal "cumulative risk assessment" process. The one-year timeframe of this comprehensive Project was exceedingly short. And while we have performed limited statistical analyses and provided some experienced evaluation, we were not able to devote resources to the verification, validation, and advanced statistical analysis that would have allowed a more definitive discussion and interpretation/characterization of the results/risks than provided here.

Instead we conclude with a last word on intangible risks, and two questions, which are simply variations of repeated themes and statements by others. It is likely that most, if not virtually all, Tribes include intangible considerations in their assessment of a site's risk. Thus, a

"remediated" site that is in fact rid of significant levels of contaminant may in some circumstance be considered still by a Tribe as "unclean". The first question is then whether one party's definition of "clean" should supersede that of another-- in particular the party that is being affected, and if so-- legally, can it be relied upon to always be that way, with the issue sitting so close to the swirling wind that is Federal Indian Policy? And the case becomes more complex – with the contamination (however small), or the intangible *fact* of contamination, affecting a traditional practice. Tribes' social well-being partly depends on keeping traditions intact[84]. Thus the closing question is whether, how, and when, do the legal mandates of federal trust responsibility and protection of culture come into play when addressing hazardous site *intangible* risks that affect Tribes?

[84] Anders, G., *Social and economic consequences of Federal Indian policy*, Lester, D., *Suicide in American Indians*, and additional comments, *supra* note 36.

Future Research and Project Follow-up Efforts

Note, to address any complex situation, a general assessment of what the situation *is* must be carried out first. This Project arguably does that. But more work was identified during the process. We provide a list of recommended future efforts below.

- First, a user's guide to the Project and Project Report that targets lay Tribal members and staff should be compiled. This effort will facilitate widespread Tribal distribution and use of the Project results and products.
- While a national policy model that includes intangible risks is complex, a model that addresses intangible risks within a Tribe to compare their site priorities, or even the priority in addressing a site versus using the resources elsewhere, is not. The literature details several methodologies that could be applied to this situation by a scientist versed in both Tribal lifestyles and policies, and in risk and statistics. Such a model could be develop to be computer-based, built as a step-by-step approach that would take Tribes through the process, that would produce in the end technically-based results and method documentation that could be used by Tribes to justify their record of decision and needs to agencies, their communities, and their Councils.

Development of THSR

THSR provides a powerful tool for Tribes, agencies, and Tribal groups to track hazardous sites of concern to Tribes, in a convenient and easy way that includes access to virtually all of the publicly-available information on the Tribe and site. It is a worthwhile product that deserves resources towards advanced development.

- **THSR can be substantially improved by implementing a number of identified changes and features** to increase its ease of use, and expand capabilities and attraction, for lay users.
- **THSR is a static database. A number of dynamic programming features could be incorporated into THSR that would prevent its obsolescence**, and facilitate THSR maintenance and updating tasks in the future, thus saving resources in the long-term. Besides dynamic linking to data sources where possible, features such as dynamic updating of database descriptive statistics could be programmed that would greatly increase its attraction and use by Tribes.
- **A THSR maintenance manual should be developed,** describing fields that must be updated, how, and how often.
- **A THSR user's manual could be further developed**. A focus group(s) should be performed for interface and graphic design development.
- **THSR information could be incorporated into AIEO's Tribal Information Management System, and vice versa**. Collaboration features can be identified, and components that should remain separate can also be singled out (e.g. components relating to Tribal proprietary issues, as TASWER is a Tribal group and AIEO is a government group). A cohesive plan would be outlined that would result in reduced maintenance needs for THSR, by sharing update tasks and even administration functions with AIEO. For example, rather than host its own static list, THSR could link dynamically into CERCLIS sites through AIEO's structure. AIEO would perform the work maintaining the link to CERCLIS. In all, THSR could serve Tribes by maintaining (and adding) the features that make it useful to Tribes as a non-federal database of registered sites.

THSR Survey

A national policy is complex, but doable. This Project provides a good baseline to start from, and a sense of direction to proceed. A primary component of that process towards a sound national policy that Tribes and agencies can agree upon, is to harvest additional data through the survey process and to verify and analyze existing and forthcoming survey responses:

- **The Survey solicitation effort should continue** (see Appendix A) with particular focus in regions where data is sparse.
- **The Survey should be examined in light of responses received to ascertain whether minor changes should be effected** to increase response clarity on select questions. Some potential changes have been identified, but a formal analysis has not been carried out.
- **Protocols and transfer of survey management should be effected formally to ensure quality control is maintained.** For example, THSR is programmed in Filemaker, a database program that the lay user is not likely to own. So, outside the framework of this Project, we programmed the Survey form in MS ACCESS as well, to allow the general user and agency user to view the Surveys received in a database program they likely already own and use. However, documentation should still be developed. Additionally, a mechanism should be put into place to ensure quality control during the transition of the survey solicitation effort and database management.
- **A verification procedure should be effected** for received surveys to effect a higher level of quality control, and to be used to validate survey analysis results.
- **A detailed evaluation of the survey results should be performed** to identify data this is not representative, and to examine data in terms of fields that go unanswered by Tribes – i.e. what is the nature of that data that is unreported, and is there a pattern?
- **A detailed statistical analysis** together with the above verification procedure, should be performed to determine whether significant associations exist between a variety of Survey parameters. Knowledge of correlations between a number of specific site circumstances and specific Tribal concerns and demographics could greatly assist policy development. For example, risks to Tribes include intangibles, and these are associated with traditions, which are regional. Logistical considerations and some site characteristics may be significantly different. Thus, regional analysis for significant differences in parameters and identified associations is critical. A number of helpful associations could be analyzed for, such as whether the risk level for CERCLIS, IHS, and FUD sites is significantly associated with types and levels of Tribal concern. If they are not, a piece a national policy work is identified. The list of useful statistical analyses is long, with a caveat, that statistical analysis must be performed by statistics experts that also possess knowledge of the subject and data.
- **The Biogeographic Areas identified in this Project and contained as a feature in the THSR should be digitized** so that all statistics and queries can be performed based on BGA Tribal grouping, rather than arbitrary EPA regions. A BGA layer provides a means for policy making that *concerns Tribes, and thus Tribal cultures,* to be based on *shared Tribal culture concerns.*
- **Numbers, types, and available surrogate exposure risks of hazardous sites on Tribal Lands should be statistically analyzed with the same parameters on non-Tribal Land**, in a methodical, technically defensible way, to assess whether an environmental justice issue is present, or is simply a myth.
- **Results from the above efforts together with the Project work here (i.e. NAERAM, THSR) should be compiled in a usable technical document for Tribes and agencies** that is framed generally within EPA and CEQ developing guidelines and reviewed methods for cumulative risk assessment. This document would provide a concrete basis and step- by step- approach guide

for developing a national policy on addressing Tribal hazardous sites, and would outline advantages and disadvantages of various methods for consensus policy development, in the context of the Tribal situation.

NAERAM Suggested Modifications

The following changes will substantially improve Tribes' abilities to use NAERAM in a correct way with greater ease, with more accurate results specific to their Tribe.

- **Additional characteristics of the modeled individual and their environment may be added.** To make the model more user-friendly, additional characteristics of the modeled individual and their environment may be input. These characteristics may be used to provide default values for certain exposure factors that the user can accept or alter.

- **The model could be made to account for more advanced exposure scenarios.** Unsteady dermal absorption from the aqueous phase, dermal vapor absorption, liquid phase inhalation, and incidental ingestion of water could be taken into account in future versions of the model.

- **More activity categories and exposure pathways could be added.** After feedback is received from the Native American community, activity categories and exposure pathways can be removed, modified, clarified, or added to the model.

- **More case examples are needed.** One case example was provided to demonstrate the basic software capabilities and to illustrate the requirements of the user inputs. Several more case examples may be built for additional activities categories and exposure pathways.

- **A user manual should be developed that highlights additional case examples, and targets the novice user.** A technically-defensible focus group should be performed with this effort.

NAERAM Software Development

The following suggestions apply to the NAERAM software package. These are *programming* efforts that would be applied to a number of *model development* suggestions above.

- **Essential software development requirement** The Native American Exposure and Risk Assessment Computer Model was created on an accelerated development cycle and is still in beta-stage testing. As with all software, the first implementation of this computer model will likely have programming errors that may result in abnormal termination (crashes) or logical errors (bugs) that may result in errant risk assessment calculations. **Given that the model has not gone through a full quality assurance/quality control (QA/QC) software development cycle, it can not be distributed in its current form to end users until the software has been reviewed and further verified.**

- **Additional file manipulation capacity requirement** Currently the model can only save information for a single user. If one attempts to modify the risk assessment information, the original data will be replaced. To allow for the simulation of more than one user the input/output file system management aspects of the software must be enhanced to enjoy the richness of a typical Windows program whereby the user has the ability to save and load multiple files through the standard windows file selection interface.

- **Report generation based on model calculations**
  Currently the model does not generate a report documenting the user, chemical, and activity information in user-friendly form. If the model is to be used in a meaningful capacity, documentation files indicating exposure pathways and associated risk calculations are essential. This capability should be incorporated into future versions of the model so that the user can create and 'print-out' risk assessment input, calculations, reports, and conclusions.

- **Enhanced user interface**
  The model in its current form only provides a computer framework for calculation of risk to Native Americans from Hazardous waste sites based on the conceptual model developed and documented by Zender Environmental. Several key calculations such as exposed surface skin area and inhalation rates which are difficult to determine currently have to be calculated by hand and entered into the computer model manually. Most of these calculations can be incorporated into the model by enhancing the user interface and augmenting the numerical routines. Additionally, default values for various contact rates and exposure factors can be made to appear as inputs in the pertinent model windows; the user could accept or change these default input values. Updates to the user interface are essential to make it more user-friendly.

- **Enhance model documentation**
  While it is very straightforward, the model currently does not have a robust help system to guide the novice user through model usage. To vastly reduce the time it takes to train a new user to utilize the software, and to ensure that model inputs are meaningful, additional 'help' and assistance routines must be built into the computer model.

Future Risk Model and Model Software Development

- **Web interface** – NAERAM can be developed for web access, as well as/or a distributable software. Online use should not be developed without first completing the several suggestions above for increasing user-friendly model features and support documentation. These elements may be transferred to web-use relatively easily. Web development could proceed without some of the more technical model development features, which could be added as the application matures. Note that web use would best be facilitated with a much more basic, graphic-heavy, and smaller step interface than is currently programmed. Web use of the model is associated with a number of different considerations than model software in terms of user needs and desires. And web use must be designed according to a number of technical factors that require research and due diligence (e.g. screen resolution and size of target audience, choice of web-based programming language, programming for different web browsers, setting up security, etc.)

- **Dynamic linking to databases**
  It may be possible to link to government or other chemical databases directly from the software, which would make input of physical and toxicological characteristics of the chemical of interest much easier for the user. If we are given permission to link to government chemical databases, and if the URLs of the databases do not change, the user would simply have to type the name of the chemical of interest or use a pull-down menu to select the chemical of interest, and then would be able to conveniently upload chemical properties into the risk assessment program. There are some chemicals this approach will not work for, if, for example, they are not listed in the databases of interest or physical/toxicological data is lacking. However, the majority of the chemicals of interest could be easily accessed by the risk assessment software.

- **Risk assessment training** – Quantitative risk assessment expertise at least in smaller or resource-poor Tribes is generally limited, as it requires advanced training beyond undergraduate college. However, Tribes can train staff members possessing fairly moderate experience and

training in the environmental field, to run NAERAM. NAERAM use can be self-taught, but for most Tribal staff, the time resources needed to learn how to use NAERAM correctly for accurate Tribal-specific exposure and risk, would well exceed the cost of a NAERAM training course. The training could include basic risk assessment concepts, where to locate the best data for your Tribe, how to recognize it, and how to use in NAERAM. A week long session, or several 2-day courses would work. Materials could be developed from the user's manual, and in fact, with forewarning, the user manual could be developed to work with a course. An on-line course could also be developed with phone support. The latter would need to be pilot-tested with a small group first.

Appendix A

THSR Survey
Solicitation and Response Profile

A brief history of compilation and verification efforts is provided below. For more detailed summary of survey and site list compilation and solicitation efforts, please see the Zender 2nd and 3rd Quarterly Reports for this Project, available through TASWER.

Survey Development

The THSR survey was approved under federal Information Collection Request No: 2059.0, OMB Control No: 2050-0189. The draft survey that had been submitted with the ICR was determined to be inadequate by Zender to delineate Tribal lifestyle risks from hazardous sites. In particular, questions that would delineate traditional practices exposure and risk in a manner amenable to quality controlled database compilation and analysis were absent, and questions concerning site characteristics were incomplete or structurally unsound. On 12/11/03, approval to modify the draft survey was obtained with the caveat that the thrust and purpose of the survey remain the same and the average time that Tribes allot to the survey would be two hours or less[1].

The final THSR survey, included at the back of the Appendix was initially compiled by Zender senior scientists, with the bulk of questions having been vetted and validated through:

- Interviews with Tribal representatives prior to the Community Health Survey workshop given by Zender as part of this project[2],
- Interviews and validation with Tribal participants of the Community Health Survey workshop,
- Solicited feedback from paid questionnaires on hazardous waste site descriptions and cultural risk at the National NTEC conference in May 2003[3],
- Feedback/validation efforts with the 2001 Central Council of Tlingit and Haida Indian Tribes survey of solid and hazardous waste sites and management practices, [4] and
- Iterative revision through Tribal feedback reviewing and interviewing for a more comprehensive list of questions, with participating Tribes at the health interview workshop (See Short Term Health Main Section of this Report).

This survey draft then underwent a series of iterative revisions based on feedback from EPA CERCLA, RCRA_Info, AIEO programs, and TASWER. At its final stage, feedback was solicited from ITEC and NTEC.

Preparation of Survey Site List and Instructions Separate draft site lists, containing primarily CERCLIS sites with Tribal interest elements, and RCRA_Info sites, for each federally recognized Tribe including bands were prepared. The cover letter was reviewed by EPA and sent to NTEC and ITEC (no feedback). Substantial effort was placed into deriving a simple, basic, and short system for Tribes to respond back about their site list. This was not an easy task because it was necessary for the system to account for all of the different Tribal situations, and for the system to be

---

[1] For an average time allotment, two hours is a substantial period because many Tribes will not have sites of concern and will spend less than five minutes on reading the survey cover letter. The bulk of Tribes will have less than 2 sites. Thus, Tribes that have many sites could take several hours and even 2 to 3 days to address the survey.

[2] 2003 Region 9 Environmental Summit, Temecula, 11th Annual Region 9 Tribal EPA Conference held at the Pechanga Resort & Casino, Temecula, California on October 22-24, 2003.

[3] National Tribal Environmental Council, National Conference, Apr 28-May 3, Albuquerque, NM 2003.

[4] Surveys compiled into an ACCESS database, available at http://www.ccthita-swan.org/dbase/start.cfm . This survey contains several site description questions similar in form and content to those included in the developed survey for this project. 110 Alaska Tribes have responded thus far.

short and straightforward enough to avoid reader disinterest. As devised, the site list check system provided simple instructions for Tribes to mark up their list and forward it to Zender:

Example of site list sent to all federally recognized Tribes with the THSR Survey

This page(s) contains an electronically generated list of the hazardous sites and facilities identified as being within your Tribe's borders or of your Tribe's concern. *Those entries listed with an asterisk (*) are not waste sites.* They are facilities or businesses that either use, treat, store, or transport hazardous materials. *If your list is blank*, then *no* sites or facilities for your Tribe have been recorded in the primary federal databases that are used to track hazardous wastes and materials.

Please go through the below list and take the following steps:

1. **Cross out** any sites that are *outside* your Tribe's borders (e.g. reservation borders) **and** *are not of concern* to your Tribe. If you know the site is on another Tribe's lands, we ask that you note this.

2. **Add** any sites or facilities, active or inactive, that are missing. If they are not within your borders, they should be of concern to your Tribe for a specific reason(s). Reason(s) may include: (1) The location is next to Tribal lands, (2) The location is on lands that are of Tribal interest (e.g. Treaty hunting lands, disputed lands, outside allotments, etc.), or (3) The location and circumstances otherwise lead you to suspect or know that pollution is negatively impacting the Tribal community and/or traditional activities practiced by Tribal members. Please add the name, location, and any federal site ID number, etc.

3. **Checkmark** (√) all sites that are within, or partly within, your Tribe's federally recognized borders. These borders for non-Alaska Tribes typically will be Reservation boundaries, and for Alaska Tribes these borders typically will be the footprint of the Native Village.

