Appendix F

Risk Assessment / Impact Predictions Data for Initial Assessment Performed with the System Assessment Capability (Revision 0)

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1.0 Introduction

The objective of this appendix is to present the data necessary to evaluate ecological and human health risk as well as economic and cultural impacts for the initial assessment performed using the System Assessment Capability (SAC), Rev. 0. The metrics, or endpoints, for evaluation of risk and impacts were defined and refined in previous documentation for the SAC: Preliminary System Assessment Capability Concepts for Architecture, Platform and Data Management (BHI 1999), and System Assessment Capability (Revision 0) Assessment Description, Requirements, Software Design and Test Plan (Kincaid et al. 2000). These documents can be found at can be found at http://www.bhi-erc.com/vadose/sac.htm#info.

2.0 Background

Four risk/impact modules will be used in the initial assessment. These include:

- Ecological Chemical Exposure Model, ECEM;
- Human health risk model, HUMAN;
- Tri-City Economic Risk Model, TCERM; and
- Cultural impacts model, CULTURE

Prior versions of these modules, ECEM and HUMAN, have been used in previous Hanford Site assessments, notably, the Columbia River Comprehensive Impact Assessment (CRCIA) (DOE 1998). In the CRCIA, the ecological risk assessment was performed using a spreadsheet-based model. After the CRCIA assessment was completed, the model was transcribed into FORTRAN to accelerate the computation time.

The HUMAN code has been updated as well, the most significant of which was adding the capability of estimating collective pollution dose via the drinking water pathway. The process for calculating population dose is described in further detail in Appendix D of the Hanford Site Environmental Report (Poston et al. 2000).

The data packages included in this appendix were developed to parameterize the models. Each data package contains all the parameters necessary to run the model. Parameters for ECEM and HUMAN were reviewed and updated if more recent information was available. Literature searches and other data gathering activities were used to collect the parameters for TCERM and CULTURE.

3.0 Interaction with other Technical Elements

The inventory and environmental transport technical elements provide a predicted distribution of contaminants in the environment as a function of time. Contaminants to be examined in the initial assessment include seven radionuclides and three hazardous chemicals. Radionuclides considered include tritium, technetium-99, iodine-129, uranium-238, strontium-90, cesium-137, and plutonium-239/240. Chemical contaminants include total uranium (i.e., as a toxin to the kidney), carbon tetrachloride, and hexavalent chromium.

The risk and impacts modules rely primarily on the groundwater, groundwater/river interface and Columbia River technical elements for these predictions. The types of results from these modules include the media important to the risk and impact modules, as shown in Table 1. The media includes groundwater, riparian soil, seep (or spring) water, pore water, sediment and surface water. Figure 1 shows a conceptual drawing of the media used in the risk and impact modules.

Table 1: Relationship between the contaminate media, environmental transport codes and the risk and impact modules.

Media	Output from Environmental Transport Codes	Input to Risk Codes			
		ECEM	HUMAN	TCERM	CULTURE
Groundwater	CFEST	X	X	X	X
Riparian Soil	RIPSAC	X			
Seep Water	RIPSAC	X			
Pore Water	MASS2	X	X		
Sediment	MASS2	X	X		
Surface Water	MASS2	X	X	X	X

