FINAL DATA ANALYSIS REPORT
FOR THE RECREATIONAL USE SURVEY
FOR THE UPPER COLUMBIA RIVER SITE
HUMAN HEALTH RISK ASSESSMENT
AND REMEDIAL INVESTIGATION/FEASIBILITY STUDY

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EXECUTIVE SUMMARY

The Upper Columbia River site (the UCR Site) is in the northeast portion of the State of Washington. The UCR Site "…consists of the areal extent of hazardous substances contamination within the United States (U.S.) in or adjacent to the UCR, including the Franklin D. Roosevelt Lake ("Lake Roosevelt"), from the border between the U.S. and Canada downstream to the Grand Coulee Dam, and all suitable areas in proximity to such contamination necessary for implementation of response actions..." (U.S. Department of Justice [DOJ] et al., 2006). The Site may include land and waters within the boundaries of the Colville Indian Reservation and the Spokane Indian Reservation, over which the Tribes have civil jurisdiction, as well as land and waters administered by the National Park Service (NPS) and the Bureau of Reclamation within the U.S. Department of the Interior (DOI). A remedial investigation and feasibility study (RI/FS) is currently underway in response to concerns regarding historical discharges of hazardous substances into the Columbia River, including but not limited to discharges of granulated slag, liquid effluents, emissions, and accidental spills and "upsets" from smelting processes and facility operations by Teck Resources Limited ("Teck") and its affiliated predecessors at the Trail facility located in Trail, British Columbia. On June 2, 2006, the U.S., on behalf of the U.S. Environmental Protection Agency (EPA) and DOJ, and Teck American Incorporated (TAI) signed a Settlement Agreement requiring Teck to perform an RI/FS at the Site (cited herein as DOJ et al., 2006).

The *Recreational Consumption and Resource Use Survey* (RecUse Survey) *for the Upper Columbia River Site Human Health Risk Assessment and Remedial Investigation/Feasibility Study* was conducted by Industrial Economics, Incorporated (IEc, 2012). The purpose of the survey was to collect data on fish consumption and recreational use of the UCR, from the Grand Coulee Dam north to the Canadian border, for use in the Baseline Human Health Risk Assessment (HHRA) for the UCR Site. A large portion of the UCR Site is within the Lake Roosevelt National Recreation Area (LRNRA), managed by the NPS. Portions of Lake Roosevelt not included in the LRNRA are managed by the Confederated Tribes of the Colville Reservation (CCT) and the Spokane Tribe of Indians (STI). The Colville and Spokane Indian Reservations also provide opportunities for recreational visitors to fish and camp at the UCR (NPS, 2006). The Two Rivers Marina, included in the RecUse Survey, is owned and operated by the STI. IEc (2010, 2012) also included the Spokane Arm of Lake Roosevelt in the RecUse Survey because some boaters use boat launches in that area to access areas on the UCR Site.[1] The IEc report refers to the geographic area included in the RecUse Survey simply as the "surveyed area" (Lake Areas 1–8; Figure 1). The surveyed area, as it will be referenced in this report, encompasses all locations where

[1] Given the popularity of the Fort Spokane boat launch as an access point to the UCR for boaters, the Spokane Arm of Lake Roosevelt was included in the RecUse Survey. However, given that it is not part of the UCR Site, recreational use that occurred in the Spokane Arm was not considered in this data analysis report and will not be used in the HHRA. For beach and camping trips, if the facility location was on the Spokane Arm of Lake Roosevelt, the data were not used to estimate exposure frequency (i.e., the number of beach or camping trips per year) or the amount of time (hours/day) recreational visitors spend swimming or wading in UCR water. Data for boat trips that departed from the Spokane Arm were included in the survey; however, the time spent in the Spokane Arm was not included in any estimates of exposure frequency (boating trips per year) or exposure time (e.g., time spent swimming or wading) that are presented in the data analysis report (or will be used in the HHRA). Fish consumption rates were calculated for fish caught in the UCR, regardless of whether the angler launched a boat from the Spokane Arm or the UCR.

survey interviews occurred, and locations identified in responses to survey questions, including areas within the UCR Site and areas outside of the UCR Site (i.e., the Spokane Arm of Lake Roosevelt).

The RecUse Survey was designed and administered by IEc under contract with DOI, with input from the EPA, State of Washington Department of Ecology (ECY), the CCT, the STI, and TAI. The survey administered questionnaires on-site to randomly selected visitors of the surveyed area during a 12-month period from October 2010 to September 2011. The questionnaires were used to collect information on the respondents' recreational activities during three types of visits: day trips by boaters, day trips to the beach, and overnight camping. During the execution of the survey, a shoreline angler questionnaire was developed and administered; however, the analysis of those data is not described in this report.[2] A 3-month fish consumption diary was also used to collect data for consumption of fish among self-identified frequent fish consumers, defined as eating a minimum of 10 fish meals a year. The RecUse Survey respondents included local visitors and those who travelled to visit the surveyed area (Figure 1). A *Final Recreational Consumption and Resource Use Survey Data Summary Report* was issued in May 2013 (IEc, 2013b).

This Data Analysis Report documents the data from the RecUse Survey and methods used to prepare the data for use in HHRA. Analysis of the RecUse Survey results indicate that the information collected is adequate to characterize site-specific exposure for all but one of the potential recreational exposure scenarios in the HHRA. Survey data were not adequate to estimate fish consumption rates for children; these will be derived and discussed in the HHRA. As such, this report provides estimates of fish consumption rates for adults and contact rates with environmental media using data derived from responses to survey questions. The RecUse Survey data were used to derive age-specific central tendency exposure (CTE) and reasonable maximum exposure (RME) parameter estimates for pathways of exposure and locations of contact with environmental media. In this report, RME estimates are also described as "upper percentile estimates" or 95th percentile (P95) values. The HHRA will use both CTE and RME parameters representative of the exposed population (as recommended by U.S. EPA, 1989; Browner, 1995). This report concludes with a discussion of exposure pathway completeness and compares the exposure factors derived from the RecUse Survey data with values in the HHRA Work Plan (U.S. EPA, 2009). This includes an evaluation of implausible responses, potential sources of bias, and uncertainties associated with the estimates derived from the survey data.

Due to the high snowfall amounts experienced in portions of the UCR watershed in 2011, the average water elevation in Lake Roosevelt was less than 1,250 feet during the annual drawdown period in 2011 (IEc, 2013b). As a result, all boat launches operated by the NPS were not available for approximately 2 weeks and many were not available for over 2 months (IEc, 2013b). Flooding at Black Sand Beach caused by melting snow resulted in the move of five survey sites from Black Sands to Evans Beach on May 30, June 5, June 12, July 2, and July 7. The effect of the large snowfall on data available for estimating exposure parameters is discussed in Sections 5.2.4, 5.4.4, and 6.5.

Based on the analysis of RecUse Survey data described in this report, data are sufficient to update the exposure pathway analysis for the recreational visitor population and to produce reliable, site-specific estimates of the exposure factors listed in Table ES-1. The survey data also indicate that the intentional

[2] Sampling weights were not developed for the shoreline angler data, which precludes the ability to make inferences with the data.

consumption of UCR water by recreational visitors is not likely a significant source of exposure for most visitors and should be removed from the HHRA Conceptual Site Model (CSM). While data were gathered for multiple scenarios that include potential exposure to surface water, sediment/soil, and air during recreational activities, some of these data will not be used in the HHRA. For example, exposure to UCR surface water while swimming is likely to lead to greater exposures than wading or water-skiing, due to the amount of skin exposed to water and greater potential for incidental surface water ingestion. Inhalation of indoor air in a tent or recreational vehicle (RV) is expected to be encompassed in the outdoor air inhalation scenario: concentrations of contaminants of potential concern (COPCs) are expected to be the same inside and outside a tent. As a result, this data analysis report presents and summarizes the data collected for some recreational exposure scenarios that will not be evaluated separately in the HHRA.

Table ES-1 lists the exposure parameters for recreational visitors derived from the RecUse Survey data that will be utilized in the HHRA.

TABLE ES-1. Exposure Parameters for the Recreational Visitor Derived from the RecUse Survey Data that will be used in the UCR Site HHRA

Exposure Scenario	Exposure Parameter	Units	RME Value		CTE Value		Relevant Section of this Document
			Adult	Child	Adult	Child	
Swimming during beach trips	Exposure Frequency[a]	days/year	20	16	6.8	5.9	Section 5.4.1.2
	Exposure Time[b]	hours/day	2.9	2.8	0.99	0.98	Section 5.4.2.4
Swimming during boat day trips	Exposure Frequency[c]	days/year	24	16	6.6	5.5	Section 5.4.1.4
	Exposure Time[d]	hours/day	2.0	2.0	0.79	0.79	Section 5.4.2.4
Swimming during camping trips	Exposure Frequency[e]	days/year	20	10	6.3	4.3	Section 5.4.1.3
	Exposure Time[f]	hours/day	6.0	6.0	1.8	1.8	Section 5.4.2.4
General trips to the beach	Exposure Frequency[a]	days/year	20	16	6.8	5.9	Section 5.4.1.2
Fish consumption from the UCR Site	Fish Consumption Rate[g]	grams/day	28	-[h]	6.3	-[h]	Section 5.2.3

[a]RME values are 95th percentile (P95) days/year for beach day trips for all UCR reaches combined; CTE values are mean days/year for beach day trips for all UCR reaches combined (children defined as 0–6 years old, adults defined as 7 years and older[3]).
[b]RME values are P95 hours/day for swimming beach trips for all UCR reaches combined; CTE values are mean hours/day for swimming beach trips for all UCR reaches combined (children defined as 0–6 years old, adults defined as 7 years and older).
[c]RME and CTE values are P95 and mean days/year, respectively, for boat day trips for all UCR reaches combined (children defined as 0–6 years old, adults defined as 7 years and older).
[d]RME and CTE values are P95 and mean hours/day, respectively, for boat day trips for all UCR reaches combined (adults and children combined).
[e]RME and CTE values are P95 and mean days/year, respectively, for camping trips for all UCR reaches combined; boat-in and drive-in camping trips combined (children defined as 0–6 years old, adults defined as 7 years and older).
[f]RME and CTE values are P95 and mean hours/day, respectively, for camping trips for all UCR reaches combined. Boat-in and drive-in camping trips combined (adults and children combined).
[g]RME and CTE values are P95 and mean g/day, respectively; estimates are for combined diary and questionnaire data.
[h]The Data Analysis Report does not provide sufficient data to estimate a daily fish consumption rate (DCR) for children. See Section 5.2.4 for additional discussion.

[3] These are the age ranges used in the HHRA, per U.S. EPA guidance (e.g., U.S. EPA, 1989).

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ACRONYMS AND ABBREVIATIONS

CCC	Citizens for a Clean Columbia
CCT	Confederated Tribes of the Colville Reservation
COPC	contaminants of potential concern
CRITFC	Columbia River Inter-Tribal Fish Commission
CSM	conceptual site model
CTE	central tendency exposure
CV	coefficient of variation
DCR	daily fish consumption rate
DCR_p	average daily consumption rate for each participant
DOI	U.S. Department of the Interior
DOJ	U.S. Department of Justice
DQO	data quality objective
ECY	State of Washington Department of Ecology
EF	exposure frequency
ET	exposure time
g	gram
HHRA	Human Health Risk Assessment
HIF	human intake factor
IEc	Industrial Economics, Incorporated
IQR	interquartile range
LCL	lower confidence limit
LTL	lower tolerance limit
LOPC	level of potential concern
LRNRA	Lake Roosevelt National Recreation Area
LTS	least trimmed squares
MCL	maximum contaminant level
ME	margin of error
MeHg	methyl mercury
MS	meal size
n	sample size
NHANES	National Health and Nutrition Examination Survey
NPS	National Park Service
P95	95^{th} percentile
RE	relative error
RecUse Survey	Recreational Consumption and Resource Use Survey
RI/FS	remedial investigation and feasibility study
RME	reasonable maximum exposure
RV	recreational vehicle
SAP	Sampling and Analysis Plan
SD	standard deviation
SRC	SRC, Inc.
STI	Spokane Tribe of Indians

TAI	Teck American Incorporated
Teck	Teck Cominco Metals Limited (currently Teck Metals Limited)
UCL	upper confidence limit
UCR	Upper Columbia River
U.S.	United States
U.S. EPA	U.S. Environmental Protection Agency
UTL	upper tolerance limit

1.0 INTRODUCTION

1.1 UCR Site Background

The Upper Columbia River site (UCR Site) is in the northeast portion of the State of Washington. The UCR Site "… consists of the areal extent of hazardous substances contamination within the United States (U.S.) in or adjacent to the UCR, including the Franklin D. Roosevelt Lake ("Lake Roosevelt"), from the border between the U.S. and Canada downstream to the Grand Coulee Dam, and all suitable areas in proximity to such contamination necessary for implementation of response actions…" (U.S. Department of Justice [DOJ] et al., 2006). The Site may include land and waters within the boundaries of the Colville Indian Reservation and the Spokane Indian Reservation, over which the Tribes have civil jurisdiction, as well as land and waters administered by the National Park Service (NPS) and the Bureau of Reclamation within the U.S. Department of the Interior (DOI). A remedial investigation and feasibility study (RI/FS) is currently underway in response to concerns regarding historical discharges of hazardous substances into the Columbia River, including but not limited to discharges of granulated slag, liquid effluent, emissions, and accidental spills and "upsets" from smelting processes and facility operations by Teck Resources Limited ("Teck") and its affiliated predecessors at the Trail facility located in Trail, British Columbia. On June 2, 2006, the U.S., on behalf of the U.S. Environmental Protection Agency (EPA) and DOJ, and Teck American Incorporated (TAI) signed a Settlement Agreement requiring Teck to perform an RI/FS at the Site (cited herein as DOJ et al., 2006).

As described in the *Human Health Risk Assessment Work Plan for the Upper Columbia River Site Remedial Investigation and Feasibility Study* (UCR HHRA Work Plan [U.S. EPA, 2009]), the UCR Site is used for recreation (camping, picnicking, boating, fishing), subsistence hunting, fishing, and gathering, and for cultural pursuits important to local Native American tribes, including the Spokane Tribe of Indians (STI) and the Confederated Tribes of the Colville Reservation (CCT). Potentially exposed populations include recreational visitors, workers, subsistence populations, and residents (U.S. EPA, 2009). Previously available information was not adequate to establish site-specific exposure parameter values for the UCR Site recreational visitor population for use in the Human Health Risk Assessment (HHRA). Therefore, the *Recreational Consumption and Resource Use Survey* (RecUse Survey), conducted by Industrial Economics, Incorporated (IEc; IEC, 2012), gathered site-specific information on fish consumption and recreational activities of visitors to the UCR Site.