4. **Send** this page(s) to us, or let us know that you have no changes. You may **mail** in the page(s) using the stamped and addressed envelope [along with your site survey(s) if you are not filling them out online], **scan** in the page(s) and **email** it to <aerbeck@zender-engr.net>, or **fax** in the page(s) to: 1 (907) 222-3614.

5. **Fill out** the site risk survey for each site. It will be of greatest benefit if you can fill out the survey for each of your sites and facilities. However, if you do not have the time for this, please consider as a minimum *filling out the survey for those sites that you have added, and for those sites and facilities that are of highest concern.* Otherwise, your concerns for these sites will remain unrecorded.

List of Hazardous Waste Sites and Hazardous Materials Facilities

ZZZ Pesticide dump	ID 1234298098345	152 No Good Road Way

Response Monitoring and Data Quality Control System To increase survey response rates, reduce data transfer input errors, and reduce resource needs, Omniform web-based software was employed to implement an online survey application venue. A brick-and-mortar file system for hard-copy surveys received was set up, and a quality control procedure for data entry was implemented. Mailed and faxed surveys were entered, and their input was fully checked by a second person before final entry into the database. An EXCEL survey follow-up spreadsheet was linked to an updated site list and survey database. This follow-up system had a number of evaluation fields that allowed us to analyze survey response rates. In this way, we were able to modify and/or focus our survey follow-up efforts by analyzing previous response rates, and determining where responses were under-represented. A summary of Survey solicitation and response results is provided further below.

Quality control protocols for phone follow-up and data entry, and detailed follow-up records are included in the THSR Survey folder located on the final documentation compact disc provided to TASWER with this Report. Protocols and interim data are also available in the 3rd Quarterly Report for this Project.

Survey Response Verification The time frame for this Project did not allow for verification of responses. Responses are self-report interviews, with no 3rd party verification. However, it is almost certain that responses are from a Tribal representative of Tribe in question. Contact emails and phone numbers were retrieved from agency lists, inter-tribal group lists, and Tribal websites. For each solicitation effort, we attempted to speak to the person in that Tribe that would best be able to respond to the survey. Generally, this was the Environmental or Natural Resource Director, where such a position existed.

Survey Distribution The pilot batch of surveys with associated site lists was posted the week of Feb 2-6, 2004, with subsequent batches over the following 3 weeks. Survey packets were addressed to Tribal Chairpersons, with a bright sticker on the packet front labeled "Attention: Environmental or Natural Resources Department". Self-addressed, stamped envelopes were included. In response to the poor response to mailing efforts, Zender compiled a list of 387 Tribal emails, and performed a mass email, including the site list for the 173 Tribes for which sites were registered in THSR. The latter effort particularly required considerable staff time, because site lists had to be cut, pasted, and attached to each email. Thirty-seven emails eventually bounced back.

Survey Solicitation Solicitation included phone follow-up for approximately 4 to 5 hours each day, beginning March 15th, through July 14th. The person employed was Alaska Native. We received feedback from several Tribes that her identity as a Tribal person contributed directly to achieving a higher response rate. In addition to phone follow-up, a project description and link to the survey, was posted at the top of the TASWER homepage. We also sponsored a drawing for prizes that ended May 28th with $850 in prizes, and an extended smaller drawing for a GPS unit. Mass emails were used as an additional solicitation tool, and each Tribe was emailed a second time to remind them about the drawing deadline. For Tribes with site lists, customized, individual emails were composed. Additionally, TASWER staff solicited survey responses while conducting work with Tribes.

Mass Email Example

Dear Tribal Environmental/Natural Resource Representative,

My name is Anna Erbeck[5], and I work with Zender Environmental. We are performing a national TASWER project to identify hazardous waste sites and risks on Indian/Native lands. As part of this effort, we have been searching federal databases for any listed hazardous waste sites or any active hazardous materials facilities that are on Indian/Native lands.

We found **0 sites and 0 facilities** for your Village.

Is that right? Do you have a hazardous waste site(s)?

We would very much like to hear from you. If you have a site or facility, then this is your opportunity to register it on a national list, and to talk about the different kinds of physical and cultural risks that are presented. We have carefully designed this project so that federal agencies are able to use the results to plan, together with Tribes, how to best respond to the sites --and to justify funding requests. So it is important that we include data from your Village. Are you wondering whether your site fits a "hazardous waste site"? If your Tribe feels it is a hazardous site - then to us, it is a hazardous waste site.

All you need to do is fill out an online survey. Just click here:

https://www.eomniform.com/servlet/FillForm/zender/TASWER_Haz

DRAWING FOR PRIZES
Fill out a survey by May 28th, 2004
Win for your Tribe funds for office supplies, computer software, books, Tribal vehicle O & M, or Native smoked salmon for a Tribal meeting!
Everyone that fills out our survey by May 20th will be entered into our drawing. If you have already filled out a survey, you are already entered.

Grand Prize: $300 gift certificate or online purchase at your choice of Office Depot, Best Buy, Napa Auto Parts, Amazon.com, or Alaska Heritage Legendary Smoked Salmon

2nd Prize: $150 gift certificate for above stores.

3rd Prizes: 10 people will win CDs from their favorite Native/Indian musician or band (must be available on-line, up to $20 value).

If you would like more information about this project, click here. Find out about TASWER, the Tribal Association of Solid Waste and Emergency Response, at www.taswer.org . You can also access the online survey from TASWER's home page. We would like you to let you know that we will email you a short reminder notice 1 week before the drawing deadline.

If you have any questions, please email, phone, or fax me at the below address. Thank you very much, and we wish you a pleasant day.

Anna Erbeck
Zender Environmental Science and Planning Services, www.zender-engr.net
308 G St. Suite 312
Anchorage, AK 99501
e-mail: (*provided)*
tel: (Project toll-free number *provided)*
fax: (*provided)*

[5] Note that a digital picture of Ms. Erbeck was inserted into the email after the first test batch emails were sent.

Response Analysis

General Analysis A summary of response statistics is provided on the next page in Table A-2. Attempts were made to contact a total of 526 Tribes, and two-way confirmed communication was established with a total of 194 Tribes. Failed contact attempts were confirmed for 234 Tribes, where phone messages could not be left (due to wrong number, no or full voice mail, etc.) and emails, where available, bounced back. A summary of comments from successfully-contacted Tribes concerning their sites is provided in Table A-2. Note: this response categorization can serve as a relative Tribal priority ranking scheme for the 311 sites associated with these Tribes. The purpose and scope of this Project does not include survey solicitation analysis. However, the THSR response profile should be very valuable for future Tribal solicitation efforts for the THSR, as well as other surveys. Thus, we mention several issues briefly below.

Table A-1 Received Tribal responses concerning their THSR sites, via submitted survey or email or phone comment.

Response Category	Sites	Tribes
New Site	87	50
Site confirmed by Tribe	50	21
May submit survey later	11	3
Important, no time for survey	19	2
Do not know/know enough	29	9
Did not do survey for site	26	8
No concern/ Not near Tribe	56	16
Other	33	9
Total	311	118

Expected Versus Achieved Return Rate Based on literature values, our return rate is very high. In terms of a comparable entity, Tribal offices are most similar to small businesses, as regards size, and diversity of roles and hierarchy. A typical Survey adjusted return rate for small businesses by professional data collection companies is 15% to 25%, for businesses where phone communication was established [6]. Next, consideration of the target audience must be accounted for. U.S. Census data indicates that American Indians respond to surveys at 75% of the rate for Caucasians, and Alaska Natives respond at 48% of the Caucasian rate[7]. Extrapolating this rate to the 15% to 25% expected return rate for small businesses, an expected adjusted return rate of 9% to 16% for Tribes emerges.

Our overall, *unadjusted* response rate of 20.5% exceeds this range. But in fact, our *adjusted* return rate, where contact was confirmed (the Tribe answered or responded to a phone call or email) *even when we did not speak with the correct contact*, was *59%,* or 4 to 7 times higher than expected. The fact that our return rate was quite high is confirmed by the experience of a previous Contractor under the same grant. Contact attempts were made for approximately 450 Tribes, and two-way communication was established for only 46 Tribes. In this case, the contractor did not ask Tribes to submit a survey, but asked them whether the CERCLIS sites listed for them were of concern. But if we apply the 15 to 25% return rate for small businesses, we have an expected unadjusted return rate of 1.5 to 2.5% -- or one-tenth the overall return rate ultimately achieved for this Project.

[6] Pearson NCS, 2004, http://www.pearsonncs.com/

[7] Response rates for the Race and Ethnic Targeted Test (RAETT): Caucasian 71.3%, American Indians 53.1% Alaska Native 34.0 % (www.census.gov)

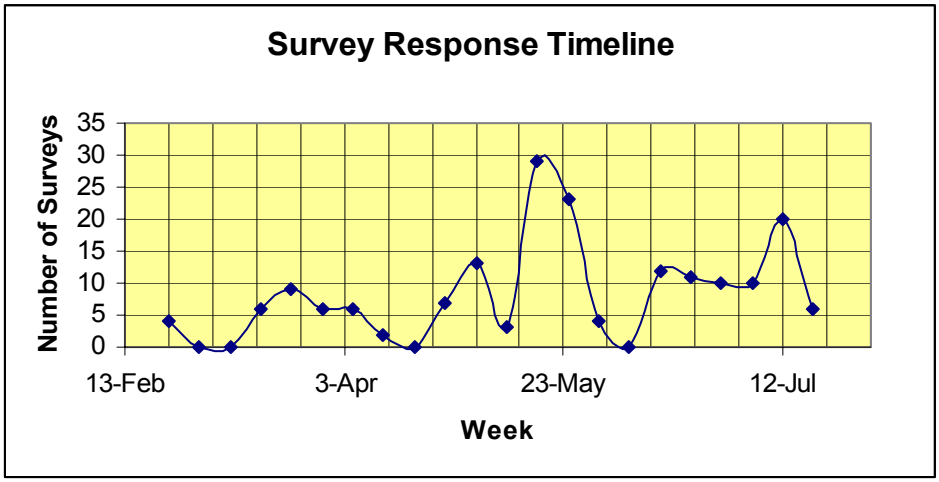
Table A-2 THSR Survey Solicitation and Response Profile July 27, 2004

	EPA Region											
Parameter	**All**	1	2	4	5	6	7	8	9	10	AK	**Explanation**
Number of Tribes	**559**	8	7	6	29	66	9	27	141	42	224	
Total number of Tribes contacted via phone	**243**	5	5	6	21	23	6	16	63	38	60	Any contact as long as a Tribe was reached, and a message left on the voice mail, or with a person.
Total number of Tribes contacted via email, fax	**361**	8	3	6	13	56	7	18	79	23	148	Including all emails that did not get bounced back. 125 Tribes were emailed and phoned.
Total number of Tribes with failed contact attempts	**234**	0	1	3	6	34	2	9	63	4	112	Either wrong contact information, or no answering machine or voice mail, and no answer on subsequent attempts.
Total number of Tribes where contact was attempted.	**526**	8	6	11	32	63	9	26	129	41	201	Including email, fax, and including failed contact attempts.
Total number of contact attempts for above (inc. phone, emails, fax)	**732**	21	13	30	41	95	12	36	168	83	233	How many attempts were made to contact these Tribes? Total number of emails, phones, faxes.
Average number of contact attempts per Tribe contacted	**1.4**	2.6	2.2	2.7	1.3	1.5	1.3	1.4	1.3	2.0	1.2	"Total number of tribes contacted" divided by "total number of contact attempts"
Number of Tribes with 2-way contact established.	**194**	6	3	4	16	27	4	13	30	31	60	How many Tribes did we converse with via phone or email (including those who did not submit a survey).
Percent of Tribes with 2-way communication who did not receive the mailed survey	**65%**	83%	67%	100%	63%	56%	75%	69%	73%	55%	67%	Responding Tribal staff said they had not seen the Survey or its unopened packet.
Number of Tribes where initial contact was achieved but the correct contact (e.g. Environmental staff) was never reached or returned call.	**80**	1	0	2	10	10	0	5	27	11	14	For these Tribes, our solicitor was generally referred from person to person to person…
Total number of Tribes turning in a survey *or* "zero site confirmation" by fax, online, email, or phone.	**115**	3	1	2	9	16	2	5	20	6	51	Excludes Tribes that responded with general feedback, but no specific sites provided. For example, concerns about aboriginal lands, insufficient staff time, etc.
Overall survey return rate	**20.6%**	37.5%	14.3%	33.3%	31.0%	24.2%	22.2%	18.5%	14.2%	14.3%	22.8%	Mean and median average =23.2%, 22.8%

Table A-2 THSR Survey Solicitation and Response Profile July 27, 2004

	EPA Region											
Parameter	All	1	2	4	5	6	7	8	9	10	AK	**Explanation**
Adjusted return rate, for Tribes where 2-way contact was achieved with correct person.	**59.3%**	50.0%	33.3%	50.0%	56.3%	59.3%	50.0%	38.5%	66.7%	19.4%	85.0%	Mean average for regions = 51.6%
Total number of surveys submitted	**181**	3	1	2	13	46	2	14	23	14	63	Some Tribes turned in multiple surveys, or responded about multiple sites.
Average number of contact times for a successful response—i.e. confirm zero sites or submit a survey	**1.9**	5	1	2.3	1.1	1.7	1.5	1.6	1	2.6	1	For Tribes who submitted surveys, or confirmed "no sites", how many contacts on average were made before they submitted at least one survey?
Responding Tribes that had non-empty site lists	**52**	2	1	1	4	12	1	4	7	4	16	
Responding Tribes with more than one site on their draft list.	**42**	1	1	1	4	10	2	3	4	3	13	
Number of above that did not turn in surveys for all of their sites.	**22**	0	1	0	2	6	2	3	3	0	5	Note: If a Tribe deleted from their list all the sites that they did not submit surveys for - this counts as turning in a survey for the purposes of this statistic.
"New sites" that Tribes added.	**96**	1	0	0	10	31	3	3	4	4	40	Sites that were not on Tribes' draft lists. One each were confirmed as CERCLIS, FUDS, DOE, 7 sites had non-federal ID numbers, others with no ID, no shared site names.
RCRA_INFO sites deleted from site lists by Tribes	**24**	0	0	4	8	0	0	0	12	0		
CERCLIS sites "deleted" from site lists by Tribes	**32**	0	0	1	0	8	0	0	0	0	23	
Number of Tribes that deleted sites	**16**	2	0	1	2	4	0	0	2	2	3	

Survey Return Timeline The Survey Return Timeline is shown in Figure A-1. Initial response to mailed surveys was disappointing, but not unexpected. Until March 17th, only four surveys were received, and three of these, from Alaska Tribes, likely submitted in response to a regional Tribal environmental conference session that TASWER hosted[8]. The return rate picked up once the phone solicitation effort began March 15, and also increased following the mass email, sent the last week of April. The rate fell during the week that Zender staff efforts were turned towards the Project Quarterly report. The Prize drawing seems to have had substantial effect on the return rate, which reached its peak just before the May 28th drawing deadline. Another peak just before project end may have been due to the imposition of a deadline for Tribes to have their sites registered and counted in the final Project report. In summary, based on this limited information, phone, email, and prize incentive tools were all useful in increasing Survey return rates.



Solicitation Media In addition to phone, email is effective and requires little staff time. It should be used as much as possible, but not abused. Online application should be used, but hard copy fax and mail must still be available.

Post-Mail as a Solicitation Media As mentioned above, only four surveys were submitted as a result of the mail-out alone. Sixty-five% of the 194 Tribes that Zender ultimately communicated with had not even received the Survey. If we assume that the Tribes where successful communication was not established would tend to be less organized, or would be associated with incorrect contact information, it is likely that *more* than 65% of remaining Tribes did not received the survey. Posting and faxing surveys was effective after the fact for those Tribes where contact was established and staff did not have access, or did not know how to use, the internet. Why? It is important to note that a significant, if not substantial, part of the problem was that the surveys were addressed to the Tribal Chairperson and not the Tribal Environmental Department. Tribal staff who had not received the Survey opined during follow-up that the Survey was likely at the Chairperson's desk or mailbox. Several also stated that they would not feel comfortable opening an envelope addressed to their Chairman. The bright, large stickers that noted "attention" to the Environmental Dept. were not considered sufficient reason for them or other Tribal staff to deliver the envelopes anywhere but the Chairperson's desk. For several Tribes, the Chairperson worked only part-time, attended many conferences, and was rarely in the office. Note- comments were recorded on the follow-up spreadsheet, available on compact disc with the Project documentation. Addresses and contact information may have been wrong for a substantial number of Surveys as well. It is impossible to confirm how many Surveys did not reach the Tribe at all. Contact information used

[8] Alaska Forum on the Environment, 2004. Anchorage, AK Feb 9 – 14.

was from EPA websites. But between Tribal staff turnover and the rapid proliferation of new area codes, about one-half of contact phone numbers were wrong, and had to be corrected by conducting internet searches for a working Tribal number. *It is recommended that mail-outs should be sent 1st Class Mail in the future so that return mail may be counted, or mail-outs should not be performed without establishing contact first.*

Survey Solicitation Planning A average of two *successful* phone calls or emails per Tribe should be allocated in planning for a survey follow-up. To achieve this number, approximately twice as many contact attempts will be needed. For the THSR Survey, assuming follow-up and quality control protocols are implemented, and contact information is of average reliability, approximately 1.5 contact attempts per hour, or less, of labor resources should be budgeted.