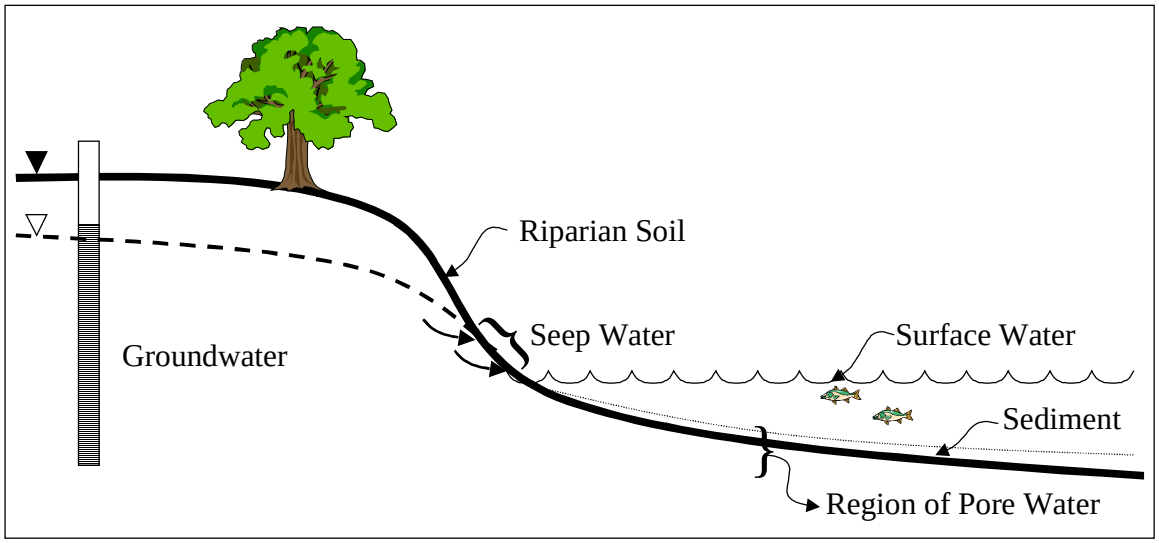

Figure 1: Conceptual drawing of the type of media used in the risk and impact modules.

Locations for evaluation of risk and impacts were chosen to coincide with the nodes that are being evaluated by the Groundwater and River Technical Elements. Goals for selecting the locations for evaluating risk and impacts were set in the design of SAC Rev. 0 (Kincaid et al. 2000). The locations for ecological risk evaluation were chosen to represent the locations where the 57 species in ECEM might reside. Figure 2 shows a close-up of the ecological locations. The riparian locations are approximately 5 m from the river's shore (the outside MASS2 river node) and the river locations are approximately 20 m into the river from the shore. To provide adequate information for contouring of risk, the locations alternate shoreline.