A large portion of the UCR Site is within the Lake Roosevelt National Recreation Area (LRNRA), managed by the NPS. Developed areas overseen by the NPS include 22 boat launches, 27 campgrounds, and 3 concessionaire-operated marinas (Seven Bays, Keller Ferry, and Kettle Falls Marinas). Designated recreational uses of the UCR Site include boating, fishing, hiking, swimming, wading, camping, canoeing, and hunting. The remainder of the UCR shoreline managed by the NPS is undeveloped. The NPS allows camping on any undeveloped shoreline. Portions of the UCR Site are managed by the CCT and the STI. The Colville and Spokane Indian reservations also provide opportunities for recreational visitors to fish and camp at the UCR Site (NPS, 2006). The Two Rivers Marina is owned and operated by the STI. IEc (2010, 2012) also included the Spokane Arm of Lake Roosevelt in the RecUse Survey because some boaters use boat launches in that area to access areas on

the UCR Site.[4] The IEc report refers to the geographic area included in the RecUse Survey simply as the "surveyed area" (Figure 1). The surveyed area, as it will be referenced in this report, encompasses all locations where survey interviews occurred, as well as locations included in responses to survey questions, including areas within the UCR Site and areas outside of the UCR Site (i.e., the Spokane Arm of Lake Roosevelt).

The RecUse Survey is one of two surveys that were conducted as part of the RI/FS. The *Tribal Consumption and Resource Use Survey* (U.S. EPA, 2010; Westat, Inc., 2012) was conducted to collect information about the CCT population's use of natural resources located within the Local Area[5] as a food source (e.g., fish, shellfish, waterfowl, game, aquatic and terrestrial plants) and as a source of materials utilized in tribal practices (e.g., reeds for basket-weaving, water for sweat lodges, native plants for ceremonial activities).

1.2 Scope and Organization of this Report

IEc (2013b) presents the RecUse Survey methodology, describes the survey instruments and collection of data, and summarizes those data. This report documents further analyses of RecUse Survey data with a focus on estimating contact rates with environmental media and fish consumption rates for respondents/participants contacted within the surveyed area[6] (Figure 1). The analyses presented herein are intended to support the calculation of representative central tendency exposure (CTE) and reasonable maximum exposure (RME) estimates for exposure parameters identified by the U.S. EPA (2009) for use in the Baseline HHRA for the UCR Site.[7] This report focuses on (1) summarizing the data collected from the RecUse Survey and describing how they may be used to estimate site-specific exposure parameters for the recreational user scenarios in the HHRA; and (2) confirming or revising the Conceptual Site Model (CSM) for the HHRA. In addition to the introduction, this report is organized into the following sections:

Section 2	This section provides a description of the objectives of the RecUse Survey.
Section 3	This section provides a brief overview of the design of the RecUse Survey, including a description of the survey instruments and data collection.

[4] Given the popularity of the Fort Spokane boat launch as an access point to the UCR for boaters, the Spokane Arm of Lake Roosevelt was included in the RecUse Survey. However, given that it is not part of the UCR Site, recreational use that occurred in the Spokane Arm was not considered in this data analysis report and will not be used in the HHRA. For beach and camping trips, if the facility location was on the Spokane Arm of Lake Roosevelt, the data were not used to estimate exposure frequency (i.e., the number of beach or camping trips per year) or the amount of time (hours/day) recreational visitors spend swimming or wading in UCR water. Data for boat trips that departed from the Spokane Arm were included in the survey; however, the time spent in the Spokane Arm was not included in any estimates of exposure frequency (boating trips per year) or exposure time (e.g., time spent swimming or wading) that are presented in the data analysis report (or will be used in the HHRA). Fish consumption rates were calculated for fish caught in the UCR, regardless of whether the angler launched a boat from the Spokane Arm or the UCR.

[5] Local Area, as defined in the *Data Analysis Report for the Tribal Consumption and Resource Use Survey for the Upper Columbia River Site HHRA and RI/FS* (SRC, 2015), is the UCR from the Grand Coulee Dam to the U.S.-Canada border, and the land located within the geographic extent of the CCT Resource Zones.

[6] The fish consumption data include sources of fish that fall outside of the surveyed area, as described later in this report.

[7] The CTE estimate represents the typical or "average" exposure in the population. The RME estimate represents exposures that are at the upper end of the exposed population distribution (e.g., 95th percentile, or P95).

Section 4 This section provides the methods used to analyze and reduce/reformat/recode the data for applications in the HHRA. This includes detailed information on conversion factors and statistical software and methods used, as well as a description of the target population and spatial analysis procedure for each survey instrument.

Section 5 This section provides the results of the RecUse Survey analysis. It includes estimates of water and fish consumption rates, as well as exposure frequency (EF; days/year for beach visits, boating, and camping trips) and exposure time (ET; hours/day for time spent outdoors, inside a tent, camper, or recreational vehicle [RV], swimming, wading, on the sand/beach, and water-skiing/tubing) estimates for recreational activities.

Section 6 This section provides a comparison of the results of the survey data analysis to the CSM and estimated exposure parameters presented in the HHRA Work Plan for the UCR Site (U.S. EPA, 2009) to evaluate whether specific recreational exposure pathways are complete.

1.3 Project Management

The RecUse Survey was conducted by IEc under contract to the DOI's NPS. Survey activities were overseen by the U.S. EPA, with input from the State of Washington Department of Ecology (ECY), the CCT, the STI, and TAI. IEc was responsible for designing the data collection instruments, as well as developing the study design and sampling and analysis strategies. These activities are described in the *Recreational Consumption and Resource Use Survey Sampling and Analysis Plan for the Upper Columbia River Site Human Health Risk Assessment and Remedial Investigation/Feasibility Study* (UCR RecUse Sampling and Analysis Plan [SAP]; IEc, 2010). IEc conducted a 4-day field pretest to evaluate the survey instruments and procedures. Several changes were made to survey questions and procedures to address issues that arose during the pretest, such as the clarification of text to separate "beach" time into time spent in the water or on the sand, changing the recall of past trips from a single number of trips over the past 12 months into the number of trips in each season over the past 12 months, and revising the text regarding drinking UCR water to ensure that respondents did not include water consumed from campground faucets (see Appendix G of IEc, 2010, for additional specifics). IEc also proposed an approach for conducting interviews with shore anglers to supplement the UCR RecUse SAP (IEc, 2011).

SRC, Inc. (SRC) contributed to the development of the UCR RecUse SAP by providing data quality objectives (DQOs) that describe visitor characteristics required for the HHRA (see Appendix B of IEc, 2010). SRC also performed Monte Carlo simulations to test alternative data analysis strategies for the high consumption angler diaries (see Appendix J of IEc, 2010) and measurements of recreational activity-specific ET and EF (see Appendix K of IEc, 2010).

The RecUse Survey was conducted by IEc from October 2010 to September 2011,[8] and the methodology and results were summarized in a draft report (IEc, 2012). Cardno ENTRIX (under contract to TAI) observed the performance of the survey for 5 days in August 2011, summarized their observations, and provided comments on survey execution (ENTRIX, 2011). A response to these comments was prepared by the DOI (2012). Comments were also provided on the draft report (IEc, 2012) by TAI, CCT, STI, U.S. EPA, and Citizens for a Clean Columbia (CCC). IEc prepared a response to comments document (IEc, 2013a) and a final version of the report titled *Recreational Consumption and Resource Use Survey for the Upper Columbia River Site Human Health Risk Assessment and Remedial Investigation and Feasibility Study: Data Summary Report* (RecUse Data Summary Report; IEc, 2013b). With this Data Analysis Report, SRC is documenting further summarization and preparation of the RecUse Survey data to support next steps in the HHRA process.

2.0 SURVEY OBJECTIVES

2.1 Overview

The primary purpose of the RecUse Survey was to obtain site-specific exposure data for recreational visitors, including the consumption of fish, for use in the HHRA (IEc, 2010).[9] Analysis of the RecUse Survey data informed such decisions as whether the HHRA will provide separate estimates for males and females or certain age groups.

Key data needed to support reliable calculations of human exposures to potentially contaminated environmental media at the UCR Site include estimates of the long-term average intake rates and contact rates for each exposure medium and for each exposure scenario of potential concern (U.S. EPA, 2009). These will be estimated for recreational exposure scenarios based in part on frequencies and durations of recreational activities that potentially place receptors in contact with exposure media (e.g., surface water, sediment) and, for the fish consumption pathway, the sources and rates of consumption of fish. Because rates of recreational activities have seasonal patterns, the RecUse Survey was administered over a 12-month period. The survey produced data on individual respondent characteristics (e.g., age, sex); type of intentional consumption of potentially contaminated media (e.g., surface water, fish); and location, frequency, and duration of recreational activities (e.g., camping, boating).[10] Efforts were made to survey as many individuals as practical to characterize the population distribution of activities (IEc, 2010). For fish consumption, detailed information regarding fish meals (e.g., fish species, organs consumed, meal size) was also collected.

Three exposure pathways identified in the Final RecUse Survey SAP DQOs (IEc, 2010) were not addressed by the RecUse Survey: consumption of shellfish, consumption of wild game, and exposures

[8] Due to high snowfall amounts experienced in portions of the UCR watershed, the average water elevation in Lake Roosevelt was less than 1,250 feet during the annual drawdown period in 2011 (IEc, 2013b; Appendix C). As a result, all boat launches operated by the NPS were not available for approximately 2 weeks and many were not available for over 2 months (IEc, 2013b).

[9] Additional information regarding the DQOs for the UCR RecUse Survey is provided by IEc (2010). Detailed information on the equations for estimating potential exposure are provided in the UCR HHRA Work Plan (U.S. EPA, 2009).

[10] Data were collected over all four seasons within a 12-month period to better characterize variations in seasonal patterns of exposure, and to better estimate more reliable long-term contact rates. Information on respondent-specific variables (e.g., age, sex) was also collected to estimate exposures for particular subpopulations that may have atypical exposures. For instance, the individuals who reported consuming the most fish were encouraged to fill out a 3-month fish consumption diary to better capture this information.

while showering. Each of these exposures was either an infrequent exposure or "unlikely to be a complete UCR exposure pathway" for the recreational visitor population (IEc, 2013b).

2.2 Study Population

As described above, the UCR Site attracts more than 1.3 million visitors per year (NPS, 2006). Recreational users at the UCR Site may include occasional visitors and residents. NPS employees and volunteers are also present at the UCR Site; however, they are not considered part of the study population for the RecUse Survey. As such, survey responses of NPS volunteers at campsites were not included in the data evaluation.

Adult and child (aged 0–6 years[11]) recreational visitors may be exposed to contaminants in UCR sediment and surface water on day trips to beaches (including swimming), to contaminants in UCR sediment and surface water while swimming on boating and camping trips, and to contaminants by consuming fish caught from the UCR. The recreational visitor population evaluated in the HHRA will be assumed to fish; swim during trips to the beach, boating, and camping trips; and spend time on UCR public beaches and relict floodplains. Exposure factors described in the remaining sections of this report were derived for both the adult and child (when possible) recreational visitor populations that will be assessed in the HHRA.

2.3 RecUse Survey Exposure Pathways and Exposure Factors

The RecUse Survey provided information to help determine which exposure pathways will be quantified in the HHRA. The survey collected data to estimate fish consumption rates and rates of activities that place humans in contact with environmental media that were identified in the UCR HHRA Work Plan as potential data gaps (U.S. EPA, 2009) (see Table 1). These parameters will be used to calculate human intake factors (HIFs) in the HHRA.

TABLE 1. Recreational Exposure Pathways and Exposure Factors

Exposure Pathways Considered	Exposure Factors
Incidental ingestion of and dermal contact with beach sediment/soil and surface water	Exposure frequency (EF): Total number of days of activity per year Exposure time (ET): Duration of activity (hours/day)
Inhalation of outdoor air near beaches and indoor air for tents, campers, and RVs	EF: Total number of days of activity per year ET: Duration of activity (hours/day)
Consumption of fish derived from the UCR Site	Total number of fish meals per year Fish meal size (mass/day) Daily fish consumption rates
Intentional ingestion of UCR surface water, but not as a source of regular drinking water	The RecUse Survey indicated intentional ingestion of water from the UCR is very rare; therefore, this exposure pathway should not be considered in the HHRA.

[11] These age ranges are consistent with those used in the HHRA, per U.S. EPA guidance (e.g., U.S. EPA, 1989).

TABLE 1. Recreational Exposure Pathways and Exposure Factors

Exposure Pathways Considered	Exposure Factors
Consumption of shellfish, wild game, and waterfowl derived from the UCR Site	None; the RecUse Survey did not collect these data.
Ingestion of drinking water derived from untreated groundwater[12]	None; the RecUse Survey did not identify any sources of untreated groundwater that could be used for drinking.
Dermal contact with and inhalation of volatiles from untreated groundwater during showering at UCR facilities	None; the RecUse Survey did not identify any sources of untreated groundwater and no enclosed showers were found at NPS facilities.

2.4 Survey Areas

The RecUse Survey divided the UCR into three lake regions (upper, middle, and lower) and eight lake areas (1–8)[13] (Figure 1). The upper region of the UCR extends southward from the U.S.-Canada border to the access point at Marcus Flats. The middle region of the UCR comprises the area between Marcus Flats and the Spokane River confluence, and the lower region of the UCR includes the area between the Spokane River confluence and the Grand Coulee Dam (Figure 1). A portion of the Spokane River Arm of Lake Roosevelt (Figure 1) was included in the RecUse Survey (i.e., the "surveyed area") because some boaters use boat launches in that area to access the UCR.[14] Locations where the boat, beach, and camp interviews were conducted are shown in Figure 2 (see also IEc, 2013b).

This report provides estimates for recreational uses of the UCR (i.e., boating, camping, and beaches located on the UCR), and estimates of consumption rates for fish caught in the UCR. The UCR Study Area, which is the focus of the HHRA, includes the locations from the RecUse surveyed area that fall within the UCR Site (i.e., River Reaches 1–6; Lake Areas 1–7; and the lower, middle, and upper regions of the UCR; Figure 1).

3.0 SURVEY DESIGN

3.1 Overview

The RecUse Survey SAP (IEc, 2010) provides a complete description of the design and implementation of the RecUse Survey. This section provides an overview of the design features that are pertinent to understanding the data analyses presented in this report. Recreational visitors to the UCR Site were contacted at public boat launches, marinas, day-use beaches, and campgrounds (Figure 2). As

[12] Evaluation of groundwater well data and reported use of wells by people living near and recreating at the UCR Site resulted in a conclusion that groundwater/well water is an incomplete exposure pathway (CH2M, 2018).

[13] The UCR RI/FS divides the UCR into six river reaches (i.e., River Reach 1–6), which are also shown in Figure 1.