Seasons Count Alaska Tribal staff were substantially less available as subsistence season began, and any future phone strategy should avoid solicitation during these times, or make allowances for a greater number of contact attempts needed.

Survey Representation The timeframe and scope of this Project allows only for a cursory descriptive evaluation of survey representation, rather than a detailed analysis. A proper representation analysis would evaluate Tribal demographic factors such as location within the Regions, Tribe size and relative urban versus rural characteristics. Still, we can observe that a twenty percent sample rate provides a basis to identify general trends, issues, and circumstances present in the full population of Tribes [9]. And, as listed in Table A-1, Tribe Regional representation, which we use here for a moderate surrogate for geographic representation, is fairly uniform across the board. Indicating a somewhat normal distribution, the mean average and median average were similar, at 23.2% and 22.5% respectively, with a standard deviation of 8.5%. For Regions 9 and 10 Lower-48 Tribes, given the numbers of Tribes, a return rate at just below 15% is not ideal, but neither is it an unreasonable number for general trend assessment and issue identification. For Region 9, the lower return rate could be partially due to the circumstance that email addresses for a number of these Tribes could not be identified. Although given the small total number of Tribes in Regions 2, 4, and 7, (and thus an associated higher relative variability), higher return rates there are likely desirable from a statistical stance[10].

Looking at the adjusted return rate, at 19.4% the poorest return experienced was clearly for Region 10 Lower-48 Tribes. One factor that may have played a role is that these Tribes partook in a comprehensive site identification effort with EPA multi-media compliance staff within the last four years. However, because the timeframe for this Project did not allow for a verification phase, any effect of that survey effort can not be confirmed. On the other extreme are Alaska Tribes, where an adjusted return rate of 85% was achieved. We expect that this high rate was due to beneficial name association with Zender, which has developed a number of well-received solid and hazardous waste

[9] Standard confidence interval calculations with corrections for finite populations reveal an error rate of plus or minus 8% at the 95% level of confidence, which can be considered adequate to identify *general* trends and issues. Note, if we could assume responses were distributed evenly among all Tribes, our 20% response would be adequate to infer *conclusions* about the situations for the full population of Tribes. A random sample of 20% from any population is considered adequate to make inferences about that population, provided a very high response rate is confirmed for that 20%. In our case, we essentially sampled the full population of Tribes, and received a 20% return rate. Due to the limited scope of the Project, we were unable to confirm *why* Tribes responded – i.e. whether the 20% was random in regards to the issues of interest, or whether there was something different about the site situations for Tribes that responded. We suspect that responding Tribes had something to say about the site list we provided. In this context, because we are interested mostly in sites and their impacts anyway, our 20% response rate would be adequate to infer general characteristics of these Tribes. But there are likely additional reasons as to why some Tribes did not respond. And we cannot infer the characteristics of the site impact situations for these Tribes. A follow-up verification and statistical analysis would be required. See any number of general references, such as Zar, Jerrold in Biostatistical Analysis 3rd ed Prentice Hall, upper saddle river, NJ, 1996.

management tools for Alaska Villages, and has facilitated a number of popular Village-oriented conference sessions.

As was mentioned in the Report conclusions, survey results are representative enough to be useful for identifying trends and *planning* for policy development. However, they should not be relied upon for *developing* policy, until and if a survey verification process and a second solicitation is carried out. As concerns the latter, a possible goal would be to establish 2-way communication with 80 percent (or more) of remaining Tribes where 2-way communication was not achieved. As a priority, this effort would focus on the 33 Tribes where no contact was attempted, and the 234 Tribes where either the contact information was wrong or voice message was not possible. Additionally, the effort should include the 270 Tribes for which a message was left, and/or an email was not bounced back, but a response was not received to confirm the message was heard or read by Tribal staff.

Combined with an incentive system, and phone and email communication by an experienced solicitor, a similar adjusted return rate can be expected, which would push the overall return rate to about 65 percent. An even higher number can be expected if three additional factors are considered. First, Tribes who expressed desire to return surveys, but did not have staff time, may be given sufficient time to respond. Second, with an expanded timeframe, the survey effort can be advertised at a number of national and regional Tribal conferences. Third, the results of the Project can be used as a tool to encourage Tribes to respond. The handout provided with this Project can be emailed or sent to Tribes to demonstrate how their responses are used. A number of comments from Tribes during this Project suggested that they did not understand the use of the surveys or THSR, and/or they did not believe the results would be used for a tangible product and continuing effort. Underlining the need for Tribes to respond so that sufficient resources may be allocated to the problem in the most optimal way, and demonstrating to Tribes that their proprietary concerns are not revealed in a harmful way will likely increase the return rate significantly as well. EPA confirmation of the former would be particularly assistive.

HAZARDOUS SITES AND THEIR RISKS TO TRIBES AND TRIBAL LANDS

Please identify all active or abandoned sites and facilities on or near your Reservation (or other Tribal/Village lands) that your Tribe/Village considers to be *hazardous*. Please include only those sites that are known, or suspected, to pose *significant risks* to the Tribal community and/or its traditional practices. For example, some activities that can produce hazardous sites (but don't always) are: Manufacturing; Energy production; Mining; Military operations; Illegal disposal of hazardous wastes; and Municipal landfill or similarly-sized waste disposal operations.

If you have more than one site, please fill out a separate form for each site.

NOTE – *you may fill out this survey on-line.* We respectfully request that you use this method if possible. Your answers will be recorded without the need for us to interpret them, and *you will not need to mail back the survey.*

To fill out this survey on-line GO TO https://www.eomniform.com/servlet/FillForm/zender/TASWER_Haz

Tribe: _____

Environmental Contact: _____

Address: _____

_____

_____

Contact Phone/fax: _____

Contact E-Mail: _____

Are you completing this survey for a site that is on the list we provided you? __Yes __No

Are you submitting a survey for any other site(s)? __Yes __No

If you are not filling out a survey for all hazardous sites that you know about, please tell us why:

___ This is important to us, but not enough staff time to list all sites

___ We have been surveyed to death and don't want to do this

___ We don't know enough about the sites

___ Other/comments_____

A. Site Name: _____

B. List EPA, DOD, DOE, State Identification Number, if any: _____
If the site is listed with a federal or state agency, but you don't have the ID number, please describe which agency and program you think the site is listed with: _____

C. If the site is not on the list we provided you, or if you are correcting location information on the list, please list the site address (with zip), if there is one. If no address, describe the location and directions. It will be most helpful to list the GIS coordinates if you have them (e.g. 43.52N 120.03E) and/or the township, section, range, etc.). Please attach a map which marks the site(s), if possible.

D. *Do you have pictures of the site?* If so, please attach, with descriptive caption/comments. Send digital pictures to aerbeck@zender-engr.net. Please keep total email file size to below 1 MB.

Note: Submitting the survey information will be interpreted as **your Tribe's permission to use and share all submitted information.**

Note that the primary purpose of this survey is to assess the needs of Tribes in regards to hazardous sites so that appropriate assistance can be planned. **Thus, submitting the survey information** will be interpreted as your Tribe's permission to **use and share all submitted information**. We will use all of the information you provide here in a database that will not be treated as proprietary or secret. However, **we accept incomplete surveys** so that you can submit only the information your tribe is comfortable sharing.

1. **Please check any land status situation(s) that apply to the site. We respect decisions to not describe the status. However, if you can complete the "general status" row, it will be very helpful.**

   General status (Reservation Tribes): ___*Inside Reservation* ___*Outside Reservation*

   Details: ___Trust ___Fee ___Allotment ___Treaty hunting/fishing ___Trust land outside Reservation

   ___Allotment outside Reservation ___Disputed (non-federally recognized)

   ___Land is not Tribal related, but of concern ___Do not know

   ___Other:_____

   General Status (Native Village Tribes): ___*On Native Village lands* ___*Off Village lands*

   Details: ___Village corporation land ___City government land ___Regional Tribal corp. ___Don't know

   ___Allotment ___Private landowner ___Federal owned ___State owned

   ___Other: _____

2. **If the site is not on land that is federally recognized as Tribe-related, how far is it from a border?**

   The site is about ____ miles/feet (circle one) from the border of _____(e.g. border of Reservation)

3. **At or adjacent to the site, contaminants are present in the following media (check all that apply):**

   ___Air ____Stream, River, or Lake ___Groundwater ___Soil ___Other:_____

4. **If the site is not on Tribe-related land, how do your people or land get exposed to the contamination? Check all that you know apply:**

   ___Air ___ Stream ___ Groundwater ___Human transport of soil (e.g. tracked dirt, etc.)

   ___Eating foods hunted or gathered at/near the site ___Drinking water from water system or well

   ___Drinking water straight from spring or stream ___Other:_____

   Any Helpful Comments?_____

5. **Is your answer to question #3 based on known or suspected data? Known data are test results, or proof of contaminants being used at site in a manner that *directly* causes contamination (e.g. eyewitness of dumping of a leaky chemical drum).**

   ____Known by test results ___Known by other proof ____Suspected

6. **What is the primary contaminant(s) that you are concerned about at your site?**

6a. If you have tested for this contaminant(s), please list the highest concentration that was found, and in what media (e.g. 20 ppm in soil). Note mg/l = ppm (parts per million) and ug/l = ppb = parts per billion.

7. Check which entities you know have investigated the site?

___Our Tribe ___EPA ___DOD ____DOE ____State ___non-Tribal local govt.

___Private site owner/past owner ____Other:_____

8. Who has jurisdiction over the site? (check all that apply):

___Unknown ___Tribe ____EPA ___DOD ___DOE ___IHS ___State ___*Other:*_____

9. Please check the site type that best applies. We ask for more details in #13.

____Municipal or County or authorized Tribal Landfill

OR

____Unauthorized waste site/open dump *with mostly or all household wastes*

OR

____Unauthorized waste site/open dump *with both business and household wastes*

OR

____Unauthorized waste site/open dump *with mostly business wastes*

OR

____Small business facility or operation *that uses hazardous materials (e.g. dry cleaner, auto body shop)*

OR

____Larger *Industrial facility, factory* or operation (e.g. metal ore processing)

OR

____Site contaminated by *oil or petroleum only* (e.g. oil drilling, leaking storage tanks or drums)

OR

____*Military* site

OR

____*Mining* site, *non-radioactive* ***or*** ____*Mining*, *uranium* or other radioactive mineral

OR

____Other (describe) _____

10. Is the site a current or former Federal facility? ___ No ___ Yes

If yes, which agency _____? Agency still operates or owns it: ___ Yes ___No

11. Is the site active? ____Yes ____No

If yes:, How long has it been active? About ____ years.

If no: When did the contamination source/dumping stop? About _____ years ago.

12. About how big is the site? Please provide at least a ballpark number, such as "100 ft by 200 ft", "about ½ acre", etc. :

13. Briefly describe the site. Include why the wastes or contamination is there, as well as the types of waste you are concerned about (e.g. Zinc mining company dumps their tailing there, or farmers dumped their banned pesticides there, including DDT).

Note: Submitting the survey information will be interpreted as **your Tribe's permission to use and share all submitted information.**

14. REGION. To look at Tribal risks from hazardous sites on a national level, we need to look by region. Do any of these region names fit comfortably with what you consider your Tribe to be part of (if yes, circle):

California area Pacific Northwest or Northwest Coast Alaska area Plains Southwest area

Southeast area Northeast area

***If no*, please describe below to us a region or list a region name that you think fits better. This could be dividing the regions above differently, or naming a smaller region.**

Our Tribe is in the _____region. If not clear from the name, please describe the region or provide other comments:

15. Also, to look at Tribal risks, we need to know all of the traditional activities that might take place in a region, *even if they are not affected* by a hazardous site. What traditional activities are performed by at least some of your Tribal members? We realize some Tribes may not wish to list some activities.

___ Using hides, oils, bones, antlers, etc. for regular-use tools or clothes

___ Hunting, fishing

___ Ceremonial or art using feathers or skins or bones

___ Ceremonial or other tool making not from animals (e.g. wood or stone carvings)

___ Farming/growing

___ Smoke house

___ Ceremonial or powwow activities such as dancing, games, consumption of ceremonial/medicinal plants, teas

___ Ceremonies with smoke (from fire, sage, etc.)

___ Making pottery

___ Building/carving of canoes, sweat lodges, other structures.

___Gathering and everyday use of plants or plant materials (in food, teas, to smoke, etc.)

___Basket making, other weaving

___Bathing/sweat lodge use

___Regular use of traditional pottery (made from local clays, etc.)

___Other artisanal activities (jewelry-making, figure-carving, etc.)

Other _____

Other _____

Other _____

Other _____

Other _____

16. Okay, now we need to know what activities *are* affected by your site. Risk from the site can happen many ways. Please go through each section to see if any apply.

a. *Traditional activities on or next to the site*:

___ None ___ Fishing ___ Harvesting plants ___ Hunting

___ Sweat lodge ___ Other Ceremony ___Other:_____

___Traditional activity happens at site, but don't want to name it.

b. *Traditional outdoor activities away from the site*, but conducted *in or next to* surface water that is contaminated by the site.

___ None ___ Fishing ___ Harvesting streamside or wetland plants

___ Hunting ___ Sweat lodge ___ Other Ceremony ___Other:_____

___Traditional activity happens, but don't want to name it.

Note: Submitting the survey information will be interpreted as **your Tribe's permission to use and share all submitted information.**

c. *Traditional outdoor activities away from the site* and site-contaminated surface water, but activities are still affected by the site:

___ None

___ Hunting animals that pass though the site

___ Use of water or other materials contaminated by the site

___ Other traditional activity (please describe if possible): _____

___Traditional activity happens, but don't want to name it.

d. *Consumption* of water, foods, or medicines, or use of firewood, contaminated by the site.

___ Fish ___ Animal ___Plants ___ Untreated water ___Treated water ___Firewood

e. *Other Tribal member activities* next to, or on, the site:

___ Dumping or salvaging wastes or materials at or next to the site

___ Walking through, or next to the site to get to a traditional activity

___ Walking on or next to the site to conduct or get to an activity other than a traditional activity

f. *Location concerns.* For each row please check the concern, if any. You may include comments.

Location/activity	Concerned because location is on or next to the site.	Concerned because location receives smoke or fumes from site.	Concerned because of site-contaminated water
Location of homes:			
Location of school, Daycare, Playground:			
Location of Elders gathering/socializing:			
Location of other facilities that Tribe uses:			

17. Concerns about the site have changed subsistence activities:

___Not at all ___Somewhat ___A lot

17a. If you answered somewhat or a lot, how have subsistence activities been changed due to site concerns (check all that apply, circle strongest response):

___Where activities are performed ___How often activities are performed ___How they are performed

___ Type of foods obtained ___ Amount of foods consumed ___An activity can no longer be performed

___ Other (please name): _____

___Our Tribe doesn't want to specify

18. Concerns about the site have changed other cultural/traditional activities:

___Not at all ___Somewhat __A lot

Note: Submitting the survey information will be interpreted as **your Tribe's permission to use and share all submitted information.**

18a. Cultural/traditional activities have changed by (check all that apply, circle strongest response):

___Where activities are performed ___How often activities are performed

___Type of activities ___How activities are performed

___Less socializing due to fewer participants ___An activity can no longer be performed

___Other (please name): _____

___Our Tribe doesn't want to specify.

18b. Activities that have been affected include (check all that apply):

___Hunting, fishing ___Farming/growing ___Bathing/sweat lodge use ___ Plant harvesting

___Ceremonial/spiritual ___Traditional art/handicraft ___ Traditional tools or clothes

___Other (please name)_____

___Other (please name)_____

___Our Tribe doesn't want to specify.

Thank You For Your Time.