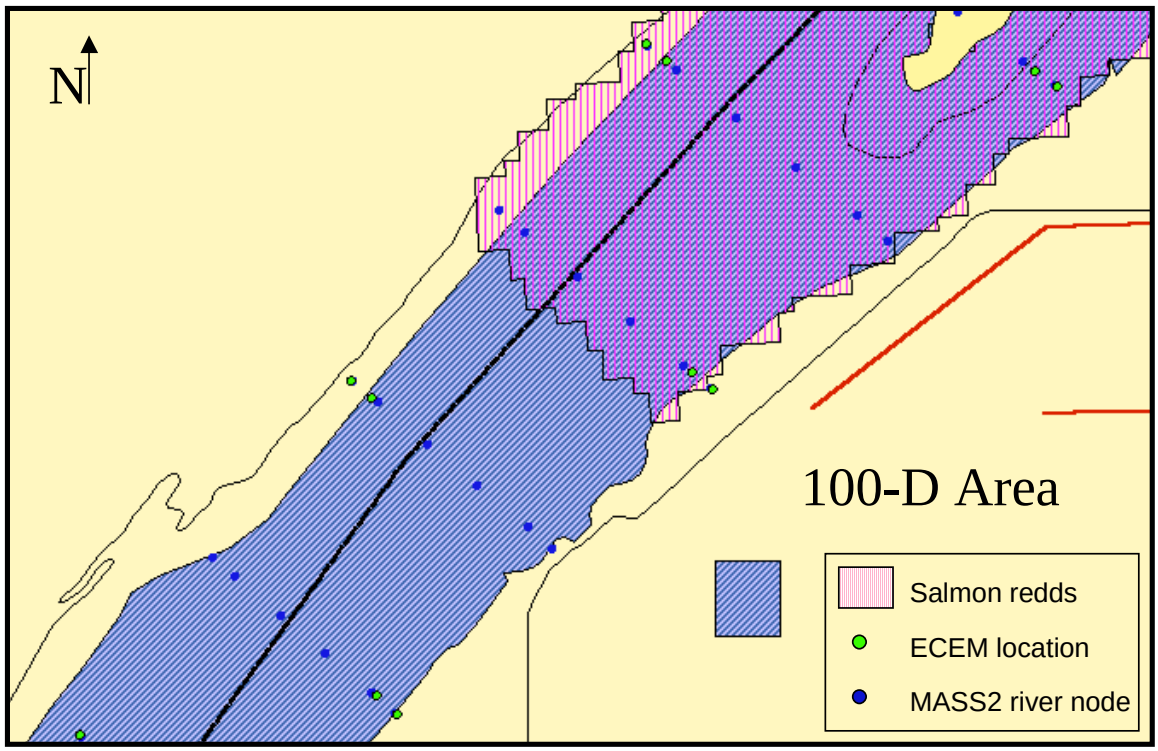

Figure 2: ArcView layout of the ecological risk locations for ECEM in the riparian zone and river (Green dots).

The locations for human health assessment in the HUMAN code depends on the scenarios evaluated. The locations were chosen to coincide with the Groundwater and River Technical Elements as well as locations that humans are currently using the river for various purposes. There are three types of locations for the HUMAN code: upland, riparian, and river locations. The upland locations are a subset of the CFEST nodes for the Residential Farmer scenario using groundwater. The riparian locations are located approximately 5 m from the river's shore (the outside MASS2 river node). These locations and river locations, a subset of the MASS2 river nodes located within the river domain, will be used to evaluate Ranger, Native American Subsistence User, and Recreational Users scenarios. A subset of the MASS2 river nodes will also be used to evaluate the Residential Farmer scenario using river water. Finally, the municipal pumping stations in the river for the cities of Richland, Kennewick and Pasco will be used for evaluating the population dose via the drinking water pathway. Figure 3 illustrates most of these types of locations to be evaluated by the HUMAN code.

TCERM is evaluating the impacts to the region's economy, and thus there are fewer nodes to be evaluated (Figure 4). The regions identified for SAC Rev. 0 are all along the Columbia River: 1) from Vernita Bridge (~ River Mile 390) to the power lines (~ River Mile 360); 2) from the power lines to the Richland Water Treatment Plant's pump house (~ River Mile 340); 3) from the Richland Water Treatment Plant's pump house to the Snake River (~ River Mile 325); and 4) from the Snake River to McNary Dam. Four types of locations were identified for each region groundwater (coinciding with MASS2 nodes): drinking water supply; fishing location; surface water contact location (for such activities as swimming, boating and water skiing); and irrigation using river water. In addition, one location on the Hanford Site was identified for irrigation and drinking water of groundwater (coinciding with a CFEST node).