[14] Given the popularity of the Fort Spokane boat launch as an access point to the UCR for boaters, the Spokane Arm of Lake Roosevelt was included in the RecUse Survey. However, given that it is not part of the UCR Site, recreational use that occurred in the Spokane Arm was not considered in this data analysis report and will not be used in the HHRA. For beach and camping trips, if the facility location was on the Spokane Arm of Lake Roosevelt, the data were not used to estimate EF (i.e., the number of beach or camping trips per year) or the amount of time (hours/day) recreational visitors spend swimming or wading in UCR water. Data for boat trips that departed from the Spokane Arm were included in the survey; however, the time spent in the Spokane Arm was not included in any estimates of EF (boating trips per year) or ET (e.g., time spent swimming or wading) that are presented in the data analysis report (or will be used in the HHRA). Fish consumption rates were calculated for fish caught in the UCR, regardless of whether the angler launched a boat from the Spokane Arm or the UCR.

described by IEc (2013b), on-site surveys were designed to collect information related to: (1) recreational activities during the current trip (beach and boat day trips) or over the past 24 hours (camper interviews); (2) the number of trips to the Site over the past 12-month period plus the current season; (3) annual fish consumption from the UCR; and (4) visitor demographics (e.g., sex, age, zip code).

The sampling plan was designed to distribute survey interviews across each season and across sampling sites, with larger sampling rates used at high-use sites during the time of highest use (e.g., weekends during peak season). The allocation of sampling effort across time approximated the temporal pattern of site visitation. The allocation of efforts across sampling sites reflected the geographic distribution of visitors, with an increased sampling rate associated with more popular sites. Sample weights were used to adjust for the unequal sampling probabilities incorporated into the study design. The calculation of the sample weights is described in IEc (2013b). For this report, *trip sample weights* were used to estimate ETs, and *person weights* were used to estimate EFs and fish consumption rates (IEc, 2013b).

3.2 Survey Instruments that Comprise the RecUse Survey

The five survey instruments shown in Appendices A, E, and H of the RecUse Data Summary Report (IEc, 2013b) were administered over a period of approximately 12 months, from October 2010 to September 2011, except for the Shoreline Angler Survey, which was administered from May 6, 2011 to September 30, 2011:

- Boater Survey. Boaters were contacted at public boat launches and marinas as they were departing for the day. Of the 19 sites that were sampled, 5 were in the Upper UCR, 5 were in the Middle UCR, and 9 were in the Lower UCR (see Figure 5). Visitors were not given the boater survey if they were also camping at a drive-in campground within the UCR.
- Beach Visitor Survey. Beach visitors were contacted as they left the beach for the day. Beach visitors that were also camping overnight at drive-in campgrounds within the UCR were not included in the beach visitor survey. Eight beach locations were sampled (two in the Upper UCR, three in the Middle UCR, and three in the Lower UCR) (see Figure 3).
- Camper Survey. The camper survey was conducted at the Two Rivers campground and at all drive-in NPS campgrounds on the UCR Site between the U.S.-Canada border and the Grand Coulee Dam (five campgrounds in the Upper UCR, five campgrounds in the Middle UCR, and six campgrounds in the Lower UCR) (see Figure 4). Visitors were contacted in the evenings at their campsites.
- Fish Consumption Diary. Respondents from the boater, beach visitor, or camper surveys who reported consuming 10 or more fish meals per year from the UCR were asked to complete a 3-month fish consumption diary. The diary requested information for every fish meal consumed, including the date of consumption, fish species, geographic origin, body parts consumed, meal size, and the size of a child's meal.
- Shoreline Angler Survey (Administered from May 6, 2011 to September 30, 2011 only). This survey was administered to shore anglers present at boat launches and marinas that were being sampled. The survey focused on fish consumption and the number of fishing trips to the UCR over the past 12 months. Information on other recreational activities (e.g., boating, camping, beach visits) was not requested.

A complete description of the survey administration, data preparation, and quality assurance procedures is provided by IEc (2013b); a summary based on IEc (2013b) follows. The survey interviews were administered by trained staff. All completed survey forms were compiled and entered into a database. A quality control review of 10% of the survey records revealed a 0.09 percent error rate (20 errors out of 21,854 data items reviewed). The errors that were identified were corrected in the final version of the database. As described by IEc (2013b), logic checks were implemented to identify inconsistent responses, responses outside of a permissible range for that field (e.g., non-negative number of fish consumed, more than one trip per day, etc.), and skip pattern violations (e.g., responses to questions about fish consumption for respondents who did not consume fish). Additional modifications were made to facilitate data analysis including standardizing responses in text fields and replacing responses that consisted of numerical ranges with midpoint values.

3.2.1 Boater, Beach Visitor, and Camper Surveys

IEc interviewers attempted to administer a boater, beach visitor, or camper survey to a randomly selected adult (i.e., the adult with the most recent birthday) within each group of individuals. In some cases, an alternate adult volunteered to complete the survey, and this was noted by the interviewer. Each survey contained five sections organized as follows:

- Section A consisted of screening questions to determine the number of adults and children in a visitor party and whether the visiting party was camping at a UCR drive-in campground.
- Section B contained questions relating to activities performed during the current boating, beach, or camping trip (e.g., time spent swimming, wading, on the beach, in a tent). Respondents were also asked about the quantity of UCR surface water they intentionally consumed.
- Section C questions were designed to obtain information about trips to the UCR Site in the current season, as well as over the past 12-month period, including destinations visited and the length of time of each camping or boating visit. For survey respondents interviewed late in a season, information about previous trips would encompass almost 15 months (the current season plus the previous four seasons). For beach day trips, the number of trips for the previous June to September period was requested. Methods for converting these data into annual (12-month) values are described in Section 4.3.1.
- Section D requested information on fish consumption over the previous 12 months as part of each survey of boaters, beach visitors, campers, and shore anglers. Data reported included the region of the UCR where the fish was caught, the species of fish, the size range of fish kept for consumption during the current trip, the number of fish meals consumed, body parts typically consumed, typical meal size (facilitated by a picture showing three different fish fillet serving sizes), and any awareness of and response to fish consumption advisories. Specific questions related to the consumption of kokanee (silvers), rainbow trout, walleye, and bass; however, information on other species was also requested.
- Section E gathered data on respondent demographics (i.e., age, sex, zip code).

3.2.2 Shoreline Angler Survey

As described in IEc (2013b), survey interviewers at boat launches and marinas observed anglers fishing from docks or the nearby shoreline. While survey staff were initially instructed not to intercept these shore anglers, these individuals were eventually included from May 6, 2011, to September 30, 2011, as part of the Shoreline Angler Survey. The shoreline angler survey was only administered at boat launch sites where interviewers were already stationed, and only when no boats were approaching the launch (i.e., when the interviewer had time available); it was not administered at beach or camping sites. The survey contained three sections (i.e., preliminary screening questions, fish consumption and demographics) similar to sections A, D and E, respectively, of the boat, beach visitor, and camping surveys described in Section 3.2.1.[15]

3.2.3 Fish Consumption Diary

As described in the RecUse Survey SAP (IEc, 2010), fish consumption diaries were also used to collect data for those survey respondents that reported consuming 10 or more fish meals from the UCR each year. For each fish meal consumed, the diaries were used to document the date of consumption, the fish species, geographic origin, body parts consumed, meal size, and the size of a child's meal (if applicable). Fish consumption diaries were mailed to respondents once a month for three months to obtain specific information on individual fish consumption (IEc, 2010). Monthly telephone reminders were placed to each respondent to encourage completion of the three-month diaries. Only diary participants who completed all three months of diaries were included in the analysis of diary data.

4.0 METHODS USED TO ESTIMATE EXPOSURE PARAMETER VALUES

4.1 Overview

This section describes the methods used to estimate fish consumption rates, focusing on fish caught in the UCR, and methods used to estimate ET and EF for recreational activities that may result in contact with potentially contaminated environmental media. "Fish caught in the UCR" do not include fish caught in the Spokane Arm of Lake Roosevelt (i.e., the Spokane River). However, fish caught in the UCR by boaters who accessed the river from boat launches in the Spokane Arm are included in the analysis. Exposure data (e.g., frequency of trips to the beach) typically exhibit large variability due to differences between individuals. Site-specific data such as those gathered through the RecUse Survey help to reduce uncertainty in exposure parameter estimates, if the sample size and data quality are sufficient. Assumptions that were made during the data reduction and estimation steps are described herein (and detailed in Appendix B), or in the RecUse Survey SAP (IEc, 2010). The information presented in this report will be used to help characterize potential exposure for the recreational visitor population in the UCR HHRA. The HHRA will use both CTE and RME (upper percentile) parameters representative of the exposed population (as recommended by U.S. EPA, 1989; Browner, 1995). The CTE is generally

[15] The survey included a screening question designed to eliminate any anglers who would potentially be intercepted during other visits to the UCR (i.e., boating, camping, or beach trips).

represented by an estimate of the mean of the population, and the RME is generally represented by an estimate of the 95th percentile (P95) of the population.

The survey data were provided to SRC by IEc as comma-delimited text files on March 29, 2013. All database queries, data reduction processes, and parameter estimates were performed using SAS statistical software.[16] The SAS *SurveyMeans* procedure was used to estimate population parameters. Appendix B contains notes on the steps used to prepare ("reduce") the data for EF, ET, and fish consumption rate calculations.

4.2 Water Consumption Estimation Methods

Water consumption amount data (ounces per day/trip) consisted of categorical responses that included one of six possible responses: less than 8 ounces, 8 ounces, 12 ounces, 16 ounces, 20 ounces, and greater than 20 ounces. Table 2 presents values for water consumption (ounces, liters) that were assigned to each of the possible responses.

TABLE 2. Conversion of Survey Responses for Water Consumption

	Value Used in Analysis	
Survey Response (ounces)	**Ounces**	**Liters**
Less than 8	4	0.118
Approximately 8	8	0.237
Approximately 12	12	0.355
Approximately 16	16	0.473
Approximately 20	20	0.591
More than 20	24	0.710

4.3 Fish Consumption Estimation Methods

4.3.1 Fish Consumption Data

Fish consumption data were collected by each survey instrument; i.e., during interviews of boaters, beach visitors, campers, and shore anglers (see Section 3.2). As stated previously, while fish caught in the Spokane Arm of Lake Roosevelt (i.e., the Spokane River) were not included in this analysis, fish caught in the UCR by boaters who accessed the river from boat launches in the Spokane Arm were included. Questionnaire data represent a 12-month dietary recall for all survey participants, while the fish consumption diaries provide data for fish consumed by frequent fish consumers (i.e., survey participants who reported consuming 10 or more fish meals per year) over 3 consecutive months. The questionnaires provide data that enabled estimates for fish consumption rates for adults and children by location. Survey participants were asked whether they typically shared fish from the UCR with any children, and if so, they were also asked whether the children were under the age of 7 or between the ages of 7 and 17 years. To facilitate the collection of data on fish meal sizes, survey respondents and diary participants were shown a photograph of three sizes of fish fillets corresponding to 6-, 8-, and 10-ounce servings.

[16] SAS|STAT and SAS|Graph software version 9.3 of the SAS System for Windows. Copyright (c) 2002–2010 by SAS Institute Inc., Cary, NC, USA. All Rights Reserved; SAS|Enterprise Guide Version 5.1. Copyright (c) 2012 by SAS Institute Inc., Cary, NC, USA. All Rights Reserved.

Respondents provided one of the following five responses for their typical meal size for fish caught in the UCR: less than 6 ounces, 6 ounces, 8 ounces, 10 ounces, or greater than 10 ounces. Table 3 shows the values for fish meal size (grams [g]) that were assigned to each of the possible responses.

TABLE 3. Conversion of Survey Responses for Fish Meal Size

	Converted Value Used in Analysis	
Survey Response (ounces)	**Ounces**	**Grams (g)**
Less than 6	4	113
Approximately 6	6	170
Approximately 8	8	227
Approximately 10	10	283
More than 10	12	340

The fish diaries provided fish consumption data for adults and children.[17] The fish diaries included the date each fish meal was consumed, fish species that made up the meal, source of the fish (e.g., river reach, store), tissue consumed (e.g., skin, fillet, eggs), and meal sizes for both adults and children (IEc, 2010). Additional information regarding the survey instruments that were used to collect fish consumption information is provided in Section 3.2.

4.3.2 Methods for Estimating Fish Consumption

Sample weights (person weights; IEc, 2013b) were used to estimate the number of fish meals consumed per year, the size of fish meals (diary data only), and the long-term daily consumption rates that are provided in Sections 5.2.1 and 5.2.2. Daily fish consumption estimates were based on a combination of the questionnaire and diary data. The diary data were used if the survey participant provided three complete monthly diaries; otherwise, the questionnaire data were used. Prior to combining the questionnaire and diary data, the fish consumption data for each participant were reduced to one value: the average daily consumption rate for that participant (DCR_p). The DCR_p included only fish sourced from the UCR (Lake Areas 1–7). The sample weights were not used to calculate the average daily consumption rates for each participant.[18]

For the questionnaire data, the DCR_p was calculated as the total fish meals reported for the preceding 12 months, multiplied by the typical meal size (g), and then divided by 365 (days), as shown in Equation 1:

$$DCR_p = \left(\left(\sum meals_p\right) \times MS\right)/365 \qquad \textit{(Equation 1)}$$

where:

DCR_p = A participant's daily consumption rate (g/day)

[17] Fish diary participants were asked to also provide data for one of the children in the household (always the child with the birthday closest to January 1).

[18] Sampling weights were not used to calculate the average daily consumption rate for each individual participant because the individual consumption rates were calculated as a step in the data reduction process and are not intended to be population estimates.

$\sum meals_p$ = Total number of fish meals reported by the participant (or child)
MS = Typical fish meal size reported by the participant (g)
365 = # days/year

For the diary data, the DCR_p was calculated as the total amount (g) of fish ingested over the three diaries, divided by 90 (days), as shown in Equation 2:

$$DCR_p = (\sum MS)/90 \qquad \textit{(Equation 2)}$$

where:

DCR_p = A participant's daily consumption rate (g/day)
$\sum MS$ = Total amount (g) of fish consumed by the participant (or child) over 3 months
90 = # days represented by three diaries

The mean and P95 for the daily fish consumption rate (DCR) were calculated using the participants' DCR_p (Equations 1 and 2) and the sample weights (person weights; IEc, 2013b). The mean and P95 DCRs are for the population of recreational users of the UCR who are fish consumers. The mean and P95 DCRs were estimated using the SAS *SurveyMeans*[19] procedure. The confidence interval for the mean DCR was calculated using the Taylor series method (SAS, 2017; Wolter, 2006), and the confidence interval for the P95 DCR was estimated using Woodruff's method (SAS, 2017).

Consideration was given to adjusting the diary and/or questionnaire data to account for the difference in the lengths of time covered by the two survey instruments (90 vs. 365 days, respectively), as well as potential differences in recall error between the two survey instruments. As described in Section 5.2.3, the analysis did not support adjusting the questionnaire or the diary data prior to combining the data from the two sources.