Please attach any additional information/data you may have about the site that you would like to share. Any additional comments or data regarding the site will be helpful, especially if the site is not federally recognized.

Once again, please note that submitting the survey information will be interpreted as your Tribe's permission to use and share all submitted information. Please call us if you have questions concerning this policy. Discussions on proprietary concerns will not be recorded or shared with other parties without your permission.

If you would like to discuss this form or the site list we sent, get clarification on the questions, or get assistance in preparing your answers, please feel free to use the contact information listed below.

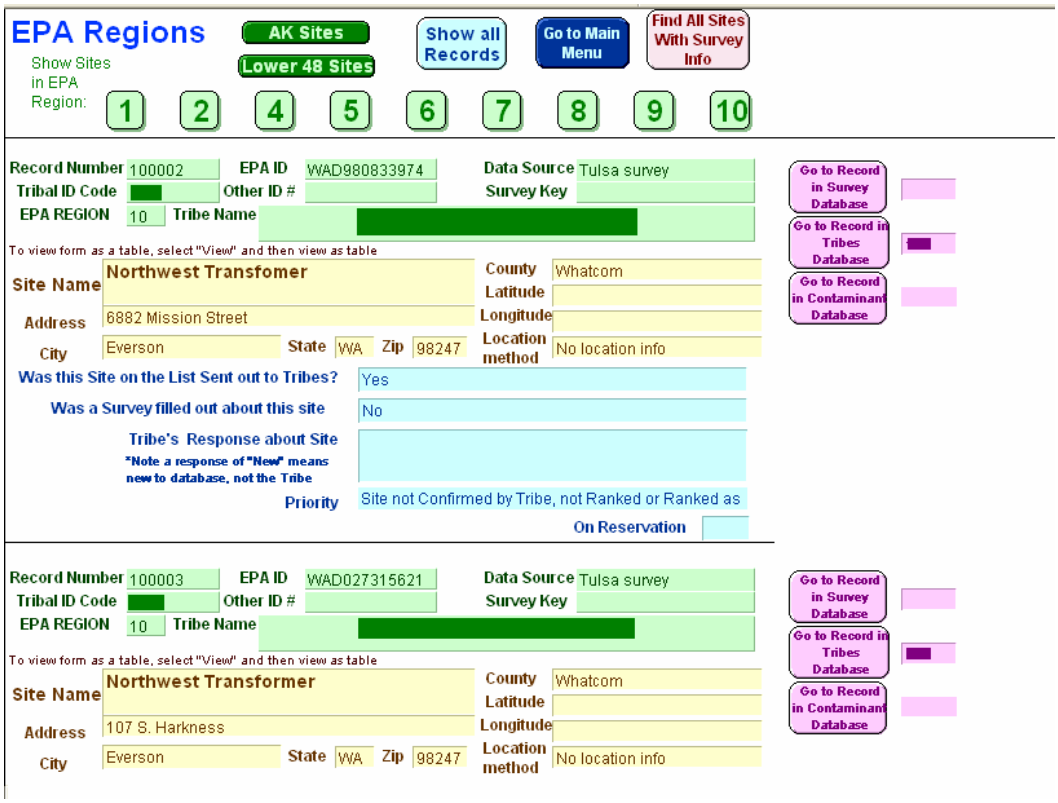
Due to the high volume of surveys being handled, we respectfully request that you email your questions if convenient. We will respond to your email within 3 business days. However, please feel free to call us (toll free) with your questions. We welcome speaking with you.

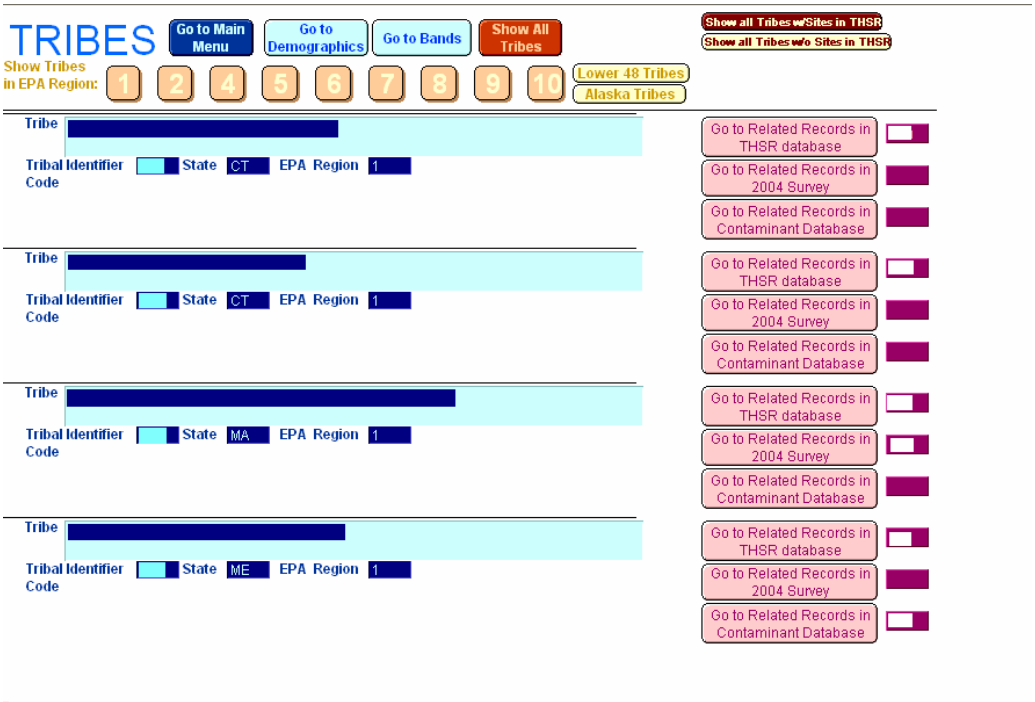
Please return surveys to: Anna Erbeck, TASWER Project Coordinator
Zender Environmental Science and Planning Services
308 G St. Suite 312
Anchorage, AK 99501

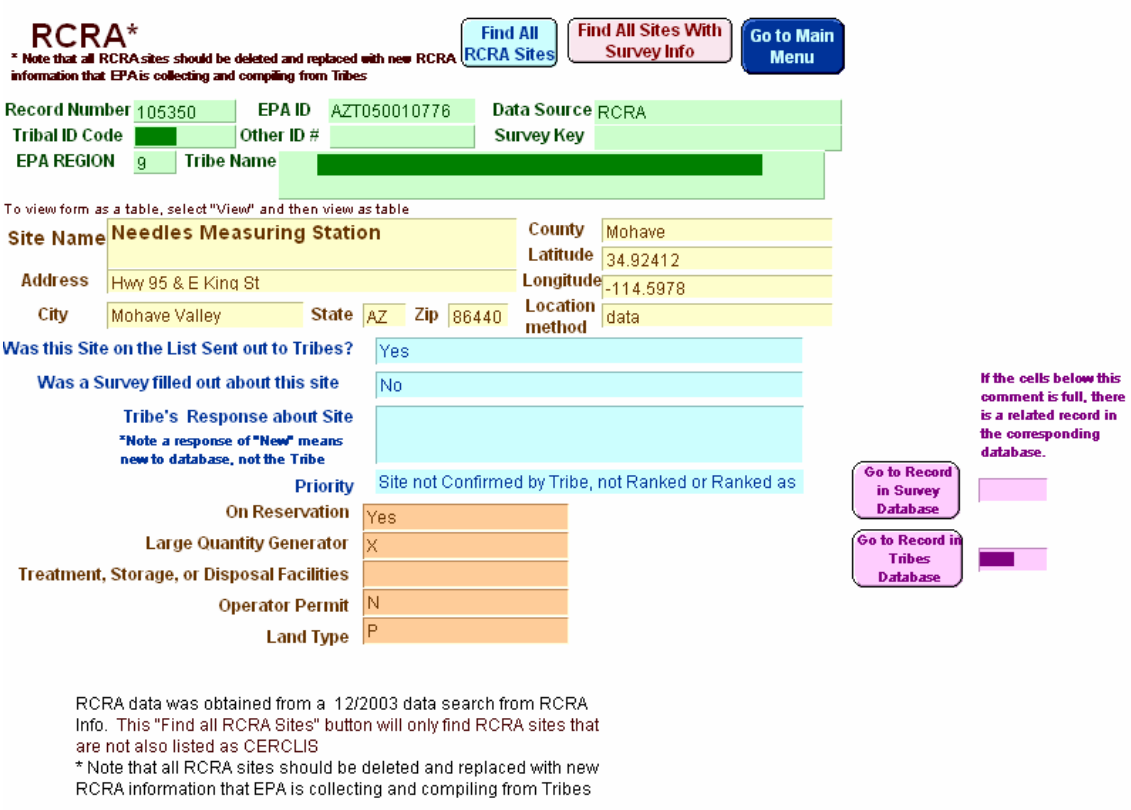
e-mail: aerbeck@zender-engr.net
tel: (866) 772-8269 Ext. 2 (toll free)
fax:(907) 222-3614

Appendix B

Screen printouts of the THSR Database and Map


EPA Regions
AK Sites
Lower 48 Sites
Show all Records
Go to Main Menu
Find All Sites With Survey Info
Show Sites in EPA Region:
1 2 4 5 6 7 8 9 10
Record Number 100002
EPA ID WAD980833974
Data Source Tulsa survey
Tribal ID Code
Other ID #
Survey Key
EPA REGION 10
Tribe Name
To view form as a table, select "View" and then view as table
Site Name Northwest Transfomer
County Whatcom
Latitude
Address 6882 Mission Street
Longitude
City Everson
State WA
Zip 98247
Location method No location info
Was this Site on the List Sent out to Tribes? Yes
Was a Survey filled out about this site No
Tribe's Response about Site
*Note a response of "New" means new to database, not the Tribe
Priority Site not Confirmed by Tribe, not Ranked or Ranked as
On Reservation
Go to Record in Survey Database
Go to Record in Tribes Database
Go to Record in Contaminant Database
Record Number 100003
EPA ID WAD027315621
Site Name Northwest Transformer
Address 107 S. Harkness
City Everson


TRIBES
Go to Main Menu
Go to Demographics
Go to Bands
Show All Tribes
Show all Tribes w/Sites in THSR
Show all Tribes w/o Sites in THSR
Show Tribes in EPA Region:
1 2 4 5 6 7 8 9 10
Lower 48 Tribes
Alaska Tribes
Tribe
Tribal Identifier Code
State CT
EPA Region 1
State MA
State ME
Go to Related Records in THSR database
Go to Related Records in 2004 Survey
Go to Related Records in Contaminant Database



RCRA*

* Note that all RCRA sites should be deleted and replaced with new RCRA information that EPA is collecting and compiling from Tribes

Find All RCRA Sites | Find All Sites With Survey Info | Go to Main Menu

Record Number	105350	EPA ID	AZT050010776	Data Source	RCRA
Tribal ID Code	[redacted]	Other ID #		Survey Key	
EPA REGION	9	Tribe Name	[redacted]		

To view form as a table, select "View" and then view as table

Site Name	Needles Measuring Station	County	Mohave
		Latitude	34.92412
Address	Hwy 95 & E King St	Longitude	-114.5978
City	Mohave Valley	State	AZ
Zip	86440	Location method	data

Was this Site on the List Sent out to Tribes?	Yes
Was a Survey filled out about this site	No
Tribe's Response about Site (*Note a response of "New" means new to database, not the Tribe)	
Priority	Site not Confirmed by Tribe, not Ranked or Ranked as
On Reservation	Yes
Large Quantity Generator	X
Treatment, Storage, or Disposal Facilities	
Operator Permit	N
Land Type	P

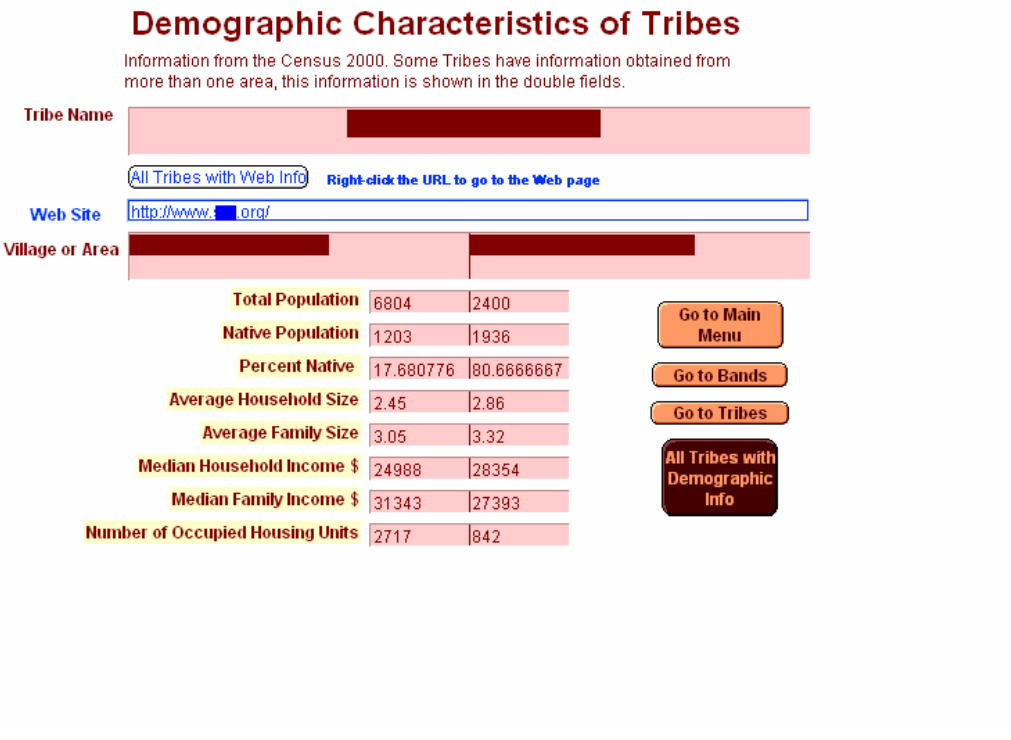
If the cells below this comment is full, there is a related record in the corresponding database.

Go to Record in Survey Database

Go to Record in Tribes Database

RCRA data was obtained from a 12/2003 data search from RCRA Info. This "Find all RCRA Sites" button will only find RCRA sites that are not also listed as CERCLIS

* Note that all RCRA sites should be deleted and replaced with new RCRA information that EPA is collecting and compiling from Tribes



Demographic Characteristics of Tribes

Information from the Census 2000. Some Tribes have information obtained from more than one area, this information is shown in the double fields.