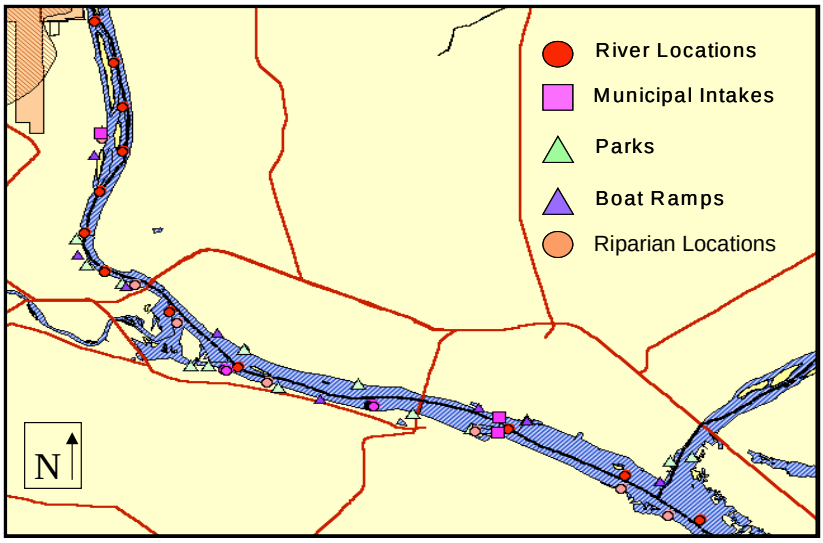

Figure 3: ArcView layout of the human health risk locations for HUMAN (does not include groundwater nodes).

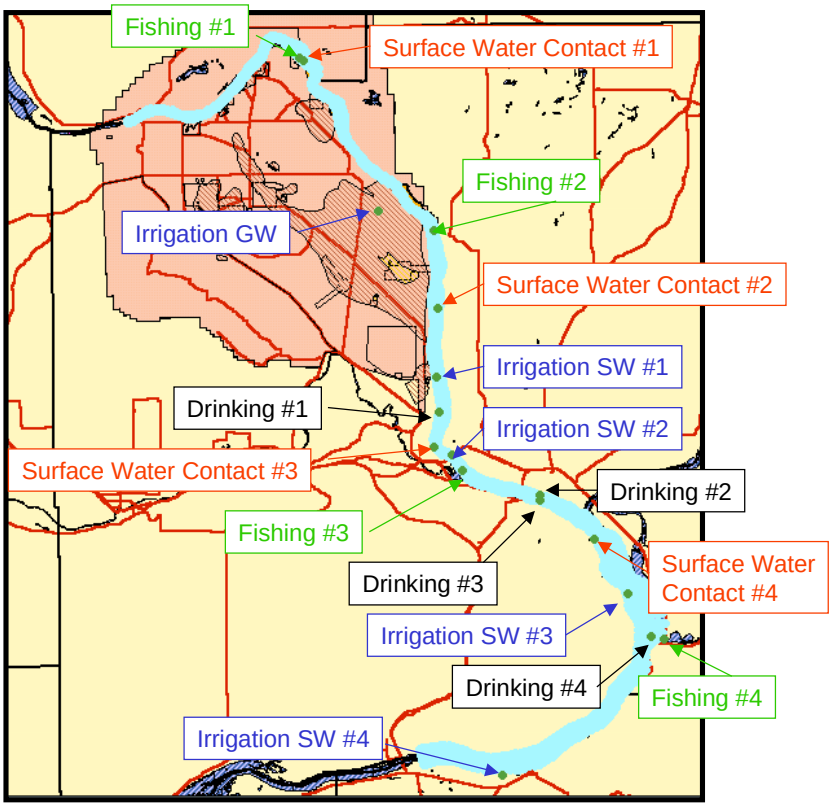

Figure 4: ArcView layout of the regional economic impact locations for TCERM. Each economic region has four types of locations: drinking water supply; fishing; surface water contact; and irrigation. There is only one location for irrigation with groundwater.

The CULTURE code has more locations for evaluation then any of the other codes. The surface water locations for the cultural impacts are the same coordinates as the nodes in MASS2. The groundwater locations for the cultural impacts are a subset of the nodes in CFEST. They include only the coordinates for the nodes on the surface of the Hanford Site, and do not include the nodes that fall into the river domain. The large number of locations for evaluating the cultural impacts will provide enough data for contouring cultural thresholds.