4.4 Exposure Frequency and Duration Estimation Methods

4.4.1 Exposure Frequency

Exposure frequencies (EF; days/year) for beach trips, boat trips, and camping trips were estimated using the data provided by each respondent and their respective sample (person) weights. In addition to their current trip to the UCR, RecUse Survey respondents were asked about beach, boating, and camping trips during the previous 12 months. The boating and camping trips captured five seasons of data; in addition to the previous four seasons, participants were also asked to provide the number of boating and camping trips they had taken for the current season (i.e., the season corresponding to the interview date).[20] Therefore, to reduce the data to the number of trips per year for each participant, the

[19] SAS|STAT software version 9.3 of the SAS System for Windows. Copyright (c) 2002–2010 by SAS Institute Inc., Cary, NC, USA. All Rights Reserved.

[20] The questionnaire asked survey participants how many "beach day trips" they took to the UCR last summer but did not ask survey participants for the number of beach day trips they took during the current season.

time period (days) corresponding to the participant's reported trip numbers was calculated as 365 days (i.e., 1 year) plus the day number of the current season. To be consistent with the sampling design, the seasons were defined as follows:

- Winter: December – February
- Spring: March – May
- Summer: June – August
- Fall: September – November

For example, an interview date of September 30, 2010 would correspond to the 30th day of Fall, 2010; therefore, the time corresponding to the participant's responses for trip frequency would be 395 days (365 + 30). The 395 days would be used as the denominator to calculate the number of trips per year for that participant.

While not addressed specifically in the RecUse Survey SAP (IEc, 2010), separate estimates for the number of past trips for children were calculated using the sample weights for the adult survey respondent. For the purposes of estimating the number of trips per year for individuals less than 18 years of age, it was assumed that respondents who brought children with them on their current trip also brought children with them on past trips. Uncertainties in estimated exposure frequencies for children are discussed in Sections 5.4 and 6.

Sample weights were used to estimate age- and sex-specific frequencies. To estimate frequencies within each of the UCR regions (i.e., Lower, Middle, and Upper), locations (UCR beaches and UCR campgrounds) and destinations (lake areas for boating trips) were assigned to each response, based on information in the RecUse Survey Report (IEc, 2013b; see Appendix B of this report). Past boat day trips to the UCR that began from launches located in Lake Area 8 (Spokane River) were included in the EF estimates by adjusting the responses for each participant to reflect the number of past trips to include only the portion of the trip that was spent in the UCR (i.e., Lake Areas 1–7). The number of past trips to each lake area was calculated for each participant by dividing the number of past trips by the number of lake areas visited (which assumed equal time was spent in each lake area visited). The number of trips to Lake Area 8 was then omitted from the number of trips for each participant. These adjusted past trips for each participant were then used to estimate EF for the UCR with the SAS *SurveyMeans*[21] procedure. Confidence intervals for the mean were calculated with a Taylor series method and tolerance intervals for the P95s were estimated with Woodruff's method (SAS, 2017).

4.4.2 Exposure Time

As described in the RecUse Survey SAP (IEc, 2010), survey respondents would not likely be able to provide accurate data on the amount of time spent engaging in specific recreational activities (e.g., swimming) during past trips. Therefore, activity time data were gathered by asking survey respondents about the time spent on recreational activities during the past 24 hours. These data were then used to estimate ETs for the population of recreational users who engage in the specific activities.

[21] SAS|STAT software version 9.3 of the SAS System for Windows. Copyright (c) 2002–2010 by SAS Institute Inc., Cary, NC, USA. All Rights Reserved.

Estimates were calculated for each of the trip types (beach day trips, boating day trips, drive-in camping, and boat-in camping), UCR region visited (Upper, Middle, Lower), and recreational activity (e.g., swimming). Separate estimates for peak and off-peak seasons were not calculated given the small sample sizes for the off-peak season. Estimates were calculated for five age groups (0–6, 7–17, 17–45 [females only], 18–54, and 55+ years old). Estimates were also calculated for adults (7 years and older) and children (younger than 7 years old), corresponding to age ranges that will be used in the HHRA. Females in the 17–45-year age group were included for estimating hazards from the developmental toxins methyl mercury (MeHg) and lead. This age group is consistent with the National Health and Nutrition Examination Survey (NHANES)[22] age-grouping for women of childbearing potential.

For boating day trips and boat-in camping, responses provided by each participant were adjusted to remove portions of times spent engaging in activities (e.g., swimming) in Lake Area 8 (Spokane River) using the same approach described for adjusting participants' responses for past trips to the UCR (Section 4.4.1). Boat day trips and boat-in camping trips that began from launches located in Lake Area 8 were included in the ET estimates by adjusting the responses for each participant to reflect the number of hours they spent engaging in activities in Lake Areas 1–7. The time spent engaging in activities was assumed to be equally divided among the lake areas visited. The activity times for each participant were calculated for each lake area they reported visiting by dividing the hours they reported for each activity by the number of lake areas they reported visiting. The time spent engaging in activities in Lake Area 8 (Spokane River) was then omitted from the ETs for each participant. These adjusted activity times for each participant were then used to estimate ETs for the UCR with the SAS *SurveyMeans*[23] procedure. Confidence intervals for the mean were calculated with a Taylor series method and tolerance intervals for the P95s were estimated with Woodruff's method (SAS, 2017).

4.4.3 Outlier Identification

Survey responses for ET and EF were compared to plausible limits based on professional judgment (SRC, 2018a). The data were also evaluated to identify potential statistical outliers; i.e., responses that are plausible but are substantially different from most of the responses (SRC, 2018b). Based on a comparison of four methods that are available in the SAS *RobustReg* procedure (Chen, 2002; SAS, 2017), potential outliers were identified using the *MM* method (SAS, 2017; Yohai, 1987). Scatter plots were used to help interpret the potential outliers identified by the four methods and to evaluate the potential effect of outliers on parameter estimates (e.g., outliers with large sample weights).

The four outlier detection methods were compared using the EF data. The evaluation also considered the effect of including the sample weights in the outlier detection algorithm, or not; and the effect of using the raw data versus the natural logarithm of the data. The results are tabulated in Appendix A.[24] To summarize, with the natural logarithms of the EF data and using the sample weights, no outliers were detected for the beach, boating, or camping EF data. However, three outliers were detected for the

[22] http://www.cdc.gov/nchs/nhanes.htm.

[23] SAS|STAT software version 9.3 of the SAS System for Windows. Copyright (c) 2002–2010 by SAS Institute Inc., Cary, NC, USA. All Rights Reserved.

[24] See Chen (2002) for a complete definition of the four outlier detection methods analyzed: *M*, *LTS*, *S*, and *MM*.

camping EF data when the unweighted log-transformed data were used, which seems consistent with the scatter plots (Figures A-1 through A-3, Appendix A).

With the raw (not transformed) EF data, the effect of using the sample weights has the largest effect on the *MM* method and the least effect on the *S* and least trimmed squares (*LTS*) methods. The effect of using the sample weights on the *MM* method varied from no effect for the beach EF data to a relatively small effect on the boating and camping EF data: 36 more boating participants were flagged as potential outliers when the sample weights were used (i.e., 10% of the responses were flagged as potential statistical outliers with weights and 6% were flagged when the sample weights were not used). Eighteen fewer camping participants were flagged as potential outliers with the sample weights: 4% of the responses were identified as potential outliers with weights and 6% of the responses were identified as potential outliers when the sample weights were not used.

Based on the results of the comparison of outlier detection methods, the potential outliers were identified using the *MM* method with the unweighted, raw data. The number of potential statistical outliers (% of participants) identified for the beach, boating, and camping data are 51 (9%), 59 (6%), and 63 (6%), respectively. The number of flagged responses seems too large when the scatter plots of the data are considered (Appendix A). For example, the *MM* method flagged the adjusted number of beach trips that exceeded 34 as potential outliers, while the scatter plots for the raw data indicate 2 responses of 100 trips as potential outliers. Similarly, the scatter plots for the boating and camping trips show that approximately 6 and 3 responses are potential statistical outliers rather than the 59 and 63 flagged by the *MM* method. Furthermore, the *MM* method did not identify any outliers with the natural logarithms of the beach and boating data and flagged 3 responses for nights spent camping as potential outliers, which is consistent with the visual inspection of the scatter plots. Given the uncertainty in selecting an approach to identify potential statistical outliers, the outlier analysis should be considered an exploratory sensitivity analysis of the data and the statistical methods that are used to estimate the population parameters for ET and EF that are presented in this report. The results of the outlier analysis are presented in Section 5.4.3.

5.0 RESULTS

5.1 Overview

A summary of population characteristics is presented in the RecUse Survey Data Summary Report (IEc, 2013b). Key findings are summarized below.

A total of 2,908 surveys of on-site visitors were attempted between October 1, 2010 and September 30, 2011 (658 beach surveys; 1,243 boating surveys; and 1,007 camping surveys). IEc (2013b) calculated the response rate as the sum of completed interviews and ineligible respondents divided by attempted interviews. As reported by IEc (2013b), the response rate for completed surveys was 82% (2,109 surveys completed) with the highest response rate seen for the camping survey (87%, 876 surveys completed), followed by the boating survey (81%, 803 surveys completed), and the beach visitor survey (77%, 430 surveys completed). Sixteen of the camping surveys were completed by campground hosts (i.e., NPS volunteers) and were removed from the analysis (IEc, 2013b). These 16 camping surveys are not included in the data presented in Table 4. Most of the boating (91%) and camping (95%) surveys were completed during the peak season (May 28, 2011 to September 30, 2011). Approximately 42% of the completed surveys were obtained from locations in the Middle UCR region, while 38% were from the

Lower UCR and 19% were from the Upper UCR (Table 4). Each survey instrument gathered information for a single adult and one child (if the adult was accompanied by children).

TABLE 4. Summary of the Number of Completed Surveys by Survey Instrument and UCR Region (IEc, 2013b)[a]

UCR Region[b]	Boating	Camping[c]	Beach	Total
Lower	308 (38%)	337 (39%)	157 (36%)	802 (38%)
Middle	410 (51%)	298 (35%)	176 (41%)	884 (42%)
Upper	85 (11%)	225 (26%)	97 (23%)	407 (19%)
Total	803 (100%)	860 (100%)	430 (100%)	2,093 (100%)

[a]Data were obtained from IEc (2013b).
[b]See Section 2.4 for description of each UCR Region.
[c]IEc (2013b) removed 16 surveys completed at campgrounds by campground hosts (i.e., NPS volunteers) from the analysis.

The age- and sex-specific characteristics of these recreational users are presented in the RecUse Data Summary Report (IEc, 2013b). Overall, 60.5% of the survey respondents were male and 39.5% were female, with an average combined age of 49.1 years. Exhibit 39 in IEc (2013b) presents the estimated distribution of respondent ages. The age range most represented by survey respondents is 50–59-year-olds (25.5% of all respondents), followed by 40–49-year-olds (21.0% of all respondents).

Figure 3 shows the beaches visited by surveyed individuals as well as the frequency each location was visited. Figure 4 depicts the locations where camping surveys were conducted as well as the campgrounds people reported visiting in the previous year, and the estimated frequency that each campground was visited. Figure 5 shows the estimated frequency of boating trips, both by launch location and by river reach visited. The estimated frequencies for each location were calculated by multiplying each visitor's number of trips to the specified location by his or her sampling weight (defined in Section 3.1), summing the resulting weighted trips for each location, and then dividing the weighted trips for each location by the sum of weighted trips across all locations. The estimated frequencies are mapped as percentages for each survey location in Figures 3–5.

5.2 Fish Consumption

As described previously, the survey questionnaires provide data for fish caught in Lake Areas 1–8 (Figure 1). [25] Data for fish sourced from other locations, including fish purchased in a store or restaurant, were not collected. The fish consumption diaries provide data on the consumption of all fish meals, including fish caught from other water bodies located within the Local Area, fish caught outside the Local Area, and fish purchased from stores or restaurants. All fish consumption estimates used only data for fish sourced from the UCR study area (i.e., Lake Areas 1–7; UCR Reaches 1–6).

[25] The RI/FS and HHRA Work Plan divide the Site into six river reaches, which are also shown on Figure 1.

5.2.1 Summary of the Fish Consumption Data Provided by the Questionnaires

All consumption estimates are for the population of recreational users of the UCR who consume fish (i.e., "consumers only").[26] Bass, kokanee, rainbow trout, and walleye were the reported fish species most frequently consumed (Table 5)[27]. Most fish consumers reported eating only fillet. Consumption of other tissues (skin, eggs, head, and guts) varied across fish species, and by age and sex. For example, of participants who reported eating the skin of kokanee, the majority were males 55 years and older. Approximately 8% of males 55 years and older also consumed the head and eggs of kokanee; 2% of males 55 years and older also reported consuming the head and eggs of rainbow trout.

TABLE 5. Percentage of the Fish Consumers who Ingest Various Types of Fish Tissue, based on Data from the Questionnaires

				% Of People Who Ate Tissue Type[d]				
Species[a]	Age Group[b] (Years)	Sex	n[c]	Fillet	Skin	Eggs	Head	Guts
Bass	18–54	Female	23	98[e]	0	0	0	0
		Male	61	95	3	0	0	0
	55+	Female	19	100	14	0	0	0
		Male	50	100	0	0	0	0
Burbot	18–54	Female	1	100	100	0	0	0
		Male	5	100	0	0	0	0
	55+	Female	0	-	-	-	-	-
		Male	2	100	0	0	0	0
Carp	18–54	Female	0	-	-	-	-	-
		Male	1	100	0	0	0	0
	55+	Female	0	-	-	-	-	-
		Male	0	-	-	-	-	-
Kokanee	18–54	Female	20	100	0	0	0	0
		Male	29	100	1	0	2	0
	55+	Female	19	100	0	0	0	0
		Male	51	100	25	8	8	0
Perch	18–54	Female	3	100	0	0	0	0
		Male	2	100	0	0	0	0
	55+	Female	1	-	0	0	0	0
		Male	2	100	0	0	0	0
Rainbow trout	18–54	Female	83	100	6	0	0	0
		Male	141	100	5	0	0	0
	55+	Female	51	98	6	0	0	0
		Male	152	100	9	2	2	0

[26] Including people who did not report eating fish would bias the estimates low by including zero fish consumption results in the database for these people. On the other hand, omitting participants who reported they eat fish from the UCR but did not report eating fish in the 12 months preceding the survey interview would bias the estimates high, assuming that these people represent a portion of the population who eat fish sourced from the UCR less than once per year.

[27] Table 5 does not include data for fish sourced only from Lake Area 8. However, Table 5 includes data for fish sourced from the Spokane River (Lake Area 8) for participants who reported sourcing a specific type of fish from more than one lake area and one of those lake areas was Lake Area 8, because the data would not allow allocating the percentage of fish tissue types consumed among the lake areas.