Tribe Name: [redacted]

All Tribes with Web Info | Right-click the URL to go to the Web page

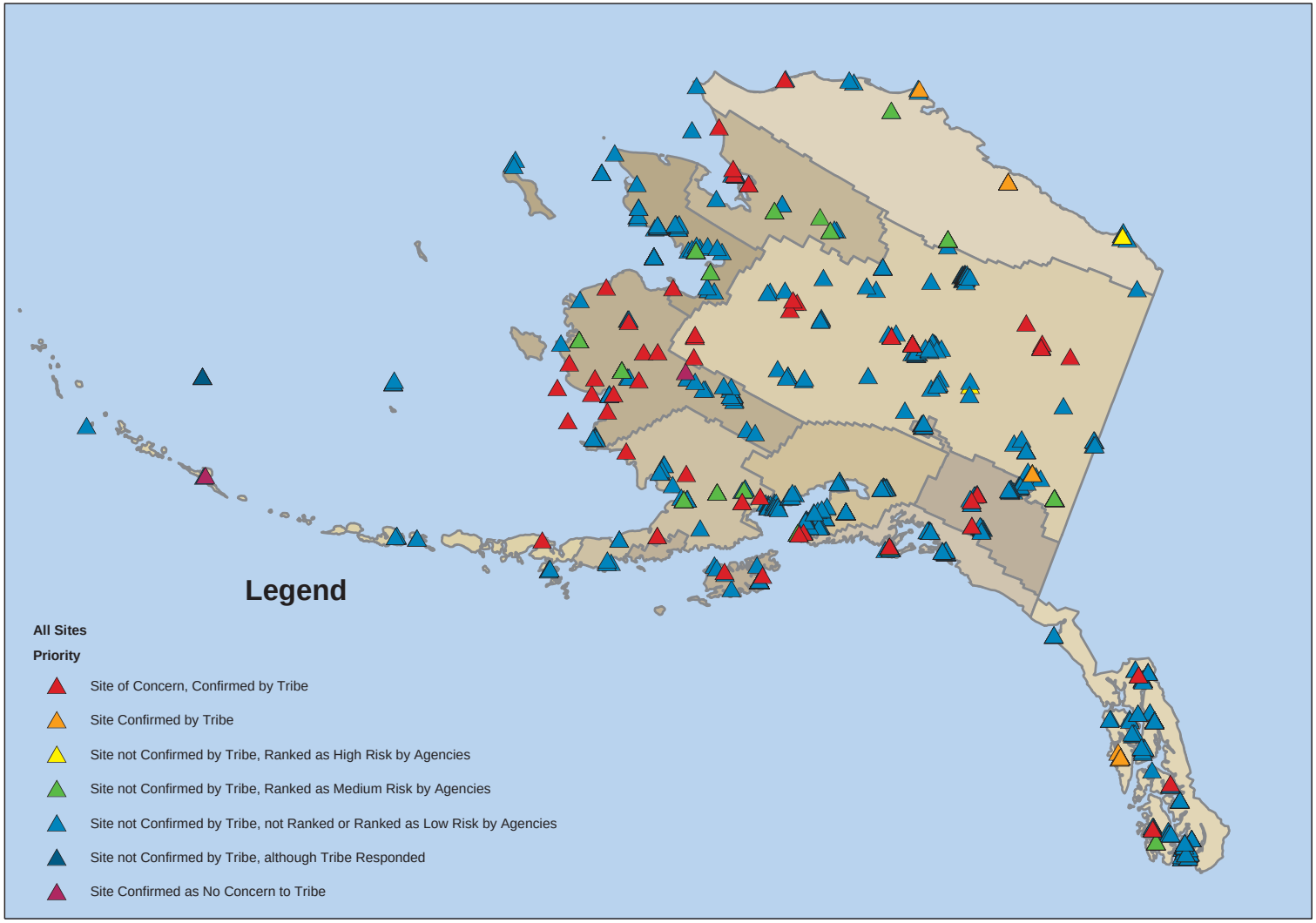
Web Site: http://www.[redacted].org/

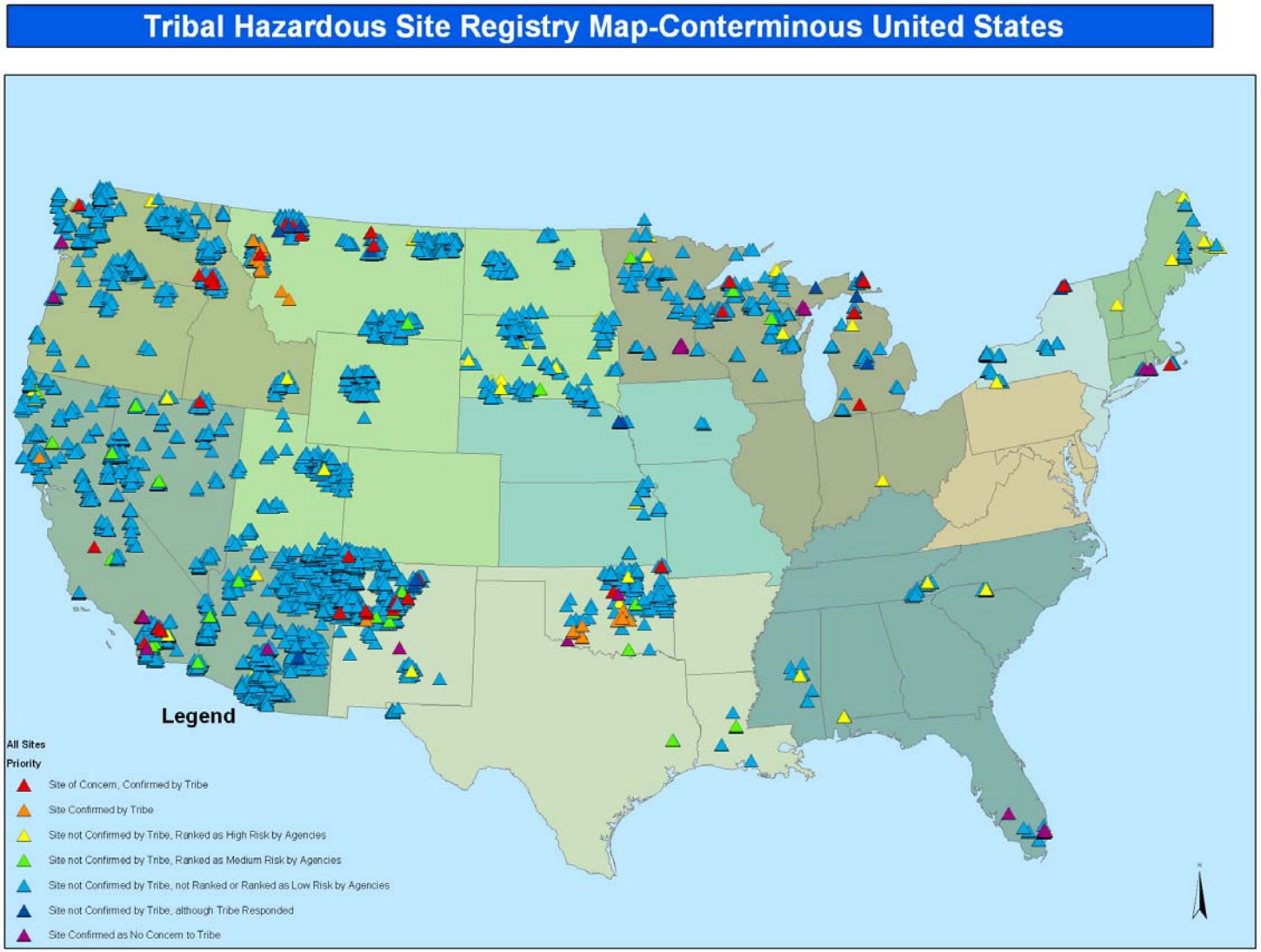
Village or Area: [redacted]

Total Population	6804	2400
Native Population	1203	1936
Percent Native	17.680776	80.6666667
Average Household Size	2.45	2.86
Average Family Size	3.05	3.32
Median Household Income $	24988	28354
Median Family Income $	31343	27393
Number of Occupied Housing Units	2717	842

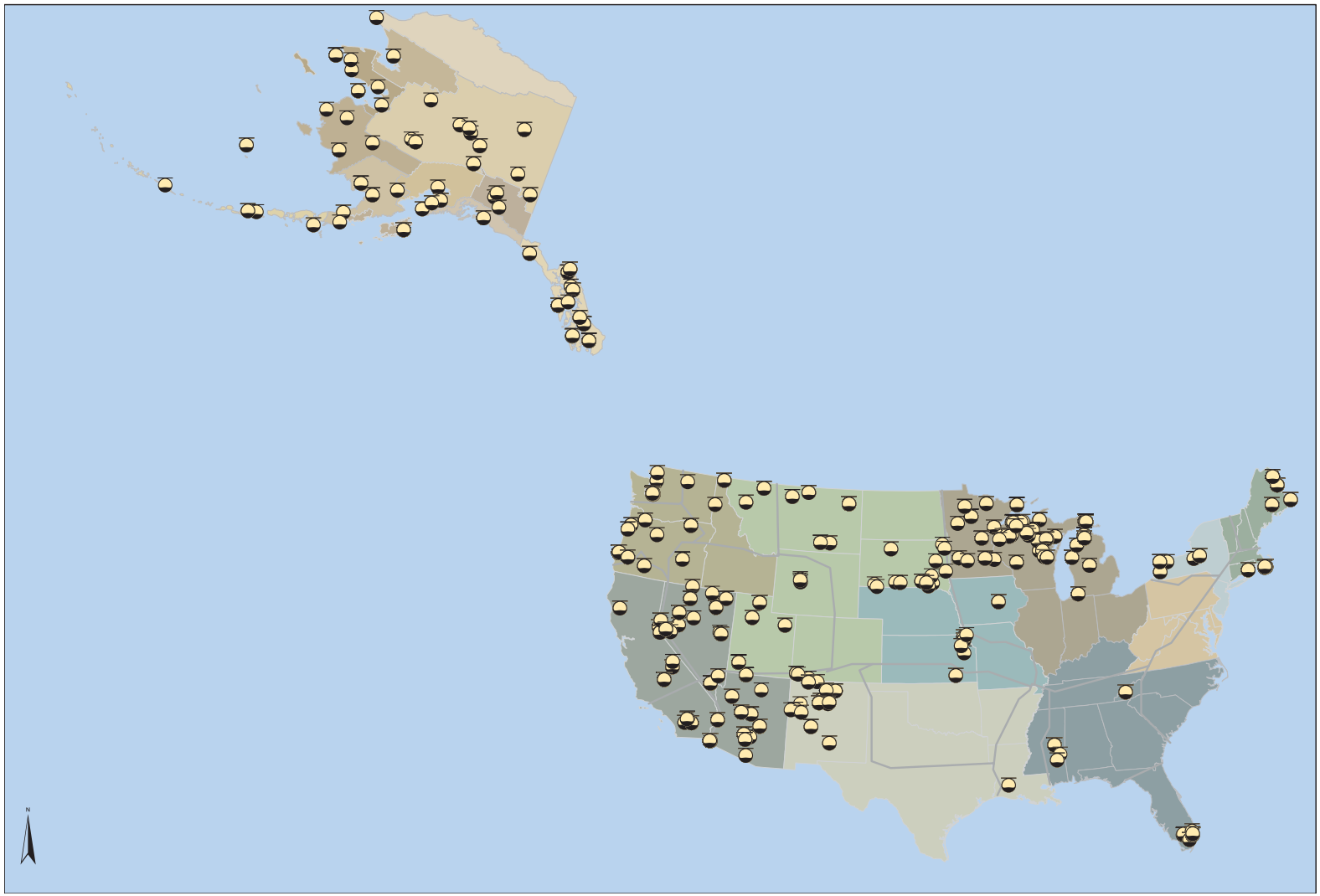
Go to Main Menu | Go to Bands | Go to Tribes | All Tribes with Demographic Info

Tribal Hazardous Site Registry Map-Alaska

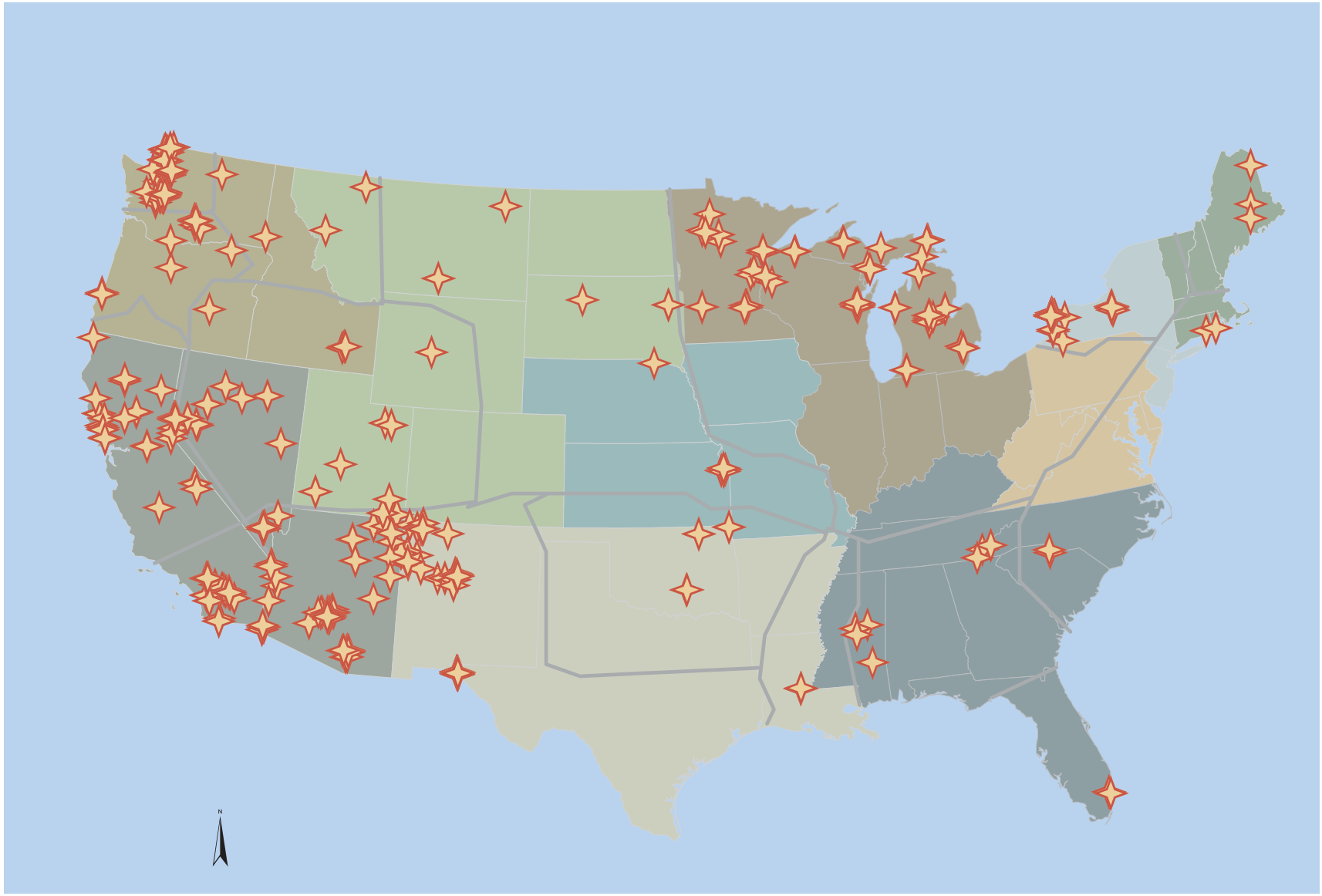



Tribal Hazardous Site Registry Map-Conterminous United States
Legend
All Sites
Priority
Site of Concern, Confirmed by Tribe
Site Confirmed by Tribe
Site not Confirmed by Tribe, Ranked as High Risk by Agencies
Site not Confirmed by Tribe, Ranked as Medium Risk by Agencies
Site not Confirmed by Tribe, not Ranked or Ranked as Low Risk by Agencies
Site not Confirmed by Tribe, although Tribe Responded
Site Confirmed as No Concern to Tribe

Tribal Hazardous Site Registry Map-LUST Sites



Tribal Hazardous Site Registry Map - RCRA



Appendix C

THSR Regional Tables

THSR Site Types by Region[0]

	EPA Region												
Type	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9, ex. NN**	**NN**	**10, ex. AK**	**AK**	**Lower 48**	**Total**
CERCLIS	12	8	6	14	166	4	105	111	235	175	143	836	**979**
RCRA	3	56	16	85	56	1	15	213	36	101	0	582	**582**
I.H.S	1	25	34	8	156	28	73	319	242	67	151	952	**1,103**
FUDS	8	10	4	20	9	3	26	149	4	74	13	307	**320**
MAS	16	21	75	260	719	5	1609	2806	701	1300	372	7512	**7,884**
LUSTs	280	28	97	907	83	59	229	1236	27	658	471	3604	**4,075**
Brownfield Projects	0	0	1	4	5	0	7	7	1	4	4	29	**33**
Other	23	17	0	1	8	0	12	11	0	115	26	187	**213**
Tribal-notified	2	0	0	10	28	2	3	3	0	5	36	53	**88**
Total number:	**345**	**165**	**233**	**1,309**	**1,230**	**102**	**2,079**	**4855**	**1246**	**2,499**	**1,216**	**14,062**	**15,278**

0 Statistical analysis of site type totals for each region produced standard deviations greater than the mean and median, indicating the number of sites in the regions is random for each site type and total number of sites.