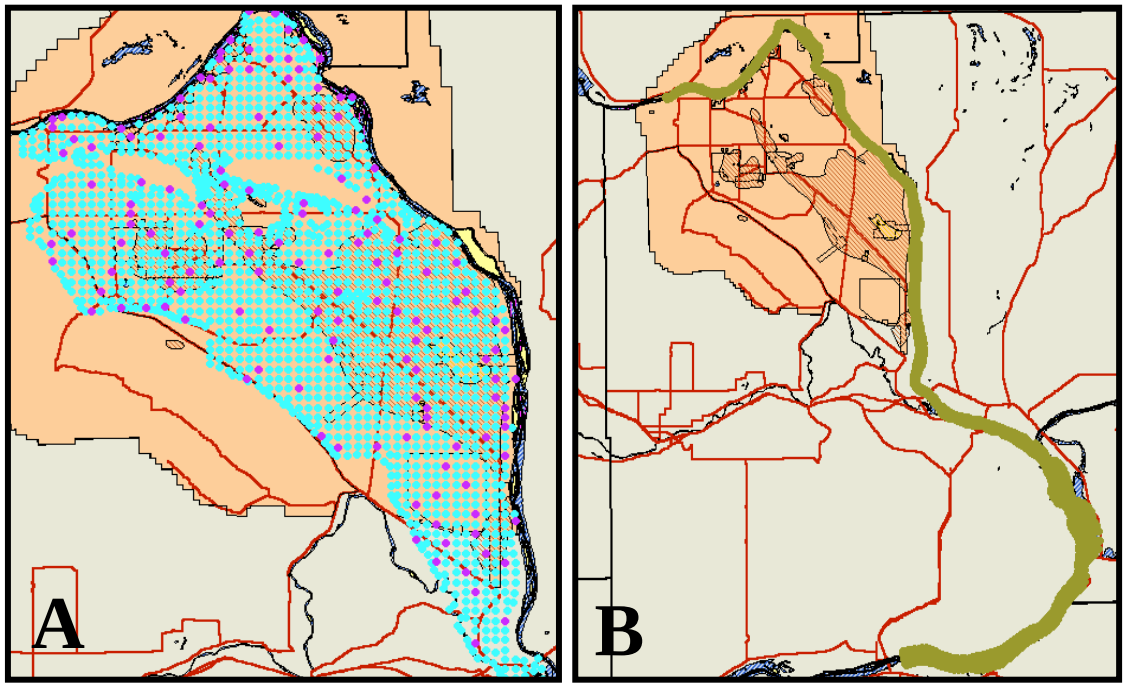

Figure 5: ArcView layout of the CULTURE groundwater (A) and surface water (B) locations. Note the purple locations in A are the cultural groundwater locations that coincide with the human health groundwater locations.

The risk/impacts modules are the last modules in the SAC computational stream. These modules use the data from the Environmental Concentration Data Accumulator. Results of each risk/impacts module are accessed through SACVIEW, a results extractor. SACVIEW is designed as a user-friendly interface to extract data in a suitable format to create tabular and graphical results. The graphical results will be shown using ArcView or Surfer.

4.0 Data Gathered

Most of the parameters for ECEM and HUMAN were used in the CRCIA (DOE 1998). Efforts were made to include data has become available since the CRCIA analysis was performed. The data packages include references to these data sources.

In the case of ECEM, several of the parameters were updated during the Biota History Matching activity for SAC Rev. 0. The parameters that were updated primarily included biological concentration factors, chemical assimilation efficiencies/ingestion absorption factors, depuration rates, and soil/plant transfer factors.

The HUMAN parameters that were updated included some modifications to the scenarios in order to show the contribution from specific types of exposures. For example, the CRCIA recreational scenarios included drinking 2L of seep water and 2 L of river water each day of exposure, whereas it is not likely that people drink untreated water while recreating on the Columbia River. Instead, people recreating on the river are likely to bring their own beverages, and thus ingestion was removed from the recreational scenarios for SAC Rev. 0.

Additionally, fact sheets on each contaminant and their effects on the human system have been developed to provide background material to interested parties (Appendix A). In the case of TCERM, parameters were collected through a literature search of regional and nation-wide reports on agricultural and recreational proscription and avoidance data (Appendix B). Efforts to collect cultural thresholds for CULTURE included discussions with stakeholders and visiting the Nez Perce Tribe (Appendix C). This initial assessment using SAC Rev. 0 explores the concept of cultural thresholds. This approach is demonstrated although it is not fully developed.