TABLE 5. Percentage of the Fish Consumers who Ingest Various Types of Fish Tissue, based on Data from the Questionnaires

Species[a]	Age Group[b] (Years)	Sex	n[c]	% Of People Who Ate Tissue Type[d]				
				Fillet	Skin	Eggs	Head	Guts
Walleye	18–54	Female	85	99	2	0	0	0
		Male	178	95[f]	0	0	0	0
	55+	Female	56	99	5	0	0	0
		Male	173	100	1	0	0	0

[a]Some fish types reported by participants were changed to reflect actual species found in the UCR: "lingcod" were changed to burbot, "triploid" were changed to rainbow trout, and "salmon" were changed to kokanee (STI, 2019).
[b]Data on fish tissue consumption were collected from the respondents; questions were not specifically addressed to children.
[c]Number of survey respondents who provided responses for the fish species.
[d]Percentages were calculated using the sample weights for individuals (person weights) (see Appendix F of IEc, 2013b).
[e]Two of the 23 female respondents who reported consuming bass did not report the type of tissue consumed.
[f]Five of the 178 male respondents who reported consuming walleye did not report the type of tissue consumed.

The estimated number of meals per person per year by UCR region for individual fish species is provided in Table 6. Respondents primarily reported consuming walleye, rainbow trout, bass, and kokanee (Table 6). In the Lower UCR region (Figure 1), most respondents reported consuming rainbow trout (n = 203), walleye (n = 160), bass (n = 78), and kokanee (n = 87). In the Middle and Upper UCR regions (Figure 1), the majority of respondents reported consuming walleye (n = 197 and 239, respectively), rainbow trout (n = 166 and 90, respectively), and bass (n = 53 and 39, respectively). Rainbow trout and walleye were the most frequently consumed species of fish sourced from the UCR.

TABLE 6. Mean Fish Meals per Year and Daily Consumption Rates for Fish Consumers (only), based on Data from the Questionnaires

UCR Lake Region[a]	Species[b]	n[c]	Average Number of Meals/Person/ Year[d]	Daily Consumption Rate (g/day)	Expected Margin of Error (ME) and Relative Error (RE)[e]	Actual ME and RE[f]
Lower	Bass	78	4.1	2.2		
	Burbot	2	8.1	5.0		
	Crayfish	1	10.0	3.1		
	Kokanee	87	3.6	2.2		
	Perch	1	1.0	0.5		
	Rainbow trout	203	5.0	2.9		
	Walleye	160	4.3	2.3		
	All species	282	8.2	4.7	5.7, 11%	1.6, 20%
Middle	Bass	53	2.3	1.4		
	Burbot	2	0.9	0.5		
	Kokanee	18	3.8	2.4		
	Perch	2	3.1	2.8		
	Rainbow trout	166	5.2	3.2		
	Walleye	197	5.0	3.1		
	All species	271	7.2	4.4	5.7, 12%	1.2, 16%

TABLE 6. Mean Fish Meals per Year and Daily Consumption Rates for Fish Consumers (only), based on Data from the Questionnaires

UCR Lake Region[a]	Species[b]	n[c]	Average Number of Meals/Person/ Year[d]	Daily Consumption Rate (g/day)	Expected Margin of Error (ME) and Relative Error (RE)[e]	Actual ME and RE[f]
Upper	Bass	39	4.9	3.9		
	Burbot	4	1.9	1.2		
	Carp	1	1.0	0.9		
	Kokanee	11	2.7	1.7		
	Perch	5	1.0	0.7		
	Rainbow trout	90	4.7	2.8		
	Walleye	239	5.6	3.7		
	All species	271	6.9	4.6	5.6, 16%	1.7, 25%
Not provided	Bass	7	0.3	0.2		
	Kokanee	6	0.3	0.2		
	Rainbow trout	30	0.4	0.2		
	Trout	1	0.7	0.4		
	Walleye	16	0.8	0.4		
All Regions[g]	Bass	147	4.0	2.4		
	Burbot	8	4.1	2.5		
	Carp	1	1.0	0.9		
	Crayfish	1	10.0	3.1		
	Kokanee	113	3.6	2.2		
	Perch	8	1.3	1.0		
	Rainbow Trout	398	5.5	3.3		
	Walleye	480	5.4	3.3		
	All Species	645	8.8	5.2	3.0, 7%	1.2, 14%

[a]The RI/FS and HHRA Work Plans divide the site into river reaches, which are also shown on Figure 1. Each UCR region consisted of the following river reaches (approximate). Upper: River Reaches 1, 2, and 3; Middle: River Reaches 4a and 4b; and Lower: River Reaches 5, 6, and 11 (see Section 2.4 for additional information).

[b]Some fish types reported by participants were changed to reflect actual species found in the UCR: "lingcod" were changed to burbot, "triploid" were changed to rainbow trout, and "salmon" were changed to kokanee (STI, 2019).

[c]Number of survey respondents who provided responses for a given species and source. Sample (person) weights were not used to calculate these values.

[d]Responses for the number of meals consumed per year were divided equally among the river areas where the respondents reported catching fish. Sample (person) weights were used to estimate the number of meals and the daily consumption rates.

[e]ME is the half-width of the confidence interval (assuming a normal distribution of means): (upper confidence limit [UCL]-lower confidence limit [LCL])/2, in units of fish meals per year.

[f]RE is the ME divided by the estimated number of fish meals per year, expressed as a percentage.

[g]"All Regions" does not include the responses when the participants identified the source as either lower, middle, or upper lake region (i.e., "Not Provided" is not included).

5.2.2 Summary of Fish Consumption Data Provided by the Fish Diaries

Of the respondents who agreed to participate (n = 199), 145 completed at least 1 month of the fish consumption diary, and 134 participants completed all 3 months of the fish consumption diary. All estimates provided in the remainder of the report are for participants who provided three complete monthly diaries. Statistics for the estimated meal sizes (g/meal) of participants are presented in Table 7. Estimated mean meal sizes ranged from 113 to 303 g across all age groups, fish species, and locations. The estimates of the mean meal sizes are similar to the estimates of the median, which indicates the distribution of meal size is not positively skewed. Statistics for the number of fish meals per year are

presented in Table 8. Rainbow trout and walleye were the most frequently consumed species of fish sourced from the UCR.

TABLE 7. Meal Size Statistics (grams) Based on Data from the Diaries

Source[a]	Species	Age Group (years)	Meal Size (g)[b]							
							Percentile			
			n[c]	Mean	LCL95	UCL95	Median	P95	LTL95	UTL95
UCR	Bass	0–6	1	170	170	170	170	170	.	.
		18–54	7	211	193	229	208	277	.	.
		55+	9	206	181	230	189	275	.	.
	Burbot	55+	1	283	283	283	283	283	.	.
	Kokanee	7–17	1	283	283	283	283	283	.	.
		18–54	1	170	170	170	170	170	.	.
		55+	14	224	191	257	227	282	229	334
	Rainbow trout	0–6	4	134	108	159	113	162	.	.
		7–17	12	192	169	216	170	250	.	.
		18–54	23	210	178	242	186	280	.	.
		55+	51	234	208	260	236	340	.	.
	Walleye	0–6	6	129	108	150	113	207	.	.
		7–17	13	188	158	217	198	257	.	.
		18–54	38	222	199	245	227	328	299	357
		55+	53	257	234	280	243	335	.	.
	Other	18–54	2	215	152	279	170	269	.	.
		55+	4	293	260	327	283	327	.	.
	All Species	0–6	8	133	112	154	113	194	.	.
		7–17	19	194	171	216	170	256	.	.
		18–54	43	213	191	235	191	288	257	320
		55+	72	239	217	261	227	340	.	.
		17–45[d]	4	175	162	187	166	210	.	.
		HHRA-Child[e]	8	133	112	154	113	194	.	.
		HHRA-Adult[e]	134	226	210	243	227	340	.	.

TABLE 7. Meal Size Statistics (grams) Based on Data from the Diaries

Source[a]	Species	Age Group (years)	Meal Size (g)[b]							
							Percentile			
			n[c]	Mean	LCL95	UCL95	Median	P95	LTL95	UTL95
Local–Not UCR	Bass	0–6	1	170	170	170	170	170	.	.
		18–54	4	274	225	323	227	332	.	.
	Kokanee	18–54	1	227	227	227	227	227	.	.
		55+	4	220	161	278	170	298	.	.
	Rainbow trout	0–6	1	113	113	113	113	113	.	.
		7–17	2	170	170	170	170	170	170	170
		18–54	7	203	157	249	204	279	.	.
		55+	5	222	204	239	227	250	.	.
	Walleye	0–6	1	170	170	170	170	170	.	.
		7–17	3	217	170	264	217	273	.	.
		18–54	8	254	223	284	227	325	.	.
		55+	11	285	243	327	283	338	.	.
	Other	55+	5	303	257	349	340	338	.	.
Outside Local Area	Bass	55+	1	283	283	283	283	283	.	.
	Kokanee	0–6	1	113	113	113	113	113	.	.
		18–54	1	170	170	170	170	170	.	.
		55+	5	191	169	212	198	213	.	.
	Perch	55+	1	227	227	227	227	227	.	.
	Rainbow trout	0–6	2	181	160	203	170	213	.	.
		7–17	2	173	167	178	170	170	.	.
		18–54	8	212	197	227	198	227	.	.
		55+	12	237	194	279	227	309	.	.
	Walleye	18–54	3	250	180	321	283	329	.	.
		55+	7	255	241	269	255	278	.	.
	Other	0–6	2	147	116	179	170	165	.	.
		7–17	1	227	227	227	227	227	.	.
		18–54	8	244	228	260	255	254	.	.
		55+	21	222	159	284	227	332	.	.
Restaurant	Other	18–54	6	143	127	159	132	181	.	.
		55+	8	207	168	246	170	278	.	.
Store	Other	0–6	1	113	113	113	113	113	.	.
		07–17	1	160	160	160	160	160	.	.
		18–54	6	156	145	168	151	159	.	.
		55+	8	209	166	252	198	274	.	.

TABLE 7. Meal Size Statistics (grams) Based on Data from the Diaries

Source[a]	Species	Age Group (years)	Meal Size (g)[b]							
							Percentile			
			n[c]	Mean	LCL95	UCL95	Median	P95	LTL95	UTL95
Unknown	Bass	55+	2	131	95	167	113	198	.	.
	Kokanee	7–17	1	142	142	142	142	142	.	.
		18–54	1	170	170	170	170	170	.	.
		55+	1	170	170	170	170	170	.	.
	Rainbow trout	18–54	2	256	223	289	283	278	.	.
		55+	1	283	283	283	283	283	.	.
	Walleye	18–54	3	221	213	230	227	225	.	.
		55+	3	227	227	227	227	227	227	227
	Other	0–6	1	113	113	113	113	113	.	.
		7–17	1	283	283	283	283	283	.	.
		18–54	6	266	244	288	283	283	.	.
		55+	10	200	161	239	227	281	.	.

LCL95, UCL95 = lower and upper two-sided, 95% upper confidence limit of the mean; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile (P95).

Notes: 1. Only participants who provided three completed diaries (i.e., three months of data) were included in this table.

2. Local Area: as defined in the *Data Analysis Report for the Tribal Consumption and Resource Use Survey for the Upper Columbia River Site HHRA and RI/FS* (SRC, 2015) as the Upper Columbia River from the Grand Coulee Dam to the U.S.-Canada border, and the land located within the geographic extent of the CCT Resource Zones.

[a]UCR = Lake Areas 1–7 (River Reaches 1–6); Local-Not UCR = Lake Area 8, Columbia River below Coulee Dam but located within Local Area, and other sources located within the Local Area, except the UCR; Outside Local Area = non-local fishing sites. Data were assigned to the "Unknown" category when the source was not provided or when they could not be assigned to one of the other source categories.

[b]Meal sizes were first averaged for each diary participant by source and fish species. Meal size statistics were calculated using the sample weights for individuals (person weights) (see Appendix F of IEc, 2013b).

[c]Number of diary participants who provided responses for a given species and source. Participants with missing age data are not included in this table.

[d]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[e]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

TABLE 8. Number of Fish Meals Per Year, Based on Data from Diaries

Source[a]	Species	Age Group (years)	Number of Fish Meals[b]							
							Percentile			
			n[c]	Mean	LCL95	UCL95	Median	P95	LTL95	UTL95
UCR	Bass	0–6	1	1.0	1.0	1.0	1.0	1.0	.	.
		18–54	7	2.6	1.7	3.4	3.0	4.6	.	.
		55+	9	2.4	0.9	3.9	1.0	3.0	.	.
	Burbot	55+	1	1.0	1.0	1.0	1.0	1.0	.	.
	Kokanee	7–17	1	2.0	2.0	2.0	2.0	2.0	.	.
		18–54	1	1.0	1.0	1.0	1.0	1.0	.	.
		55+	14	1.6	1.0	2.2	1.0	2.9	.	.
	Rainbow trout	0–6	4	1.4	0.9	1.8	1.0	1.9	.	.
		7–17	12	2.2	1.0	3.4	1.0	6.1	.	.
		18–54	23	3.3	1.1	5.5	1.0	7.8	.	.
		55+	51	5.7	4.3	7.1	5.0	10	7	13

TABLE 8. Number of Fish Meals Per Year, Based on Data from Diaries

			Number of Fish Meals[b]							
							Percentile			
Source[a]	Species	Age Group (years)	n[c]	Mean	LCL95	UCL95	Median	P95	LTL95	UTL95
Local–Not UCR	Walleye	0–6	6	1.4	1.0	1.8	1.0	3	.	.
		7–17	13	2.5	1.7	3.2	2.0	5	.	.
		18–54	38	4.9	3.1	6.7	3.0	11	.	.
		55+	53	6.0	4.9	7.1	6.0	10	.	.
	Other	18–54	2	1.8	0.7	2.9	1.0	3	.	.
		55+	4	4.1	0.2	8.1	1.0	8	.	.
	All Species	0–6	8	1.8	1.1	2.5	1.0	3.4	.	.
		7–17	19	2.7	1.2	4.2	2.0	7.3	.	.
		18–54	43	5.8	3.0	8.5	4.0	14	.	.
		55+	72	9.0	7.1	11	8.0	20	.	.
		17–45[d]	4	12	6.4	17	15	17	.	.
		HHRA-Child[e]	8	1.8	1.1	2.5	1.0	3.4	.	.
		HHRA-Adult[e]	134	7.4	5.7	9.0	6.0	19	.	.
	Bass	0–6	1	1.0	1.0	1.0	1.0	1.0	.	.
		18–54	4	1.0	1.0	1.0	1.0	1.0	1	1
	Kokanee	18–54	1	1.0	1.0	1.0	1.0	1.0	.	.
		55+	4	1.4	0.9	1.9	1.0	2.3	.	.
	Rainbow trout	0–6	1	1.0	1.0	1.0	1.0	1.0	.	.
		7–17	2	1.6	1.1	2.2	2.0	1.9	.	.
		18–54	7	1.7	0.9	2.5	1.0	4.1	.	.
		55+	5	1.6	0.4	2.8	1.0	4.3	.	.
	Walleye	0–6	1	2.0	2.0	2.0	2.0	2.0	.	.
		7–17	3	2.6	0.7	4.5	2.0	5.2	.	.
		18–54	8	3.9	2.1	5.7	2.0	10	.	.
		55+	11	2.5	2.0	3.1	3.0	3.7	.	.
	Other	55+	5	3.6	0.0	7.5	1.0	10	.	.
Outside Local Area	Bass	55+	1	2.0	2.0	2.0	2.0	2	.	.
	Kokanee	0–6	1	1.0	1.0	1.0	1.0	1.0	.	.
		18–54	1	2.0	2.0	2.0	2.0	2.0	.	.
		55+	5	8	0	18	2	22	.	.
	Perch	55+	1	2.0	2.0	2.0	2.0	2.0	.	.
	Rainbow trout	0–6	2	1.0	1.0	1.0	1.0	1.0	1	1
		7–17	2	2.0	1.9	2.1	2.0	1.9	.	.
		18–54	8	2.1	1.9	2.3	2.0	2.5	.	.
		55+	12	3.3	1.9	4.7	3.0	5.3	.	.
	Walleye	18–54	3	1.9	0.6	3.2	1.0	3.5	.	.
		55+	7	1.6	1.1	2.0	2.0	1.9	.	.
	Other	0–6	2	1.6	1.0	2.2	2.0	1.9	.	.
		7–17	1	4.0	4.0	4.0	4.0	4.0	.	.
		18–54	8	4.1	3.4	4.9	4.0	6.2	.	.