Composition of THSR Site Types for Each EPA Region[0]

Site Type	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9, inc. NN**	**10, ex. AK**	**AK**	**Mean**	**Median**	**St. dev.**	**Lower 48**	**All regions**
CERCLIS	3.5%	4.8%	2.6%	1.1%	13.5%	3.9%	5.1%	5.7%	7.0%	11.8%	5.9%	5.0%	3.9%	5.9%	6.4%
RCRA	0.9%	33.9%	6.9%	6.5%	4.6%	1.0%	0.7%	4.1%	4.0%	0.0%	6.3%	4.1%	10.0%	4.1%	3.8%
I.H.S	0.3%	15.2%	14.6%	0.6%	12.7%	27.5%	3.5%	9.2%	2.7%	12.4%	9.9%	10.8%	8.5%	6.8%	7.2%
FUDS	2.3%	6.1%	1.7%	1.5%	0.7%	2.9%	1.3%	2.5%	3.0%	1.1%	2.3%	2.0%	1.5%	2.2%	2.1%
MAS	4.6%	12.7%	32.2%	19.9%	58.5%	4.9%	77.4%	57.5%	52.0%	30.6%	35.0%	31.4%	25.2%	53.4%	51.6%
LUSTs	81.2%	17.0%	41.6%	69.3%	6.7%	57.8%	11.0%	20.7%	26.3%	38.7%	37.0%	32.5%	25.4%	25.6%	26.7%
Brownfield Projects	0.0%	0.0%	0.4%	0.3%	0.4%	0.0%	0.3%	0.1%	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Other	6.7%	10.3%	0.0%	0.1%	0.7%	0.0%	0.6%	0.2%	4.6%	2.1%	2.52%	0.61%	3.55%	1.3%	1.4%
Tribal-notified	0.6%	0.0%	0.0%	0.8%	2.3%	2.0%	0.1%	0.0%	0.2%	3.0%	0.89%	0.39%	1.09%	0.4%	0.6%
Total number:	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**

0 Statistical analysis of site type totals for each region produced standard deviations greater than the mean and median, indicating the number of sites in the regions is random for each site type and total number of sites.

Where each THSR site type is found:

	EPA Region											
Type	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9,** exc .NN	**NN**	**10,** ex. AK	**AK**	**Total**
CERCLIS	1.2%	0.8%	0.6%	1.4%	17.0%	0.4%	10.7%	11.3%	24.0%	17.9%	14.6%	**100%**
RCRA	0.5%	9.6%	2.7%	14.6%	9.6%	0.2%	2.6%	36.6%	6.2%	17.4%	0.0%	**100%**
I.H.S	0.1%	2.3%	3.1%	0.7%	14.1%	2.5%	6.6%	28.9%	21.9%	6.1%	13.7%	**100%**
FUDS	2.5%	3.1%	1.3%	6.3%	2.8%	0.9%	8.1%	46.6%	1.3%	23.1%	4.1%	**100%**
MAS	0.2%	0.3%	1.0%	3.3%	9.1%	0.1%	20.4%	35.6%	8.9%	16.5%	4.7%	**100%**
LUSTs	6.9%	0.7%	2.4%	22.3%	2.0%	1.4%	5.6%	30.3%	0.7%	16.1%	11.6%	**100%**
Brownfields	0.0%	0.0%	3.0%	12.1%	15.2%	0.0%	21.2%	21.2%	3.0%	12.1%	12.1%	**100%**
Other	10.8%	8.0%	0.0%	0.5%	3.8%	0.0%	5.6%	5.2%	0.0%	54.0%	12.2%	**100%**
Tribal-notified	2.2%	0.0%	0.0%	11.2%	31.5%	2.2%	3.4%	3.4%	0.0%	5.6%	40.4%	**100%**

Average number of THSR Sites for each Tribe in the Region[1]

Type	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9,** Inc.NN	**10,** ex. AK	**AK**	**Lower 48**	**Total**	**Mean**	**St. Dev.**	**Median**
CERCLIS	1.5	1.1	1.0	0.5	2.5	0.4	3.9	2.5	4.2	0.6	2.2	1.6	1.8	1.4	1.3
RCRA	0.4	8.0	2.7	2.9	0.8	0.1	0.6	1.8	2.4	0.0	1.6	1.0	2.0	2.4	1.3
I.H.S	0.1	3.6	5.7	0.3	2.4	3.1	2.7	4.0	1.6	0.7	2.6	1.8	2.4	1.8	2.5
FUDS	1.0	1.4	0.7	0.7	0.1	0.3	1.0	1.1	1.8	0.1	0.8	0.5	0.8	0.5	0.8
MAS	2.0	3.0	12.5	9.0	10.9	0.6	59.6	24.9	31.0	1.7	20.1	13.2	15.5	18.6	9.9
LUSTs	35.0	4.0	16.2	31.3	1.3	6.6	8.5	9.0	15.7	2.1	9.7	6.8	12.9	11.8	8.7
Brownfields	0.0	0.0	0.2	0.1	0.1	0.0	0.3	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Other	2.9	2.4	0.0	0.0	0.1	0.0	0.4	0.1	2.7	0.1	0.5	0.4	0.9	1.3	0.1
Tribal-notified	0.3	0.0	0.0	0.3	0.4	0.2	0.1	0.0	0.1	0.2	0.1	0.1	0.2	0.1	0.1
All types	**43.1**	**23.6**	**38.8**	**45.1**	**18.6**	**11.3**	**77.0**	**43.3**	**59.5**	**5.4**	**37.7**	**25.6**	36.6	22.2	41.0

[1] Site totals divided by total number of tribes in the Region, as a surrogate for total Tribal lands acreage.

Average number of sites per Tribe with sites reported[2]

Type	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9,** Inc.NN	**10,** ex. AK	**AK**	**Lower 48**	**Total**	**Mean**	**St. Dev.**	**Median**
CERCLIS	1.5	1.3	1.0	0.5	3.3	0.6	3.9	2.6	4.3	0.7	2.7	1.9	2.0	1.4	1.4
RCRA	0.4	9.3	2.7	2.9	1.1	0.1	0.6	1.8	2.5	0.0	1.9	1.1	2.1	2.8	1.5
I.H.S	0.1	4.2	5.7	0.3	3.1	4.0	2.7	4.2	1.6	0.7	3.1	2.2	2.7	1.9	2.9
FUDS	1.0	1.7	0.7	0.7	0.2	0.4	1.0	1.1	1.8	0.1	1.0	0.6	0.9	0.6	0.8
MAS	2.0	3.5	12.5	9.0	14.1	0.7	59.6	26.0	31.7	1.8	24.2	15.4	16.1	18.6	10.7
LUSTs	32.3	4.7	8.0	31.3	1.5	7.9	6.2	9.3	11.7	2.3	10.6	7.3	11.5	11.1	7.9
Brownfields	0.0	0.0	0.2	0.1	0.1	0.0	0.3	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Other	2.9	2.8	0.0	0.0	0.2	0.0	0.4	0.1	2.8	0.1	0.6	0.4	0.9	1.3	0.1
Tribal-notified	0.3	0.0	0.0	0.3	0.5	0.3	0.1	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2
All types	**43.1**	**27.5**	**38.8**	**45.1**	**24.1**	**14.6**	**77.0**	**45.2**	**61.0**	**6.0**	**45.4**	**29.8**	38.2	21.2	41.0

[2] Total site types divided by total number of Tribes that are associated with sites in THSR.

Appendix D

Empirical Study Questionnaires

Tribal Group Questionnaire

QUESTIONS ON YOUR HAZARDOUS WASTE SITE

1. We are trying to look at different ways that people value things. If you had to, could you **circle which statement is the most important** of the two for each box below? This means– if you could do something about only one situation– please circle which one it would be.

- There are 3 elders left in a tribe. They go berry picking near a hazardous waste site.
- A lot of Tribal members go dump their garbage at an open dump. Some of the waste is household hazardous waste, like used oil, batteries, household cleaners, fertilizer. Sometimes the dump is set on fire and you can smell the smoke.

- There are 3 elders left in a tribe. They are the only ones who know how to make baskets the traditional way and they still need to teach new people more about these ways. They gather grasses near a site they think is polluted even though scientists can not find evidence of pollution there. But the elders are still worried about the contamination from the hazardous waste site and decide not to make baskets anymore. The traditional way of making these baskets is lost.
- People that live closer to a dump site get colds and coughs more often than other people.

- The same situation with the 3 elders left, not making baskets anymore—and losing the tradition.
- A sacred site is polluted with chemicals someone dumped. The Tribal members know it is polluted. You can't see any pollution and it is not harming anyone's physical health.

- There is an illegal dump site on the reservation that some non-members created to dump all their trash. There aren't any homes nearby and no one uses the area for subsistence or other activities.
- There is a dump site on the reservation that some tribal members use for all their trash. They live right near the dump.

- An open dump with some household hazardous wastes is starting up. It is near a home where many of the elders gather to pass the day with each other.
- There is an abandoned feed/farm supply store on the reservation. They left partly-full containers of some of their fertilizers and pesticides. Kids use the area and building to play hide and go seek. None of them have gotten hurt.

- A Tribe thinks their land is polluted and people are afraid to hunt or fish or gather grasses. So they are losing their traditions. The pollution there is very small and not big enough to harm people's physical health-- no matter how much they eat. But no matter how much education, people feel the contamination is too much and it will harm them. The Tribe's old ways are being lost.

- A Tribe's lands and waters are definitely polluted. If people eat too much fish, they are a little more likely to get cancer or get sick than someone who doesn't eat the fish. But people in this Tribe continue to eat the fish and practice their traditional ways anyhow.

2. **If people change the way they do traditional practices to avoid pollution, but they still do the same amount of traditional practices (e.g. eat as much subsistence foods) – is that bad or not? Check one.**

___ doesn't really matter ___matters some ___yes, it matters a lot ___it is extremely important

3. **Can you check (√) 4 or less items below for what is most important?** We realize many of these issues below are very connected and hope that it is still possible to check the 4 that sound most important to you. It will help us a lot. You are welcome to star (**) really important issues.

__ Tribal sovereignty – land jurisdiction issues about the site	__ Keeping and practicing traditions
__ Keeping land clean	__ Elders' health and well-being
__ Tribal sovereignty – people jurisdiction about the site (e.g. non-member dumping)	__ People being concerned about environment or health – even if there is nothing wrong.
___ Not having people's bodies be contaminated by pollution from the site – even if the pollution doesn't cause any physical sickness.	__ Site cleanup even if scientists found that there was nothing wrong with the site and no harmful chemicals.
__ Spiritual / mental health of tribal members – content with their life	__ Finding the site owners or responsible people and having them pay or apologize
__ Self-determination and not needing to rely on local or state agencies.	___ Listing site as a CERCLA or other -
__ Subsistence resources – keeping them pollution-free	___ Contamination of scared sites
___ Long-term physical health of members – keeping them free of pollution that might cause cancer or serious health problems even if the risk is very, very low.	__Short-term physical health of tribal members – keeping them free from symptoms like coughs, headaches, congestion, nausea

Non-Tribal Group Questionnaire

1. We are trying to look at different ways that people value things in the context of garbage, dumps, and contamination. If you had to, could you **circle which statement is the most important** of the two for each box below? This means– if you could do something about only one situation– please circle which one it would be.

- A once thriving farming town located near the foothills in the Central Valley has lost much of its population to the City. There are 3 senior citizens left in this close-knit community who have lived there all their lives, and were there when some people still used horses to plow. In the fall, they go collect blackberries near a hazardous waste site.
- Many of the town's residents dump their garbage at an unauthorized open dump in the hills. Some of the waste is household hazardous waste, like used oil, batteries, household cleaners, fertilizer. Sometimes the dump is set on fire and town residents can smell the smoke.

- The same farming community -- This town was settled in the mid-1800's. There is a traditional secret recipe for a type of apple pie that the town was famous for winning at the State Fair. The 3 senior citizens learned the recipe from their parents, who learned from their parents, about how to make it. It involves an elaborate preparation, and picking the apples just at the right time and a particular place. But they just found out that place is near the site where a pesticide retailer dumped his excess inventory. The site was completely cleaned up by EPA, and no residual contamination was found. But the seniors are still worried about contamination and decide not to make the pies anymore. The traditional way of making these pies is lost.
- Even adjusted for contributing factors, residents that live closer to the unauthorized dump site in the hills get colds and coughs more often than people who live out further away from the dump.

- The same situation with the 3 seniors not making the traditional apple pies—and the town losing the tradition.
- Someone dumped their leftover pesticides a couple of years ago in the yard of an old church (still used). Everyone knows about what happened. Assume you can't see any pollution effects and the contamination is not harming anyone's physical health (no one lives nears there).

- There is an illegal dump site within the town's boundaries that some RV tourists created to dump all their trash. There aren't any homes near there and no one uses the area for farming or other activities.

- There is a dump site in the hills that some town residents use for all their trash. Their homes are right near the dump.

- Another open dump with some household hazardous wastes is starting up. It is near a home where the town's older citizens gather to pass the day with each other.

- There is an abandoned feed/farm supply store within the City limits. They left partly-full containers of some of their fertilizers and pesticides. Kids use the area and building to play hide and go seek. None of them have gotten hurt.

- A close-knit rural North Eastern Californian community thinks their land is polluted, and people are afraid to hunt or fish or gather berries. This is a town that has traditionally lived off the land for much of their diet. Hunting and fishing has been an integral part of their societal activities, and it was for their parents and their parent's parents. So they are losing their lifestyle they grew up with. The contamination there is actually very minor, and not significant enough to harm people's physical health-- no matter how much venison, fish, or berries they consume. But no matter how much the University scientists who have researched this issue countless times tell people that there is no problem, people feel the contamination is too much and it will harm them. The town's culture is essentially being lost.

- Another close-knit rural town's land, creeks, and lake are definitely polluted. If people eat too much fish, they are a slightly more likely to get cancer or get sick than someone who doesn't eat the fish. But people in this town continue to consume the fish and hunt and fish and collect berries regardless.

2. Each region of the Country has a "unique flavor", partly due to its unique traditions and customs- – i.e. activities, behaviors, or events that have been historically practiced and have been passed down several generations. Examples could be quilt making, square dancing, Southern hospitality, 4th of July parades, Times Square New Year's celebration. If people change the way these traditions are done, but they still do them, is that bad or not? For example, changing the route of a parade to accommodate traffic. Please check one.

___ doesn't really matter ___matters some ___yes, it matters a lot ___it is extremely important

3. Please complete the following in terms of how you think ***a present-day Indian Tribe or Alaska Native Village would most likely answer*:**

Can you check (√) 4 or less items below for what is most important about hazardous waste sites? We realize many of these issues below are very connected and hope that it is still possible to check the 4 that sound most important to you. It will help us a lot. You are welcome to star (**) really important issues.

__ Tribal sovereignty – land jurisdiction issues about the site	__ Keeping and practicing traditions
__ Keeping land clean	__ Elders' health and well-being
__ Tribal sovereignty – people jurisdiction about the site (e.g. non-member dumping)	__ People being concerned about environment or health – even if there is nothing wrong.
___ Not having people's bodies be contaminated by pollution from the site – even if the pollution doesn't cause any physical sickness.	__ Site cleanup even if scientists found that there was nothing wrong with the site and no harmful chemicals.
__ Spiritual / mental health of tribal members – content with their life	__ Finding the site owners or responsible people and having them pay or apologize
__ Self-determination and not needing to rely on local or state agencies.	___ Listing site as a CERCLA or other -
__ Subsistence resources – keeping them pollution-free	___ Contamination of scared sites
___ Long-term physical health of members – keeping them free of pollution that might cause cancer or serious health problems even if the risk is very, very low.	__Short-term physical health of tribal members – keeping them free from symptoms like coughs, headaches, congestion, nausea

Appendix E

Relative Health Risk Study: Technical Discussion

Self Reported Health Effects Associated With Hazardous Sites In Tribal Communities

An increased prevalence of self-reported health symptoms among residents near waste sites has been consistently found [1-5]. Worldwide, links between exposures to hazardous waste and increases in reported symptoms such as fatigue, headaches, and respiratory complaints have been identified [1-3, 5-12]. However, these studies have only been performed with indigenous people in the United States by Zender Environmental [13, 14].

Many Native Americans have subsistence diets so there are concerns about contaminants getting into food and water supplies [15, 16]. There is also a concern that limiting consumption of traditional foods and increasing consumption of less healthy foods pose a greater health threat to Native Americans than environmental contamination [17] because cardiovascular disease and diabetes are increasing in indigenous people [18, 19].

Health effects associated with potentially hazardous waste sites in Tribal communities were examined. The study design was a retrospective cohort design with a cross-sectional component. The purpose of the study was to determine if exposure to hazardous sites was associated with an increase in self-reported symptoms of poor health.

Methods In September of 2003, an effort to recruit federally recognized Tribes to participate in a household survey commenced. Using standardized methods (see Tribal Health Interview Study Training Manual, submitted with 2nd Quarterly Report to TASWER), Tribal representatives were trained to administer door-to-door surveys in their communities. Survey efforts terminated in August 2004. Per agreement with respective Tribal Councils, the Tribes are not identified.
Surveys were customized for each participating Tribe. Each Tribe selected one primary and one secondary site of concern. Representatives evaluated standardized survey items for cultural sensitivity and provided translation when necessary.