5.0 References

BHI, 1999, *Groundwater/Vadose Zone Integration Project: Preliminary System Assessment Capability Concepts for Architecture, Platform and Data Management*, CCN 0512242, Bechtel Hanford, Inc., Richland, Washington. Available at: http://www.bhi-erc.com/vadose/Workgrps/sac.htm#info

DOE, 1998. Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment, DOE/RL-96-16, Revision 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/crcia/reports/doe-rl_96-16/crcia03_98.htm

Kincaid, C.T., P.W. Eslinger, W.E. Nichols, A.L. Bunn, R.W. Bryce, T.B. Miley, M.C. Richmond, S.F. Snyder, and R.L. Aaberg, 2000, *System Assessment Capability (Revision 0): Assessment Description, Requirements, Software Design, and Test Plan*, BHI-01365, Draft A, Bechtel Hanford, Inc., Richland, Washington. Available at: http://www.bhi-erc.com/vadose/Docs/BHI01365.pdf

Poston, T.M., R.W. Hanf, and R.L. Dirkes, 2000, Hanford Site Environmental Report for Calendar Year 1999, PNNL-13230, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.hanford.gov/docs/annualrp99/

6.0 Assessment Data

SAC Rev. 0 data for the risk and impact modules can be found in the following subsections.

6.1 ECEM

The parameters for ECEM can also be found in the SAC information server (http://www.bhi-erc.com/projects/vadose/sac.htm) under the file name: “Ecem_Parameters 11-10-00.xls”

6.2 HUMAN

The parameters for HUMAN can also be found in the SAC information server (http://www.bhi-erc.com/projects/vadose/sac.htm) under the file name: “Human_Parameters 2001-03-06.xls”.

6.3 TCERM

The parameters for TCERM can also be found in the SAC information server (http://www.bhi-erc.com/projects/vadose/sac.htm) under the file name: “TCERM params 10-30-2000”.

6.4 CULTURE

The parameters for CULTURE can also be found in the SAC information server (http://www.bhi-erc.com/projects/vadose/sac.htm) under the file name: “Culture params 3-5-01”.

Appendix A:

Human Health Fact Sheets

Human Health Fact Sheets for SAC Rev. 0 Contaminants of Concern

Nine contaminants of concern were identified for study in SAC Rev. 0 based on their distribution at Hanford, mobility in the environment and their potential for contributing to risks and impacts. For more detail on the selection of the contaminants of concern, see Section 2.0 of GW/VZ Integration Project System Assessment Capability (Revision 0) Assessment Description, Requirements, Software Design, and Test Plan (BHI-01365, Draft A) - May 15, 2000. The fact sheets below provide general information about the physical and chemical properties of the contaminants and to highlight why these contaminants might potentially be a health concern. Each fact sheet is divided into the following sections:

- What is It?
- Where Does It Come From?
- How is It Used?
- What's in the Environment?
- What Happens to It in the Body?
- What is the Primary Health Effect?
- What is the Risk?
- Where Can I Find More Information?

Since most of the contaminants of concern are radionuclides, an additional fact sheet is provided to discuss what is ionizing radiation and why ionizing radiation is a health concern. Also, a pictorial of the primary distribution of the radionuclides of concern is provided.

Chemicals

- Carbon Tetrachloride
- Chromium

Radionuclides

- Cesium
- Iodine
- Plutonium
- Strontium
- Technetium
- Tritium
- Uranium

Other Resources

- Ionizing Radiation
- Primary Distribution of Select Radionuclides

Appendix B:

Background and Rationale for Estimates of Activity and Product Avoidance Rates in Response to Contamination Information.

Appendix C:

Presentation to Nez Perce Tribe, September 21, 2000 and Letter from Nez Perce Tribe