TABLE 8. Number of Fish Meals Per Year, Based on Data from Diaries

Source[a]	Species	Age Group (years)	Number of Fish Meals[b]							
			n[c]	Mean	LCL95	UCL95	Percentile			
							Median	P95	LTL95	UTL95
		55+	21	1.7	1.2	2.2	1.0	4.3	.	.
Restaurant	Other	18–54	6	2.5	1.9	3.1	3.0	2.9	.	.
		55+	8	1.2	0.9	1.6	1.0	2.2	.	.
Store	Other	0–6	1	2.0	2.0	2.0	2.0	2.0	.	.
		07–17	1	11	11	11	11	11	.	.
		18–54	6	5.5	4.4	6.5	6.0	7.5	.	.
		55+	8	4.4	2.1	6.6	2.0	12	.	.
Unknown	Bass	55+	2	1.1	0.9	1.4	1.0	1.6	.	.
	Kokanee	7–17	1	2.0	2.0	2.0	2.0	2.0	.	.
		18–54	1	2.0	2.0	2.0	2.0	2.0	.	.
		55+	1	4.0	4.0	4.0	4.0	4.0	.	.
	Rainbow trout	18–54	2	1.5	0.9	2.1	2.0	1.9	.	.
		55+	1	1.0	1.0	1.0	1.0	1.0	.	.
	Walleye	18–54	3	4.4	1.6	7.3	7.0	6.5	.	.
		55+	3	1.0	1.0	1.0	1.0	1.0	1	1
	Other	0–6	1	4.0	4.0	4.0	4.0	4.0	.	.
		7–17	1	1.0	1.0	1.0	1.0	1.0	.	.
		18–54	6	3.3	0.0	6.7	1.0	5.7	.	.
		55+	10	1.6	1.1	2.2	1.0	2.9	.	.

LCL95, UCL95 = lower and upper two-sided, 95% upper confidence limit of the mean; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile (P95).

Notes: 1. Only participants who provided three completed diaries (i.e., three months of data) were included in this table.

2. Local Area: as defined in the *Data Analysis Report for the Tribal Consumption and Resource Use Survey for the Upper Columbia River Site HHRA and RI/FS* (SRC, 2015) as the Upper Columbia River from the Grand Coulee Dam to the U.S.-Canada border, and the land located within the geographic extent of the CCT Resource Zones.

[a] UCR = Lake Areas 1–7 (River Reaches 1–6); Local-Not UCR = Lake Area 8, Columbia River below Coulee Dam but located within Local Area, and other sources located within the Local Area, except the UCR; Outside Local Area = non-local fishing sites. Data were assigned to the "Unknown" category when the source was not provided or when they could not be assigned to one of the other source categories.
Data were assigned to the "Unknown" category when the source was not provided or when they could not be assigned to one of the other source categories.

[b] Meal numbers were first totaled for each diary participant by source and fish species. The number of fish meal statistics were calculated using the sample weights for individuals (person weights) (IEc, 2013b, Appendix F).

[c] Number of diary participants who provided responses for a given species and source. Participants with missing age data are not included in this table.

[d] This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[e] Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.2.3 Estimates for Fish Consumption

The mean and P95 DCRs for fish were calculated as described in Section 4.3.2. Prior to combining the questionnaire and diary data, the data were evaluated to determine if they should be adjusted due to possible differences in the number or size of fish meals reported on the two survey instruments. A comparison of the meal sizes reported in the diaries to the meal sizes reported on the questionnaires for each of the diary participants showed that the meals were on average 10% larger in the diaries, but no clear relationship between the meal sizes is evident from the data (Figure 6). On average, without adjusting the data, the number of meals reported on the three diaries was approximately 39% of

the number of meals that were reported on the questionnaire; however, it is not clear how much of this difference is explained by the length of time covered by the 2 survey instruments (3 months vs. 12 months) and there is no clear pattern in the responses. Given the lack of any pattern between the questionnaire and diary data, the daily ingestion rates from the diary and questionnaire (Equations 1 & 2) were combined without making any adjustments.

Estimates of the mean and P95 DCRs for fish (g/day) are provided in Table 9. The mean and P95 DCRs for adults are 6.3 and 28 g/day, respectively. The margins of error (MEs) for the mean and P95 DCRs for adults are 1.1 and 6.0 g/day, respectively. While the 95% confidence intervals are narrow for the mean DCR (5.2, 7.4 g/day), the 95% tolerance intervals for the P95 (22, 34 g/day) are substantially wider, although the relative errors (RE) are similar (mean RE = 17%, P95 RE = 21%).

The questionnaires do not provide sufficient information to estimate a DCR for children 0–6 years of age. Too few children 0–6 years old reported fish consumption on the diary to derive a reliable estimate of the mean or P95 DCR. The mean and P95 DCRs for children (3.5 and 5.8 g/day, respectively) represent data obtained from the diary only.

The data include 3 completed diaries for just 4 women between the ages of 17 and 45 years; however, data for an additional 74 women in this age group are available from the questionnaires, for a total sample size of 81 (Table 9). The estimate of the mean and P95 for women 17–45 years of age, based on the combined questionnaire and diary data (n = 81), are 3.8 and 26 g/day, respectively.

The method used to estimate DCRs presented in Table 9 deviated from the method that is described in the RecUse SAP (the SAP method). The SAP method included a "proportion" parameter (IEc, 2010; Equation 5) that was designed to facilitate estimating DCRs by river reach, species, and month. The ingestion rate by the SAP method was found to be very sensitive to the proportion parameter (Figure 7). At this time, the method described in Section 4.3.2 is preferred. If DCR estimates are required by location or fish species for the HHRA, a modified version of the SAP method may be considered.

TABLE 9. Daily Fish Consumption Rates (grams/day), Based on All Fish Species for UCR Reaches 1–6

Age Group (years)	N [a]	Mean	LCL95	UCL95	P95	LTL95	UTL95
0–6	7	3.5	1.9	5.0	5.8	.	.
7–17	19	6.4	2.3	10	20	.	.
18–54	373	4.7	3.7	5.6	24	17	30
55+	305	7.8	5.8	9.7	34	24	45
17–45[b]	81	3.8	1.7	5.9	26	.	.
HHRA-child[c]	7	-[d]	-[d]	-[d]	-[d]	.	.
HHRA-adult[c]	697	6.3	5.2	7.4	28	22	34

LCL95, UCL95 = lower and upper two-sided, 95% upper confidence limit of the mean; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile (P95).

[a]Sample sizes for the 0–6 and 7–17 age groups represent the diary only; questionnaires did not provide fish consumption data for children.

[b]This age group includes women, 17–45 years of age. This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as younger than 7 years of age.

[d]The Data Analysis Report does not provide sufficient data to estimate a DCR for children. See Section 5.2.4 for additional discussion.

5.2.4 Sources of Uncertainty in Fish Consumption Rate Estimates

As described in Section 4.3.1, participants reported fish meal sizes by choosing one of five categories: less than 6 ounces, 6 ounces, 8 ounces, 10 ounces, or greater than 10 ounces. Table 3 shows the fish meal size (g) that were assigned to each of the possible responses. Meal sizes reported as greater than 10 ounces were assigned a meal size of 12 ounces for the purposes of estimating DCR. A meal size of 12 ounces is consistent with fish meal sizes reported in Table 6 in Columbia River Inter-Tribal Fish Commission (CRITFC, 1994), which shows that 97.6% of meals were 12 ounces or less in size. However, to evaluate the sensitivity of imputing meal sizes for the largest meal size category (i.e., larger than 10 ounces), DCRs were estimated using 14 ounces for the largest meal size category. Imputing 14 ounces for the largest meal size category had no effect on the mean or P95 DCR for children. The mean and P95 DCR for adults increased by approximately 0.2 and 0.4 g/day, respectively. The largest effect of the increase in maximum fish meal on DCR was observed for women 17–45 years old; the mean and P95 DCRs increased by approximately 0.2 and 2 g/day, respectively. This shows that the estimates for the DCRs are not sensitive to the value that was imputed for the largest meal size.

The DCRs were estimated for fish sourced from the UCR (Lake Areas 1–7; Figure 1); however, fish travel freely between the UCR and the Spokane Arm of Lake Roosevelt (Lake Area 8) to meet their life history and habitat needs due to the lack of physical barriers between the Spokane Arm and the mainstem of the UCR. To evaluate uncertainty in fish DCRs introduced by the omission of fish consumption data from Lake Area 8, the DCRs were also calculated using fish consumption data for fish sourced from Lake Area 8 (Spokane River), using the combined questionnaire and fish diary data (Section 5.2.3). Including fish sourced from Lake Area 8 did not have a substantial effect on the DCR estimated for adults (Table 10). Including fish sourced from Lake Area 8 increased the mean DCR for children from 3.5 to 4.5 g/day and the P95 DCR from 5.8 to 10 g/day (Table 10).

TABLE 10. Estimate of Daily Fish Consumption Rates (grams/day) using Combined Diary and Questionnaire Data to Evaluate Effect of Including Fish Sourced from Lake Area 8

	Child DCR (g/day)[b]			Adult DCR (g/day)[b]		
Statistic[a]	Without Area 8[c]	With Area 8[d]	Delta (w/o 8 – w/ 8)[e]	Without Area 8[c]	With Area 8[d]	Delta (w/o 8 – w/ 8)[e]
n	7	7	0	697	702	5
SumWgt	57	57	0	18850	18889	39
Mean	3.5	4.5	1.0	6.3	6.4	0.1
LCL95	1.9	1.7	-0.2	5.2	5.3	0.05
UCL95	5.0	7.3	2.3	7.4	7.6	0.2
Minimum	1.3	1.3	0	0.1	0.1	0
Maximum	6.3	11	5.0	134	134	0
P95	5.8	10	4.2	27.9	28.4	0.5
LTL95	.	.	.	21.9	22.5	0.5

TABLE 10. Estimate of Daily Fish Consumption Rates (grams/day) using Combined Diary and Questionnaire Data to Evaluate Effect of Including Fish Sourced from Lake Area 8

	Child DCR (g/day)[b]			Adult DCR (g/day)[b]		
Statistic[a]	Without Area 8[c]	With Area 8[d]	Delta (w/o 8 – w/ 8)[e]	Without Area 8[c]	With Area 8[d]	Delta (w/o 8 – w/ 8)[e]
UTL95	.	.	.	33.9	34.3	0.4

LCL95, UCL95 = lower and upper two-sided, 95% upper confidence limit of the mean; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile (P95).
[a]Diary data were used for participants who completed 3 monthly diaries and questionnaire data were used for participants who did not complete 3 diaries.
[b]Adults are defined as 7 years and older; children are defined as younger than 7 years of age.
[c]Without Area 8: statistics for DCR for the UCR. The data include fish sourced only from Lake Areas 1–7; fish sourced from Lake Area 8 (Spokane River) are not included.
[d]With Area 8: statistics for DCR for fish sourced from Lake Areas 1–8; fish sourced from Lake Area 8 (Spokane River) are included.
[e]Delta (w/o 8 – w/ 8): shows the difference between statistics that were estimated with fish sourced from Lake Areas 1–8 and statistics that were estimated without fish sourced from Lake Area 8. Positive values indicate higher DCRs when the fish sourced from Lake Area 8 are included.

Exhibit 15 of the RecUse SAP (IEc, 2010) provides the anticipated sample size for questionnaires that included UCR fish consumers and the anticipated REs.[28] Table 6 compares the anticipated REs to REs that were calculated using the questionnaire data. The actual RE for all lake regions combined is just 14%, which corresponds to an ME of +/- 1.2 meals/year. The actual REs exceed the anticipated REs for each of the lake regions, but the actual MEs are all less than a third of the anticipated MEs because the anticipated REs are based on an estimate of 42 meals/year (IEc, 2010; Patrick, 1997). The actual sample size for all regions (n = 645) is very large, but less than the anticipated sample size (n = 976).

The presence of fish consumption advisories for the UCR is likely to cause a low bias in the estimates for DCRs for fish. Participants who reported eating fish sourced from the UCR were asked if they were aware of fish consumption advisories that were issued for the UCR. Approximately one-half of the male fish consumers and one-third of the female fish consumers were aware of some advisories (IEc, 2013b). The effect of the advisories on DCRs for fish is uncertain. While only 3% of those who were aware of the advisories reported fishing less, approximately 20% of those who were aware of the advisories reported consuming less fish due to the advisories (IEc, 2013b).

Another source of uncertainty in the DCRs is the severe drawdown in Lake Roosevelt in 2011 due to the high snowfall amounts experience in portions of the UCR watershed that year (IEc, 2013b). As a result, all boat launches operated by the NPS were not available for approximately 2 weeks and many were not available for over 2 months (see Appendix C). This likely resulted in a low bias in the fish consumption rates that were reported on questionnaires; this is discussed in Section 6.5.

The sample size (n = 7) is not sufficient to produce reliable estimates for DCRs for children. A reliable estimate of DCRs for children may be derived by multiplying the estimated DCRs for adults presented in Table 9 by a ratio of children-to-adult dietary intake. The ratio of children-to-adult dietary intake could be estimated using estimated energy requirements for children and adults based on regression models presented in IOM (2005).