Residents were considered eligible for the study if they had not left their community during the previous 10 days nor admitted use of controlled substances not prescribed by a physician. Residents were approached by the Tribal representative, asked to participate, had their eligibility determined, and completed the interviewer-administered questionnaire. The head of household usually completed the majority of the questionnaire, while other household members were questioned about their symptoms. Legal guardians acted as proxies for children under the age of 12. Surveys were examined for completeness at the end of each interview and rechecked every evening for missing data and participants were re-contacted as necessary to complete the forms.
Survey items included questions about general site concerns as well as information about the previous 10 days. Predictor variables were based heavily on the site of primary concern and included distance of residence from the hazardous site, odor complaints, and subsistence practices. Number of visits to the site was measured simultaneously with the outcome variables. Outcome variables included: self-reported incidence during the previous 10-day period of: skin irritation/rash, dizziness/feeling of faintness, fever greater than 99.9^{o} F, stomach upset, vomiting, diarrhea, earache, eye irritation, congestion, sore throat, cough, headache, and numbness, tingling, or weakness in limbs. Information was gathered about age, sex, race, income, level of environmental concern, including impact on subsistence practices, tobacco use and exposure, seasonal allergies, and diagnoses of diabetes or asthma.

Data Analysis Odds ratios and 95% CIs were used to quantify the relationship between hazardous site contact and other environmental exposures and the incidence of health symptoms. Odds ratios were used for the exposure variables of distance, odor complaints, burning waste, and consumption of subsistence foods. Because visits to the primary site and outcome measurements

both occurred in the same time frame, prevalence odds ratios (POR) were calculated to quantify the relationship between number of visits and symptoms experienced.

Resident distance from the primary site was categorized into those living within 1/3 mile of the site, 1/3 to 2/3 miles of the site and those living further than 2/3 miles from the site. Odor complaints about the site were categorized as none, moderately bothered, and highly bothered during the proceeding 10-day period. Number of visits to the primary site during the previous 10 days was categorized as: none, moderate (1-2 visits) and high (3 or more visits). Number of visits to the secondary site was categorized into weekly, semiweekly or less, and no visits. For both the primary and secondary site, visits were defined as being at a location within 100 yard of the respective site. Subsistence practices were defined by eating subsistence foods more than half of the time versus other levels of consumption. Separate models were constructed for each symptom and each predictor variable. Multivariable models were used to estimate the odds ratios and prevalence odds ratios while controlling for covariates. Covariates included in all the models were age (continuous), gender, race, (Native or non-Native), income less than $25,000 per year per household versus income equal to or greater than $25,000, community of residence, level of general environmental concern (none, moderate, high or moderate and high versus none), and tobacco exposure. Exposure to tobacco was defined as having smoked at least 100 cigarettes in a lifetime and currently smoking. Models used to predict dizziness/feeling of faintness and numbness and tingling or weakness in limbs also included self-reported diabetes as a covariate. Models predicting respiratory complaints (congestion, sore throat, and cough) included self-reported allergies and asthma as covariates. Models using subsistence diet as a predictor were adjusted for environmental concern affecting subsistence, rather than general environmental concern.

To adjust for the lack of independence between members of the same household and differing covariates within clusters, logistic-binomial regression for random effects with distinguishable data was used [20, 21].

Results One hundred seven households representing 502 residents comprised the study population. Demographic characteristics of the study population are depicted in Table 1. Exposure characteristics including residence distance from the site, site odor complaints, site visits, level of environmental concern, and consumption of subsistence foods are detailed in Table 2. Twenty-six households representing almost 25 percent of all households were located within 1/3 mile of a site, 75 households representing approximately 70 percent of households lived 1/3 to 2/3 miles from the site, while only six households representing only 5.6% of households lived further than 2/3 miles from the site. Eighty households representing 80 % of the people had been bothered by site odors during the proceeding 10 days. Sixty-five residents (12.9%) visited the site one or two times in past 10 days and 22 residents (4.4%) visited the site at least three times. Twenty-one households (19.6%) visited the secondary site semi weekly or less and 16 households (15.0%) visited the site weekly. Seventy-three households representing approximately 70 percent of residents had at least some level of general concern about the environment. Additionally, 78 households representing 73.7% of residents had concerns about the environment that had altered their subsistence activities. 54.2% of households consumed subsistence foods more than ½ the time, 27.1% of households approximately ½ the time, and 18.7% less than ½ the time.

Prevalence and number of people experiencing symptoms within 10 days prior to the survey are displayed in Table 3. Prevalences ranged from 5.0% for numbness, tingling, or weakness in limbs to 25.3% for congestion. All of the 13 symptoms had prevalences over five percent and six symptoms had prevalences over 10 percent. Because the occurrence of symptoms was not rare, odds ratios (OR) and prevalence odds ratios (POR) do not approximate relative risks.

Resident distance from the primary site and visits to the secondary site were not associated with the occurrence of any symptoms.

Complaints of being moderately and highly bothered by odors from the sites were evaluated and adjusted for as predictors of symptoms using one model. Being moderately bothered by odors from sites during the previous 10 days was significantly associated with skin irritation/rash (OR=3.06; 95%

CI: 1.21; 7.95) and stomach upset (OR=7.1; 95% CI: 1.6, 31.4). Complaints of being highly bothered by odors were associated with skin irritation/rash (OR=9.9; 95% CI: 1.4,67.8), fever greater than 99.9^{o} F (OR=12.0; 95% CI: 1.4,103.7), and headache (OR=4.5; 95% CI: 1.1, 18.0). Odds ratios were adjusted for age, sex, race, community of residence, environmental concern, and tobacco exposure. Results are displayed in Table 4.

Frequency of visiting the sites were evaluated and adjusted for as predictors of symptoms using one model. Visiting the site once or twice in the previous 10 day period was positively associated with an increased odds of experiencing five symptoms (Table 4): dizziness/feeling of faintness (POR=7.1, 95% CI: 1.4, 36.0), congestion (POR=2.8, 95% CI: 1.1, 7.1), sore throat (POR=8.5, 95% CI: 2.6, 28.1), cough (POR=4.9, 95% CI: 1.8, 13.5), and headache (POR=6.5, 95% CI: 2.8, 15.1). Models predicting diarrhea were of moderate significance (POR =5.1, p-value =0.052). Visiting the site three times or more in the previous 10 day period was positively associated with increased odds of experiencing five symptoms (Table 4b): dizziness/feeling of faintness (POR=11.7, 95% CI: 1.2, 113.7), stomach upset (POR=10.6, 95% CI: 2.1, 53.3), sore throat (POR=6.2, 95% CI: 1.2, 32.0), cough (POR=5.2, 95% CI: 1.2, 22.9), and headache (POR=11.4, 95% CI: 2.9, 44.3). Prevalence odds ratios were adjusted for age, sex, race, community of residence, environmental concern, and tobacco exposure. Models predicting respiratory symptoms were adjusted for self-reported incidence of asthma and seasonal allergies.

Consumption of subsistence foods was evaluated and adjusted for as predictors of symptoms in one model (Table 4). Consuming subsistence foods half of the time was found to be protective against eye irritation (OR=0.18, 95% CI: 0.09, 0.38). Consuming subsistence foods more than half of the time was found to be protective against eye irritation (OR=0.26, 95% CI: 0.15, 0.44) and congestion (OR=0.25, 95% CI: 0.07, 0.89). Models were adjusted for community of residence, level of environmental concern affecting subsistence, and tobacco use.

Discussion We found meaningful associations for 10 of the 13 symptoms investigated. Even after adjusting for several potentially confounding factors, odds ratios were often elevated, often exceeding 3.0.

Distance from the site is an objective predictor variable for symptoms of poor health but was not associated with the incidence of any symptom. We may not have been able to detect effects because the most of the residents lived quite close to the site and there may be little difference in health effects at the ½ mile level. With over 98% of residents living within 1 mile of the site, all could be susceptible to potential effects of living near these potentially hazardous sites. Because many of the residents did not have traditional employment outside the home, distance of employment site from the site was not examined and perhaps should be in future studies.

No significant differences where detected between residents who visited the secondary site and the incidence of any symptom. This could be due to the fact there residents very rarely visited these sites (Table 3).

Odor complaints are a more subjective measurement than distance and were positively associated with an increase in experiencing 4 symptoms. Odor complaints can be construed to be a more sensitive variable because they are partially a function of wind direction as well as distance. However, people exposed to disagreeable odors may associate the experience with any adverse health effects they later experience [1, 22, 23]. The results were adjusted for level of environmental concern and therefore could be indicative of real risk. Odor complaints were not highly correlated with residence distance from sites but this could be partially because the prevailing wind direction may be away from homes and towards the sites. Some people complaining of odors may have been bothered by these odors at their place of employment or some other location in the community rather than at their home. For those models predicting fever and headache, an association was found only for the more highly exposed group, indicating a threshold effect. However, in models predicting skin irritation/ rash, odds ratios were lower in the more highly exposed group. This could be due to any number of factors, including sample size, confounding, or other spurious effect. Being moderately

disturbed by odors was a predictor of stomach upset but high odor complaints was not significant. Could be due to some confounding factor not adjusted for in the analysis, simply not enough cases of stomach upset in the more highly exposed group.

Visiting the site during the previous 10 days appears to be the most robust predictor for many of the symptoms. However, it is not known if participants actually visited the site prior to experiencing symptoms. For those models predicting dizziness/feeling of faintness, cough, and headache, visiting the sites 3 or more times in a 10 day period were greater (often considerably so) than those visiting the sites 1 or 2 times, indicating a dose response effect. In models predicting symptoms of stomach upset, only the more highly exposed group had a meaningful elevation of risk, perhaps indicating a threshold effect. In the model predicting diarrhea and congestion, effects were only found in the less exposed group. These finding do not support a causative effect and raises the question about some unidentified confounder not adjusted for in the analysis. It could be that not enough cases of these symptoms occurred in those visiting more frequently to find a definitive result. However, results using site visits as a predictor of symptoms of poor health is relatively convincing. From a pragmatic point of view, people who actually visit the site are unquestionably exposed to the hazards of that site.

No evidence was found in this study to support the notion that traditional foods increased symptoms of poor health; in fact, consumption of these foods was found to be protective against diarrhea and experiencing a cough. Consuming traditional foods was examined because of fears of environmental contamination of these foods [17, 24]. Consumption of subsistence foods more than half of the time was found protective against symptoms of eye irritation and congestion. Consumption of subsistence foods was also found protective against eye irritation but no dose response effect was detected. Several households voiced concerns about the safety of their traditional foods and almost ¾ of all residents told investigators they had altered their subsistence habits based on these fears. Incidental reports were relayed about sightings of malformed fish and game, other reports indicated that some species had completely disappeared. Although this study did not explore subsistence in depth it was interesting to note that only protective effects were detected with the increased consumption of traditional foods.

This study was plagued by the same problems that are inherent with all studies of self-reported health symptom studies. It is difficult to conclude whether these symptoms are a result of toxicologic action of chemicals, a depressed immunity because of stress related to the waste sites, or an effect of reporting or recall bias [3]. By asking residents about symptoms they have experienced in the past 10 days, it is hoped that recall bias was minimized. Adjusting for level of environmental concern could reduce positive effects related to stress.

Although a substantial number of studies have been conducted, risks to health from sites are hard to quantify. However, there was more exposure information than is typical in these types of studies but again little information on if these exposures correlate with physiologic dose of toxins. Low-level environmental exposures are by their nature difficult to establish. By studying worst-case sites we increase the likelihood of finding significant effects if they exist. The most important aspect of this study is that it is the first to attempt to characterize adverse health risks to Native Americans with respect to solid waste disposal.

Literature Cited

1. NRC. Environmental Epidemiology: Public health and hazardous waste. Vol. 1. 1991, Washington, D.C.: National Academy Press. 282.
2. NRC. Environmental Epidemiology: Use of the gray literature and other data in environmental epidemiology. Vol. 2. 1997, Washington, D.C.: National Academy Press. 189.
3. Vrijheid, M. Health effects of residence near hazardous waste landfill sites: A review of epidemiologic literature. Environmental Health Perspectives, 2000. 108 (Suppl. 1): p. 101-112.

4. Rushbrook, P.E. Regional health issues related to hazardous wastes. Central European Journal of Public Health, 1994. 2 Suppl: p. 16-20.
5. Checkoway, H., N. Pearce, and D. Crawford-Brown. Research Methods in Occupational Epidemiology. 1989, New York: Oxford University Press.
6. Dunne, M.P., et al. The health effects of chemical waste in an urban community. Medical Journal of Australia, 1990. 152(11): p. 592-597.
7. Fielder, H.M.P., et al. Assessment of impact on health of residents living near the Nant-y-Gwyddon landfill site: Retrospective analysis. British Medical Journal, 2000. 320(7226): p. 19-23.
8. Kasseva, M.E. and S.E. Mbuligwe. Ramifications of solid waste disposal site relocation in urban areas of developing countries: A case study in Tanzania. Resources Conservation & Recycling, 2000. 28(1-2): p. 147-161.
9. Levine, R.S., et al. Hazardous wastes and public health: General considerations and analysis of existing data sources in Florida. Progress in Clinical and Biological Research, 1983. 140: p. 3-12.
10. Miller, A.B. Review of extant community-based epidemiologic studies on health effects of hazardous wastes. Toxicology and Industrial Health, 1996. 12(2): p. 225-233.
11. Miller, M.S. and M.A. McGeehin. Reported health outcomes among residents living adjacent to a hazardous waste site, Harris County, Texas, 1992. Toxicology & Industrial Health, 1997. 13(2/3): p. 311-19.
12. Pukkala, E. and A. Ponka. Increased incidence of cancer and asthma in houses built on a former dump area. Environmental Health Perspectives, 2001. 109(11): p. 1121-1125.
13. Zender, L.E. and S. Sebalo. A Guide to Closing Solid Waste Disposal Sites in Alaska Villages. 2001, Central Council of Tlingit and Haida Indian Tribes of Alaska.
14. Gilbreath, S. Health Effects Associated with Solid Waste Disposal in Alaska Native Villages, in Graduate Group in Epidemiology. 2004, University of California, Davis: Davis.
15. Duffy, L.K., T. Rodgers, and M. Patton. Regional health assessment relating to mercury content of fish caught in the Yukon-Kuskokwim Delta rivers system [published erratum appears in Alaska Med 1999 Jan-Mar; 41(1):15]. Alaska Medicine, 1998. 40(4): p. 75-7, 89.
16. Egeland, G.M., R.A. Ponce, and J.P. Middaugh. A public health perspective on the evaluation of subsistence food safety. International Journal of Circumpolar Health, 1998. 57 Suppl 1: p. 572-575.
17. The use of traditional foods in a healthy diet in Alaska: Risks in perspective. State of Alaska Epidemiology Bulletin, 1998(6).
18. Bell, R.A., et al. An epidemiologic review of dietary intake studies amoung American Indaians and Alaskan Natives: Implications for heart disease and cancer risk. Annals of Epidemiology, 1997. 7(4): p. 229-240.
19. Mahoney, M.C. and A.M. Michalek. Health status of American Indians/Alaska Natives: General patterns of mortality. Family Medicine, 1998. 30(3): p. 190-5.
20. Egret for Windows. 1999, Cytel Software Corporation: Cambridge.
21. Neuhaus, J. Statistical methods for longitudinal and clustered designs with binary responses. Stat Methods Med R. Statistical Methods in Medical Research, 1992. 1(3): p. 249-73.
22. Neutra, R., et al. Hypothesis to explain the higher symptom rate around hazardous waste sites. Environmental Health Perspectives, 1991. 94: p. 31-38.
23. White, M.C., et al. Health concerns for communities exposed to hydrogen sulfide: A perspective from two communities. Environmental Epidemiology & Toxicology, 1999. 1(3-4): p. 236-240.
24. Hild, C.M. Cultural concerns regarding contaminants in Alaskan local foods. International Journal of Circumpolar Health, 1998. 57 Suppl 1: p. 561-566.

Tables

Table 1. Select demographic information for study participants.

Characteristic	Individuals (n=502)	
	Number	Percent
Race		
Alaska Native	489	97.4%
Other	13	2.6%
Age		
>6	82	16.3%
6-17	175	34.9%
18-34	93	18.5%
35-59	119	23.7%
60+	33	6.6%
Sex		
Female	268	53.4%
Male	234	46.6%
Tobacco exposure		
Cigarette smoking (ages 11-17)	19	16.5%
Cigarette smoking (ages 18 & over)	127	51.8%
Cigarette smoking (ages 11 and over)	146	40.6%
Passive smoking (non-smokers only)	258	72.3%
Other Conditions		
Diabetes	9	1.8%
Asthma	18	3.6%
Allergies	41	8.2%
Yearly household income		
<$25,000	186	37.1%
$25,000+	316	62.9%
Household size		
Mean	4.7	
Median	5	

Table 2. Prevalence of symptoms recalled by study participants during the previous 10 days, Summer 2000.