[28] REs are the half-width of the confidence interval divided by the parameter estimate; RE (%) = t*standard error/parameter estimate, where the t is the value of the t-distribution for n-1 and alpha = 0.05.

5.3 Intentional Consumption of UCR Water

The RecUse Survey provided data on intentional consumption of water from the UCR during boating, camping, and beach visits. Water consumption was rare at the UCR during recreational activities. Over the 12 months of the survey, only one adult (no children) was reported to have consumed water from the lower region of the UCR, one adult and two children drank water from the middle region of the UCR, and four adults and three children drank water from the upper region of the UCR. This exposure pathway was therefore considered incomplete for the HHRA.

5.4 Recreational Use

The RecUse Survey provided data on camping, swimming, wading, water-skiing/tubing, boating, and visiting beaches. Data on these scenarios will be used to provide information on:

- Types of exposures that occur during each activity (i.e., oral, dermal, inhalation).
- Number and percentage of individuals exposed, stratified by UCR location, age, and sex.
- Frequency and length of time of exposures related to specific recreational activities.

As described in Section 2.3, the data from the RecUse Survey will be used to estimate exposure parameters for pathways associated with recreational scenarios in the HHRA. The survey frequency data consist of recalls of the number of days each participant engaged in a recreational activity in the 12 months preceding the RecUse Survey interview. The time data consist of the number of hours per day that a participant engaged in an activity. Estimates are presented by activity, UCR location category (see Figures 3–5), age category, and sex. The activities are briefly defined in this report; more detailed descriptions are provided in IEc (2013b).

Responses to questions regarding the number of trips taken per year and the amount of time spent engaging in various activities were compared to plausible limits. The plausible limits were based on professional judgment (SRC, 2016). The activities and associated plausible limits (in parentheses) are summarized below:

- Total hours spent swimming or wading (8 hours/day for day trips and 12 hours/day for campers).
- Total hours spent water-skiing, tubing, or participating in similar activities (8 hours/day for day trips and 12 hours/day for campers).
- Total hours spent on the beach or sand along the shore (16 hours/day for day trips and 24 hours/day for campers).
- Number of UCR boat trips or camping days[29] per season (90 per season [360 per year] each for boating and camping trips).
- Number of UCR beach trips per season (summer: 122 days).

[29] Survey questionnaires asked for the number of "nights" spent camping; for the purposes of estimating EF, the number of nights are treated as if they were equivalent to days (which assumes half of the first day and last day are spent camping and half are spent traveling to and from the camp site).

Responses that exceeded the plausible limits follow:

- One respondent (with a child) reported taking 150 trips to the beach in the prior summer.
- One respondent reported between 160 and 250 boating trips per season (this person was accompanied by one or more children).

Responses that exceeded the plausible limits were replaced with the plausible limit.

5.4.1 Exposure Frequency

5.4.1.1 Overview

This section presents estimates for the number of days spent engaging in recreational activities (other than fishing), and the location where these activities occur (i.e., UCR Region). As described in Section 2.3, EF describes how often a person is likely to be exposed to the potentially contaminated medium over the course of a typical year and is expressed in units of days/year. The RecUse Survey collected frequency data from 2,093 individuals regarding their participation in recreational trips associated with surface water (e.g., swimming, wading, boating) and soil/sediment (e.g., beach-going, camping) within the 12 months preceding the survey interview. These data will be used in the HHRA to refine the EF estimates for the recreational exposure scenario.

Table 11 presents estimates of the mean and P95 for the number of beach day trips/year, the number of boat day trips/year and the number of days spent camping/year by UCR region, age group, and sex. Each of the recreational trip types is discussed separately in the following sections for beach, camping, and boating trips.

TABLE 11. Estimated Frequency (days/year) of Recreational Visits to the UCR

UCR Region	Age Group (years)[a]	Sex	Beach Trips			Boat Trips			Camping Trips		
			n[b]	Mean	P95	n	Mean	P95	n	Mean	P95
Lower	0–6	F	12	9.2	12.0	16	5.4	17.8	5	5.5	8.2
		M	17	2.5	12.0	15	3.4	13.8	11	4.5	6.5
	7–17	F	15	4.2	10.0	36	4.3	18.6	27	5.6	12.8
		M	28	11.6	60.0	54	7.1	28.7	24	9.9	32.9
	18–54	F	42	7.5	16.0	81	4.4	17.2	50	5.3	13.6
		M	36	8.5	60.0	113	6.3	36.2	63	7.2	22.6
	55+	F	21	6.2	12.0	37	5.8	30.3	21	6.0	11.9
		M	18	3.2	5.0	94	6.1	18.6	38	5.4	16.6
	17–45[c]	F	31	4.5	20.0	55	3.8	18.6	31	5.3	12.7
	Adult[d]		163	7.3	20.0	417	5.8	19.9	224	6.4	19.9
	Child[d]		29	6.3	12.0	34	4.2	13.8	18	5.1	10.3
Middle	0–6	F	16	5.4	24.0	18	3.5	6.3	15	3.8	8.9
		M	32	3.4	10.0	22	4.8	12.2	16	4.8	10.7
	7–17	F	40	6.0	21.0	45	5.8	18.6	32	3.8	8.7
		M	43	5.5	12.0	61	4.8	17.6	46	4.6	19.4
	18–54	F	102	6.7	34.0	98	4.0	11.4	85	5.8	24.9
		M	96	6.9	21.0	142	3.9	16.6	92	7.0	20.2
	55+	F	24	6.0	20.0	39	3.3	10.7	43	5.6	16.9
		M	27	3.8	5.0	110	3.3	12.3	100	4.8	15.5
	17–45[c]	F	82	7.8	55.0	67	4.3	10.2	62	5.4	24.0
	Adult[d]		333	6.1	20.0	496	3.9	15.9	400	5.4	19.4
	Child[d]		48	4.0	15.0	42	4.2	16.0	33	4.3	10.3
Upper	0–6	F	14	4.9	16.0	14	4.1	5.6	13	3.3	5.0
		M	16	4.8	10.0	21	3.2	17.0	24	3.1	8.8
	7–17	F	25	3.4	15.0	44	4.2	14.6	28	5.2	8.3
		M	24	5.9	10.0	50	4.4	14.1	30	2.7	9.3
	18–54	F	50	4.5	15.0	87	3.3	11.3	59	7.0	21.0
		M	41	6.0	24.0	127	4.6	15.0	62	4.0	11.3
	55+	F	14	4.1	12.0	29	3.1	14.6	28	4.4	13.1
		M	22	4.8	8.0	90	4.9	22.4	51	3.4	9.7
	17–45[c]	F	46	4.7	15.0	66	3.1	10.1	42	4.3	8.3
	Adult[d]		177	4.8	15.0	428	4.3	15.0	262	4.3	13.1
	Child[d]		30	4.9	15.0	37	3.6	9.6	37	3.2	8.1
All (UCR Reaches 1–6)	Adult[d]		582	6.8	20.0	883	6.6	23.8	759	6.3	19.9
	Child[d]		86	5.9	16.0	75	5.5	16.0	77	4.3	10.3

M = male; F = female; n = sample size; P95 = estimate of the 95th percentile

[a]The survey did not gather information on the number of past trips for children in the group. It was assumed that values for individuals less than 18 years of age accompanied the respondent on all other UCR trips within the past 12 months.

[b]Number of survey respondents.

[c]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[d]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.1.2 Exposure Frequency for Beach Visits

Beach visitors could be exposed to potentially contaminated environmental media at the UCR Site through incidental ingestion of soil/sediment or surface water, or through dermal contact with these media. As discussed in Section 3.2, beach visitors were contacted as they left the beach for the day (beach visitors who were also camping at NPS campgrounds were not included in the beach survey). Visitors to eight beach locations were interviewed (two in the Upper UCR, three in the Middle UCR, and three in the Lower UCR; Figure 3).

Table 12 describes the number of visits to UCR beaches by UCR region, age group, and sex. EF is expressed as the mean number of days per year that these separate populations went to a UCR day-use beach, and the range and distribution of the data are presented for each population. In the Lower UCR, the mean number of visits to a beach per year ranged from 2.5 (for male children aged 0–6 years) to 11.6 (for males aged 7–17 years) visits per year. The average number of visits to a beach in the Middle UCR ranged from 3.4 visits (for male children aged 0–6 years) to 7.8 visits (for females aged 17–45 years). In the Upper UCR, the mean number of beach visits per year ranged from 3.4 (for females aged 7–17 years) to 6.0 (for males aged 18–54 years).

TABLE 12. Estimated Frequency (days/year) of UCR Beach Visits

UCR Region	Age Group (years)[a]	Sex	n[b]	Mean	LCL95	UCL95	SD	CV	Min	Max	Percentile			
											P50	P95	LTL95	UTL95
Lower	0–6	F	12	9.2	5.8	12.5	38.3	4.2	1.0	56.0	12.0	12.0	.	.
		M	17	2.5	1.5	3.6	18.2	7.2	1.0	30.0	1.0	10.0	.	.
	7–17	F	15	4.2	2.8	5.6	20.3	4.8	1.0	38.0	4.0	10.0	.	.
		M	28	11.6	4.5	18.6	72.3	6.3	1.0	60.0	6.0	60.0	.	.
	18–54	F	42	7.5	4.7	10.2	31.2	4.2	1.0	56.0	5.0	16.0	.	.
		M	36	8.5	3.2	13.8	62.2	7.3	1.0	60.0	5.0	60.0	.	.
	55+	F	21	6.2	2.8	9.6	34.1	5.5	1.0	50.0	2.0	12.0	.	.
		M	18	3.2	2.3	4.0	27.7	8.7	1.0	50.0	3.0	5.0	.	.
	17–45[c]	F	31	4.5	2.9	6.2	28.8	6.4	1.0	56.0	2.0	20.0	7.9	22.3
	Adult[d]		163	7.3	5.3	9.2	48.8	6.7	1.0	60.0	3.0	20.0	12.0	45.6
	Child[d]		29	6.3	2.9	9.6	32.3	5.2	1.0	56.0	4.0	12.0	1.0	22.2
Middle	0–6	F	16	5.4	2.4	8.5	21.7	4.0	1.0	25.0	3.0	24.0	.	.
		M	32	3.4	2.4	4.4	17.1	5.0	1.0	40.0	2.0	10.0	3.0	17.4
	7–17	F	40	6.0	4.0	8.0	32.1	5.3	1.0	105.0	3.0	21.0	10.0	51.0
		M	43	5.5	4.3	6.8	17.6	3.2	1.0	48.0	6.0	12.0	6.9	17.7
	18–54	F	102	6.7	3.2	10.1	38.3	5.7	1.0	70.0	2.0	34.0	.	.
		M	96	6.9	5.2	8.6	34.1	4.9	1.0	105.0	4.0	21.0	14.6	55.3
	55+	F	24	6.0	3.7	8.3	22.8	3.8	1.0	60.0	4.0	20.0	.	.
		M	27	3.8	2.2	5.4	45.9	12.1	1.0	122.0	2.0	5.0	.	.
	17–45[c]	F	82	7.8	3.3	12.4	40.4	5.2	1.0	70.0	3.0	55.0	.	.
	Adult[d]		333	6.1	4.9	7.2	34.0	5.6	1.0	122.0	3.0	20.0	14.5	26.8
	Child[d]		48	4.0	2.8	5.2	18.8	4.7	1.0	40.0	2.0	15.0	6.0	24.6
Upper	0–6	F	14	4.9	2.3	7.5	14.2	2.9	1.0	25.0	2.0	16.0	.	.
		M	16	4.8	2.7	6.9	13.3	2.8	1.0	24.0	2.0	10.0	.	.
	7–17	F	25	3.4	2.5	4.4	11.9	3.5	1.0	20.0	2.0	15.0	5.7	18.9
		M	24	5.9	3.8	8.0	19.9	3.4	1.0	60.0	4.0	10.0	8.2	42.5
	18–54	F	50	4.5	3.2	5.8	15.5	3.5	1.0	60.0	2.0	15.0	8.9	19.3
		M	41	6.0	3.6	8.4	18.0	3.0	1.0	32.0	4.0	24.0	.	.
	55+	F	14	4.1	2.0	6.3	23.4	5.7	1.0	62.0	3.0	12.0	.	.
		M	22	4.8	2.2	7.4	31.5	6.6	1.0	50.0	2.0	8.0	.	.
	17–45[c]	F	46	4.7	3.4	6.1	15.6	3.3	1.0	60.0	3.0	15.0	8.8	20.0
	Adult[d]		177	4.8	3.9	5.7	19.5	4.1	1.0	62.0	3.0	15.0	9.2	20.2
	Child[d]		30	4.9	3.2	6.5	13.5	2.8	1.0	25.0	2.0	15.0	9.1	24.6

TABLE 12. Estimated Frequency (days/year) of UCR Beach Visits

UCR Region	Age Group (years)[a]	Sex	n[b]	Mean	LCL95	UCL95	SD	CV	Min	Max	Percentile			
											P50	P95	LTL95	UTL95
All (UCR Reaches 1–6)	Adult[d]		582	6.8	5.8	7.8	39.1	5.7	1.0	122.0	3.0	20.0	14.9	24.2
	Child[d]		86	5.9	3.9	7.9	26.7	4.5	1.0	56.0	3.0	16.0	12.0	19.8

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% upper confidence limit of the mean; SD = standard deviation; CV = coefficient of variation (SD/mean); min = minimum; max = maximum; P = percentile of the estimated population distribution of frequency of beach visits; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile (P95).

[a]The survey did not gather information on the number of past trips for children in the group. It was assumed that values for individuals less than 18 years of age accompanied the respondent on all other UCR trips within the past 12 months.

[b]Number of survey respondents.

[c]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[d]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.1.3 Exposure Frequency for Camping

Campers along the UCR could contact potentially contaminated surface water and/or soil/sediment via incidental ingestion and dermal contact. They could also inhale potentially contaminated airborne particulates during outdoor activity or while inside tents, campers, or RVs, as described in the HHRA Work Plan (U.S. EPA, 2009). The EF estimated for camping will be used to estimate potential risks for this recreational user. Visitors to the UCR Site can camp along the UCR by either boating or driving to their campsite. In the RecUse Survey, both types of camping (boat-in and drive-in) were grouped together as "past trips," so the EF for camping (i.e., the number of days per year spent camping along the UCR) represents the combination of both types. As detailed in Section 3.2, the camper survey was conducted at all NPS campgrounds on the UCR between the United States-Canada border and the Grand Coulee Dam (five campgrounds in the Upper UCR, five campgrounds in the Middle UCR, and six campgrounds in the Lower UCR; Figure 4). Visitors were contacted in the evenings at their campsites.