Exposure Characteristics	Individuals (n=502)		Households (n=107)	
	Number	Percent	Number	Percent
Distance from Primary Site				
Less than1/3 mile	103	20.5%	26	24.3%
2/3 to 1/3 mile	360	71.7%	75	70.1%
2/3 mile or more	39	7.8%	6	5.6%
Primary Site odors				
Not bothered	105	20.9%	27	25.2%
Moderately bothered	141	28.1%	31	29.0%
Highly bothered	256	51.0%	49	45.8%
Primary Site visits in past 10 days				
No visits	415	82.7%		
1 or 2 times	65	12.9%		
More than twice	22	4.4%		
Visits to Secondary Site				
No visits	349	69.5%	70	65.4%
Semiweekly or less	103	20.5%	21	19.6%
Weekly	50	10.0%	16	15.0%
General environmental concerns				
No concerns	154	30.7%	34	31.8%
Moderately concerned	209	41.6%	44	41.1%
Highly concerned	139	27.7%	29	27.1%
Environmental concerns affecting subsistence				
No concerns	132	26.3%	29	27.1%
Moderately concerned	221	44.0%	46	43.0%
Highly concerned	149	29.7%	32	29.9%
Subsistence diet				
Less than the time	94	18.7%	20	18.7%
Half the time	128	25.5%	29	27.1%
More than half the time	280	55.8%	58	54.2%

Table 3. Exposure characteristics of the study population.

Symptom	Frequency	Percent
Skin irritation/rash	43	8.6%
Dizziness/feeling of faintness	28	5.6%
Fever > 99.9° F	64	12.7%
Stomach upset	73	14.5%
Vomiting	30	6.0%
Diarrhea	42	8.4%
Earache	39	7.8%
Eye irritation	41	8.2%
Congestion	127	25.3%
Sore throat	72	14.3%
Cough	122	24.3%
Headache	88	17.5%
Numbness, tingling, or weakness in limbs	25	5.0%

Table 4. Adjusted* odds ratios and prevalence odds ratios for exposures predicting symptoms.

Symptom	Moderately bothered by odors					Highly bothered by odors			
	Odds Ratio	95% C.I.				Odds Ratio	95% C.I.		
		Lower	Upper	p-value			Lower	Upper	p-value
Skin irritation/rash	12.50	1.74	89.87	0.012		9.87	1.44	67.83	0.020
Fever > 99.9° F	8.94	0.75	106.87	0.084		12.00	1.39	103.67	0.024
Stomach upset	7.05	1.58	31.39	0.010		1.13	0.18	7.17	0.894
Headache	2.29	0.55	9.65	0.257		4.52	1.13	18.03	0.032

* Adjusted for age, sex, race, income, community of residence, environmental concern, and tobacco exposure

Symptom	Visited site one or two times					Visited site more than twice			
	Prevalence Odds Ratio	95% C.I.				Prevalence Odds Ratio	95% C.I.		
		Lower	Upper	p-value			Lower	Upper	p-value
Dizziness/feeling of faintness**	7.06	1.38	36.03	0.019		11.70	1.20	113.68	0.034
Stomach upset	2.33	0.84	6.44	0.103		10.55	2.09	53.30	0.004
Diarrhea	5.09	0.99	26.30	0.052		3.27	0.35	30.29	0.296
Congestion**	2.76	1.08	7.06	0.033		1.59	0.35	7.18	0.547
Sore throat**	8.50	2.57	28.13	< 0.001		6.17	1.19	32.00	0.030
Cough**	4.89	1.77	13.47	0.002		5.23	1.19	22.89	0.028
Headache	6.48	2.79	15.07	< 0.001		11.43	2.94	44.34	< 0.001

* Adjusted for age, sex, race, income, community of residence, environmental concern, and tobacco exposure

** These models also adjusted for self-reported incidence of asthma and seasonal allergies

Symptom	Consuming subsistence foods half of the time					Consuming subsistence foods more than half of the time			
	Odds Ratio	95% C.I.				Odds Ratio	95% C.I.		
		Lower	Upper	p-value			Lower	Upper	p-value
Eye irritation	0.18	0.09	0.38	< 0.001		0.26	0.15	0.44	< 0.001
Congestion	0.33	0.05	2.29	0.262		0.25	0.07	0.89	0.032

* Adjusted for community of residence, level of environmental concern affecting subsistence, tobacco use

Appendix F

Summary of Results Pictorial

TASWER
TRIBAL ASSOCIATION FOR SOLID WASTE & EMERGENCY RESPONSE

Hazardous Waste Sites on Tribal Lands

A Summary of Results from the

2004 Tribal Hazardous Waste Sites Project

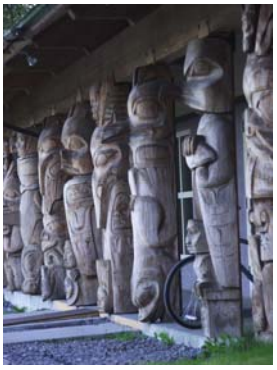
developed by

Zender Environmental Science and Planning Services

The purpose of this one-year Project was to assess the overall national situation of hazardous wastes sites on, or next to, Tribal Lands, and to describe the risks to Tribes that the sites pose. Sites were identified through federal databases, agency websites, and 115 Tribes responded to a survey, that included questions about risks to Tribal lifestyles. We compiled this information into the **T**ribal **H**azardous **S**ites **R**egistry (THSR), a new database for Tribes. Descriptive statistics are provided on the following pages….

How many sites are there?

- ✓ Over 15,000 hazardous sites and facilities that present potential risks to Tribal lifestyles were identified[1].
- ✓ 979 of these sites are Superfund sites
- ✓ 582 are hazardous waste facilities
- ✓ 1,104 are open dumps
- ✓ 7,884 are mines
- ✓ 4,075 are Leaky Underground Storage Tanks
- ✓ 320 are Formerly Used Defense sites
- ✓ At least 33 are Brownfields - 88 are newly identified sites or site groups from this project



Do they affect Tribal lifestyles?

- ✓ *Yes*, 57% of responding Tribes have changed their subsistence activities due to concerns about a hazardous site[2].
- ✓ *And* 52% of responding Tribes have changed other cultural/traditional activities, such as performing ceremonies, making baskets and other art/tools, and making traditional medicine, because of their concerns about a site.

How is subsistence affected?

- ✓ 43% of Tribes changed *where* they hunt, fish, and gather foods
- ✓ 27% changed *how often* they performed these activities
- ✓ 34% changed *how much* traditional food they ate
- ✓ 39% changed *what types* of traditional food they ate
- ✓ 30% of Tribes have had a subsistence activity *stop altogether.*

CILC Collection, UC Berkeley
www.mip.berkeley.edu/

How are other traditional activities affected?

40% of Tribes changed *where* their traditional lifestyle activities take place

28% of Tribes changed *how often* they performed their traditions

27% changed *the way* their traditional activities are done

26% of responding Tribes have watched at least one traditional activity *stop altogether.*

THSR Site Characteristics

Is the number of sites different for each EPA region?

Yes, each region had very different site numbers:

Region:	1	2	4	5	6	7	8	9, Ex. NN*	NN*	10, ex. AK	AK
Sites:	345	165	233	1,309	1,230	102	2,079	4855	1246	2,499	1,216

*NN=Navajo Nation

Do different Regions deal with different site types?

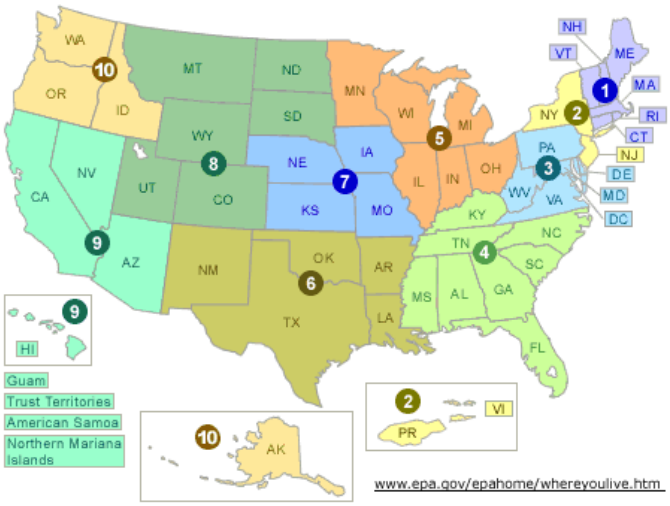
Yes, **Region 1** had only one IHS site, and 80% of their sites were LUST sites,

but only 17 % of **Region 2**'s sites are LUSTs. At 34%, Region 2 had the highest proportion of their sites as RCRA facilities, but at 5%, not very many of their sites were Superfund sites.

At less than 3%, just 6 sites, an even smaller portion of **Region 4**'s sites were Superfund. Like Region 1, the most common site type there were LUSTs, comprising 42% of their sites. But at 32%, or 75 sites, Region 4 also had a sizeable portion of Mine (MAS) sites.

Just 1.1% of **Region 5** sites were CERCLIS types, the lowest portion of CERCLIS sites of all the Regions. But at 69%, Region 5 had the 2nd highest portion of LUST site.

Although they comprised only 14% of **Region 6**'s sites, at 166, Region 6 had the second highest number of Superfund sites. But, at 59 %, the most common site type was a mine.



Like Regions 1, 4, 5, and Alaska, the most common site type in **Region 7** was a LUST. But, at 28% of their sites, Region 7 also had the highest proportion of IHS sites

With a full 77% of their sites being mines, **Region 8** had the highest proportion of that type, and at less than 1%, the lowest proportion of RCRA facilities except Alaska.

Likewise, at 1,300 in number, the bulk of **Region 10** sites are mines, *excluding Alaska.* And at 175, Region 10, without Alaska, has the second highest number of CERCLIS sites.

Region 9, had the highest number of RCRA sites by far, as well as the highest number of IHS sites, at 319. But with or without Navajo Nation, the biggest share of sites in **Region 9** are mines, at about 57% in either case.

Alaska was the only region with no RCRA sites. But at 143 and 151 respectively, it has a relatively high number of Superfund and IHS sites.

In at least 91% of Tribes, some number of Tribal members practice traditional activities[3]:

While activities differed, Tribes in the Lower-48, as a group, listed nearly the same numbers and proportions of traditional activities as Alaska Native Villages.[4] Of course, these practices differed among regions.

The top three activities in Alaska are:

- ✓ 94% of Tribes listed hunting and fishing
- ✓ 66% of Tribes listed gathering and everyday use of plants
- ✓ 68% of Tribes listed smoke houses

NPS, Cultural Resources www.nps.gov

In the Lower-48, the most prevalent activities are:

- ✓ 68% of Tribes listed hunting and fishing
- ✓ 63% listed powwow activities
- ✓ With a tie at 56 % for:
- ✓ Ceremonies with smoke (fire, sage, etc), Gathering/using of plants, and Farming and growing

But about 58% of hazardous sites impact subsistence practices substantially, with concerns from 80% of those sites changing where Tribes hunt and fish. Similar, but slightly lower numbers, are true for other traditional activities.

These are high numbers. But what is striking is that traditional activities continue even at sites that are significantly contaminated:

CILC Collection, UC Berkeley
www.mip.berkeley.edu/

- ✓ 71 % of Tribes reported that traditional activities take place on, or next to, the site of concern
- ✓ 58% of Tribes reported members consume fish, game, plants contaminated by a site
- ✓ 33% of Tribes reported that at least some Tribal members continue to drink *untreated* water from streams with site drainage, (i.e. traditional drinking of water
- ✓ Traditional activities were conducted in, or next to, water contaminated by 68% of reported sites.

Steam bath

Why? Because Tribes value their traditions and traditional lifestyles:

In a related study, compared to non-Tribal persons, Tribal members were substantially less likely to trade off their traditions in exchange for tangible physical benefits such as contaminant-free foods and environment, and short- and long-term physical health[5].

And traditional activities can be affected in ways that don't depend on physical contamination:

- ✓ Even when traditional activities took place away from the site and site-contaminated water, 58% of Tribes *still felt these activities were impacted by the sites.*
- ✓ Even if a tradition continues to be performed at the same level *how* it is performed matters greatly. In one study, 76% of Tribal members thought it very important, compared to only 20% for non-Tribal people.[6]
- ✓ For about one-third of sites, Tribes reported traditional activities being impacted-- not by decreasing in frequency or changing location, but by how the activities were performed and the sociability they provided.

What Do We Know About The Priorities Of Tribes In Addressing Hazardous Sites And Facilities?

Heavy metals, particularly lead and mercury from various sources, were cited to be of greatest concern about 50% more often than petroleum hydrocarbons, the 2nd most frequently listed contaminant.

And Contaminant Concerns Appear to Differ Regionally

In Alaska, the 3rd highest number of concerns was registered for asbestos, and in the Lower 48, it was for dioxins.

What Types of Sites Are of Concern?

We aren't certain, but the site types for which Surveys were most frequently submitted were:

- ✓ Open dumps at 16% to 19% of Survey sites
- ✓ Military waste sites at 12%
- ✓ And Petroleum product-only sites; Sites fitting RCRA small facilities criteria; and sites where wastewater and sewage were of concern at 9% to10% of Survey sites.

And that varied regionally:

- ✓ In the Lower-48, the most Surveys were submitted for small facilities (14%), open dumps (10% to 16%), and mines & mining sites(10%).
- ✓ In Alaska, the most Surveys were submitted for Village open dumps & landfills (36%), military sites (22%), and then petroleum-only sites (10%).

What Types of Traditional Activities took place on or near Survey sites?

The top three are:

Hunting and fishing	70%
Plant harvesting	58%
Ceremonial/spiritual activities	47%

Are any short-term health risks associated with the sites?

In a scientific study, Tribal members experienced dizziness, stomach upset, diarrhea, sore throat, cough, and headache an average of between *5 to 10 times more* if they had been at or next to a hazardous site in the past 10 days[8].

In terms of Tribal Priorities, Traditions Matter, Size Alone Probably Doesn't.

The size of sites that Tribes reported as being of concern varies greatly. Half of sites are less than two acres, but about one-third of sites are over 2,800 acres.

Does Tribal jurisdiction play a role in Tribal Site Priorities?

We don't know for certain. But we do know that Tribes are concerned about lands outside their Reservations and Villages, including customary use and aboriginal lands. For Lower-48 Tribes:

- ✓ 35% of Survey sites were off-Reservation.
- ✓ At 40%, the most common land status for Survey sites was on-Reservation trust land
- ✓ 12% of Survey sites were off-Reservation, and reported as "not Tribal Related"
- ✓ Treaty hunting and fishing (Off-Reservation) and Fee Lands (On-Reservation) tied at 4% of sites.
- ✓ 26% of sites were marked as "Other" land status types, and about half of those were on- and half were off-Reservation.

Endnotes:

1 Site numbers and types are derived from compilation of a number of federal databases, website lists, and Tribal survey responses.

2 Responding Tribes refers to Tribes that responded with concern over a site(s) to the "THSR survey" developed and distributed for this project. See Final Report Appendix A for response rates and representation discussion.

3 Including three AK Tribes who were known to practice traditional activities, but did not answer questions. The number is conservative because for Tribes who did not mark traditional activities, it was not possible to confirm that traditional activities were indeed absent.

4 The proportion and number of Tribal members practicing the activities was not examined, but is expected to differ considerably among Regions and individual Tribes.

5 See Intangible Risk Section description of unpublished Zender Environmental study, or www.zender-engr.net .

6 Fishers exact test P value = 0.026. A group of 17 Tribal environmental representatives from 5 EPA regions, 25 to 65, and a group of 21 Caucasian persons living in 4 EPA regions, took a set of parallel questions intended to elicit familiarity with subject matter and values discussed. For example, "elder" was replaced by "senior citizen".

7 Within one standard deviation of mean, approximately 68% of Tribes. See Report Appendix A for details.

8 See Final Report Appendix E for details. The technique employed is the that developed and discussed in. Gilbreath, S. Health Effects Associated with Solid Waste Disposal in Alaska Native Villages, in Graduate Group in Epidemiology. 2004, University of California, Davis: Davis.