Table 13 describes the number of days camping at the UCR by UCR region, age group, and sex. EF is expressed as the mean number of days per year that these separate populations spent camping at the UCR (overnight visits); the range and distribution of the data are presented for each population. In the Lower UCR, the mean number of days spent camping at the UCR per year ranged from 4.5 (for male children aged 0–6 years) to 9.9 (for males aged 7–17 years). The average number of days spent camping in the Middle UCR ranged from 3.8 days (for females aged 0–6 years and 7–17 years) to 7.0 days (for males aged 18–54 years). In the Upper UCR, the mean number of days spent camping at the UCR per year ranged from 2.7 (for males aged 7–17 years) to 7.0 (for females aged 18–54 years).

TABLE 13. Estimated Frequency (days/year) of Camping Trips in the UCR

UCR Region	Age Group (years)[a]	Sex	n[b]	Mean	LCL95	UCL95	SD	CV	Min	Max	Percentile			
											P50	P95	LTL95	UTL95
Lower	0–6	F	5	5.5	3.6	7.3	13.3	2.4	1.8	8.2	6.1	8.2	.	.
		M	11	4.5	3.0	6.0	17.3	3.8	0.8	24.6	2.8	6.5	.	.
	7–17	F	27	5.6	4.2	7.0	21.0	3.7	0.8	14.8	4.4	12.8	.	.
		M	24	9.9	6.3	13.6	46.4	4.7	0.9	32.9	6.1	32.9	.	.
	18–54	F	50	5.3	4.3	6.3	19.5	3.7	0.8	20.0	4.4	13.6	9.5	19.0
		M	63	7.2	5.1	9.3	42.0	5.8	0.8	56.3	4.2	22.6	.	.
	55+	F	21	6.0	4.3	7.8	39.1	6.5	0.9	48.9	4.7	11.9	.	.
		M	38	5.4	3.3	7.4	66.8	12.5	0.8	120.3	2.9	16.6	.	.
	17–45[c]	F	31	5.3	3.9	6.7	21.3	4.0	0.8	20.0	4.4	12.7	8.9	18.8
	Adult[d]		224	6.4	5.5	7.3	42.4	6.6	0.8	120.3	4.5	19.9	13.6	22.5
	Child[d]		18	5.1	3.8	6.3	15.9	3.1	0.8	24.6	5.6	10.3	.	.
Middle	0–6	F	15	3.8	2.8	4.7	9.2	2.4	0.9	14.2	3.2	8.9	.	.
		M	16	4.8	3.4	6.2	12.0	2.5	1.6	21.4	3.6	10.7	.	.
	7–17	F	32	3.8	3.0	4.6	13.7	3.6	0.9	24.0	3.4	8.7	4.9	20.5
		M	46	4.6	2.8	6.4	27.3	5.9	0.8	64.2	2.6	19.4	.	.
	18–54	F	85	5.8	3.8	7.9	31.1	5.3	0.8	49.2	2.9	24.9	11.4	41.6
		M	92	7.0	3.6	10.4	42.2	6.0	0.8	65.0	3.2	20.2	.	.
	55+	F	43	5.6	3.8	7.3	22.5	4.0	0.9	34.8	3.9	16.9	.	.
		M	100	4.8	4.0	5.6	22.4	4.7	0.8	69.6	2.9	15.5	10.2	19.1
	17–45[c]	F	62	5.4	3.5	7.2	24.1	4.5	0.8	28.2	3.6	24.0	.	.
	Adult[d]		400	5.4	4.5	6.3	30.0	5.6	0.8	69.6	2.9	19.4	13.5	21.8
	Child[d]		33	4.3	3.5	5.2	10.6	2.4	0.9	21.4	3.2	10.3	8.7	18.5
Upper	0–6	F	13	3.3	2.3	4.4	6.6	2.0	0.8	10.5	3.5	5.0	.	.
		M	24	3.1	2.1	4.1	10.0	3.2	0.9	16.5	1.7	8.8	8.0	16.3
	7–17	F	28	5.2	4.2	6.2	10.3	2.0	0.9	23.3	4.3	8.3	.	.
		M	30	2.7	1.3	4.2	11.3	4.1	0.9	20.0	1.7	9.3	.	.
	18–54	F	59	7.0	2.6	11.4	43.3	6.2	0.8	92.5	2.8	21.0	.	.
		M	62	4.0	2.4	5.6	21.3	5.3	0.8	44.1	2.5	11.3	8.1	33.3
	55+	F	28	4.4	2.4	6.3	15.4	3.5	0.9	19.0	2.4	13.1	.	.
		M	51	3.4	2.8	4.1	13.3	3.9	0.8	28.4	2.7	9.7	5.1	16.6
	17–45	F	42	4.3	3.3	5.3	10.1	2.3	0.8	25.1	3.9	8.3	6.9	19.6
	Adult[d]		262	4.3	3.4	5.2	25.0	5.8	0.8	92.5	2.6	13.1	8.8	16.8
	Child[d]		37	3.2	2.4	4.0	8.8	2.8	0.8	16.5	1.9	8.1	4.7	10.7

TABLE 13. Estimated Frequency (days/year) of Camping Trips in the UCR

UCR Region	Age Group (years)[a]	Sex	n[b]	Mean	LCL95	UCL95	SD	CV	Min	Max	Percentile			
											P50	P95	LTL95	UTL95
All (UCR Reaches 1–6)	Adult[d]		759	6.3	5.7	7.0	36.2	5.7	0.8	137.5	3.9	19.9	16.9	21.8
	Child[d]		77	4.3	3.7	5.0	13.9	3.2	0.8	27.9	3.2	10.3	9.5	13.4

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% upper confidence limit of the mean; SD = standard deviation; CV = coefficient of variation (SD/mean); min = minimum; max = maximum; P = percentile of the estimated population distribution of frequency of camping trips; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile (P95).

[a]The survey did not gather information on the number of past trips for children in the group. It was assumed that values for individuals less than 18 years of age accompanied the respondent on all other UCR trips within the past 12 months.

[b]Number of survey respondents.

[c]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[d]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.1.4 Exposure Frequency for Boating

Boaters could contact potentially contaminated environmental media through incidental ingestion of soil/sediment or surface water, or through dermal contact with these media. Boaters along the UCR were contacted at public boat launches and marinas as they were departing for the day. Of the 19 UCR Sites that were surveyed, 5 were in the Upper UCR, 5 were in the Middle UCR, and 9 were in the Lower UCR (Figure 5). The number of boat trips was divided evenly among the visited river reaches to enable estimating an EF for each population and UCR region.

As shown in Table 14, summary statistics (mean, P95, standard deviation [SD], range, and percentiles) were calculated for frequency by UCR region, age group, and sex. In the Lower UCR, the number of boating trips (assumed to be the number of days per year spent boating) by population (age and sex) ranged from 0.2 to 213, with the mean number of trips ranging from 3.4 (male children 0–6 years old) to 7.1 (males aged 7–17). Boaters in the Middle UCR took from 0.2 to 152 trips per year, with the mean number of boating trips ranging from 3.3 (females and males ages 55+ years old) to 5.8 (females aged 7–17). The number of boat trips per year in the Upper UCR ranged from a minimum of 0.3 trips to a maximum of 217, with the mean number of boating trips ranging from 3.1 trips (females aged 55+ years and females aged 17–45 years) to 4.9 trips (males aged 55+ years).

TABLE 14. Estimated Frequency (days/year) Spent Boating in the UCR

UCR Region	Age Group (years)[a]	Sex	n[b]	Mean	LCL95	UCL95	SD	CV	Min	Max	Percentile			
											P50	P95	LTL95	UTL95
Lower	0–6	F	16	5.4	1.9	8.8	55.5	10.4	0.5	114.4	2.0	17.8	.	.
		M	15	3.4	0.1	6.7	42.5	12.5	0.4	38.6	0.4	13.8	.	.
	7–17	F	36	4.3	2.8	5.8	22.7	5.3	0.4	19.7	1.7	18.6	.	.
		M	54	7.1	4.1	10.1	59.4	8.4	0.3	64.4	4.2	28.7	12.5	64.3
	18–54	F	81	4.4	3.2	5.7	35.7	8.1	0.2	57.5	2.9	17.2	8.5	34.1
		M	113	6.3	4.2	8.3	71.1	11.3	0.4	134.0	2.0	36.2	13.8	57.9
	55+	F	37	5.8	3.5	8.1	51.9	8.9	0.4	63.7	2.6	30.3	7.1	49.3
		M	94	6.1	4.3	7.9	76.8	12.5	0.3	212.8	2.3	18.6	14.2	36.6
	17–45[c]	F	55	3.8	2.3	5.3	31.6	8.3	0.3	46.9	1.5	18.6	8.3	36.0
	Adult[d]		417	5.8	4.9	6.7	60.6	10.4	0.2	212.8	2.1	19.9	16.3	29.6
	Child[d]		34	4.2	1.7	6.7	46.8	11.0	0.4	114.4	1.6	13.8	7.0	102.3
Middle	0–6	F	18	3.5	1.1	5.9	57.5	16.5	0.3	152.4	1.1	6.3	.	.
		M	22	4.8	3.4	6.1	22.5	4.7	0.4	52.3	4.2	12.2	.	.
	7–17	F	45	5.8	3.0	8.7	30.2	5.2	0.4	50.8	3.5	18.6	.	.
		M	61	4.8	3.1	6.6	28.0	5.8	0.3	55.2	2.1	17.6	15.2	28.7
	18–54	F	98	4.0	2.8	5.3	23.2	5.8	0.3	50.8	2.1	11.4	9.3	19.0
		M	142	3.9	3.1	4.7	23.5	6.1	0.3	56.0	2.0	16.6	10.1	27.4
	55+	F	39	3.3	2.1	4.6	22.5	6.8	0.4	31.9	1.4	10.7	5.8	28.0
		M	110	3.3	2.4	4.2	33.1	10.1	0.2	152.4	1.0	12.3	8.9	18.4
	17–45[c]	F	67	4.3	2.7	5.9	25.5	5.9	0.3	50.8	2.3	10.2	7.7	34.6
	Adult[d]		496	3.9	3.4	4.4	27.0	6.9	0.2	152.4	1.7	15.9	11.2	17.6
	Child[d]		42	4.2	2.7	5.7	40.7	9.8	0.3	152.4	2.3	16.0	6.2	53.1
Upper	0–6	F	14	4.1	0.5	7.7	48.0	11.7	0.6	113.4	1.8	5.6	.	.
		M	21	3.2	2.0	4.5	17.0	5.3	0.3	36.0	1.8	17.0	.	.
	7–17	F	44	4.2	2.7	5.7	20.2	4.8	0.3	83.0	1.4	14.6	8.3	31.5
		M	50	4.4	2.7	6.1	41.6	9.5	0.4	156.3	1.8	14.1	6.0	21.1
	18–54	F	87	3.3	2.5	4.0	15.2	4.6	0.4	49.8	1.7	11.3	7.8	16.6
		M	127	4.6	3.5	5.7	44.7	9.7	0.3	217.3	2.0	15.0	9.8	21.3
	55+	F	29	3.1	1.5	4.8	17.4	5.6	0.3	30.3	0.8	14.6	.	.
		M	90	4.9	3.5	6.3	34.4	7.0	0.3	113.4	1.9	22.4	11.1	35.1
	17–45[c]	F	66	3.1	0.0	4.0	12.4	3.9	0.4	33.4	1.8	10.1	6.7	16.5
	Adult[d]		428	4.3	3.7	4.8	33.9	8.0	0.3	217.3	1.8	15.0	12.4	17.0
	Child[d]		37	3.6	2.1	5.0	31.6	8.9	0.3	113.4	1.8	9.6	4.5	40.0
All (UCR Reaches 1–6)	Adult[d]		883	6.6	5.9	7.2	58.1	8.9	0.4	380.2	2.6	23.8	19.9	30.1
	Child[d]		75	5.5	3.3	7.8	76.3	13.8	0.4	380.2	2.0	16.0	11.4	39.7

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% upper confidence limit of the mean; SD = standard deviation; CV = coefficient of variation (SD/mean); min = minimum; max = maximum; P = percentile of the estimated population distribution of frequency of boating; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile (P95).

[a]The survey did not gather information on the number of past trips for children in the group. It was assumed that values for individuals less than 18 years of age accompanied the respondent on all other UCR trips within the past 12 months.

[b]Number of survey respondents.

[c]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[d]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.2 Exposure Time

5.4.2.1 Overview

This section provides an overview of the time spent engaging in recreational activities (other than fishing) and the location where these activities occur (i.e., UCR Region). As described in Section 4.4.2, ET describes how much time a person is likely to spend engaging in specific recreational activities over the course of a typical day and is expressed in units of hours/day. The RecUse Survey collected activity time data (hours/day) from 2,093 individuals participating in recreational activities performed within the previous 12 months that were associated with surface water (e.g., swimming, wading, boating) and soil/sediment (e.g., beach-going, camping). These data will be used in the HHRA to refine the ET estimates for the recreational exposure scenario.

Group average ETs were calculated by type of recreational activity (drive-in camping, boat-in camping, boating, or beach day), age group, and location where these activities occur in the UCR (i.e., lower, middle, and upper regions). Time data are summarized in this section for time spent outdoors at the beach or boating, time spent wading in shallow water, time spent swimming and wading in deeper water, time spent water-skiing and tubing, time spent on the sand/beach, and time spent inside a tent, RV, or camper.

5.4.2.2 Time Spent Outdoors

Table 15 presents estimates of the population mean and P95 for trip durations (hours/day) for beach and boating day trips. As shown below, the mean length of beach trips ranged from 2.0 to 2.8 hours/day for all adults combined and 2.0 to 2.6 hours/day for all children combined. The mean length of boat trips for all adults combined ranged from 4.7 to 6.1 hours/day and mean boat trips for all children combined lasted 3.9 to 5.6 hours/day.

The estimates for children differ from adults because the data for children are a subset of the data for adults. While the data for the adults used all data from the completed boating questionnaires, the data for children are limited to interviews that provided data for children (i.e., questions B4 and B6 of the RecUse Survey Boat Questionnaire). Differences in sample sizes for estimates that are not provided by sex can be explained by some missing values for sex; records with missing values for sex do not appear in the estimates provided by sex.

TABLE 15. Estimated Group Exposure Time (hours/day) Spent Outdoors During Beach and Boating Day Trips[a]

UCR Region	Age Group (years)	Sex	Beach Trips			Boat Trips		
			n[b]	Mean	P95	n[b]	Mean	P95
Lower	0–6	F	17	3.1	6.0	5	4.7	7.4
		M	20	2.3	5.1	6	3.5	9.5
	7–17	F	24	2.3	4.6	20	5.7	24.0
		M	28	3.7	6.8	44	5.9	12.0
	18–54	F	42	2.8	5.8	51	6.1	24.0
		M	36	2.8	5.8	81	5.7	12.0
	55+	F	14	2.4	4.2	28	4.3	8.8
		M	11	2.7	6.3	60	5.9	9.8

TABLE 15. Estimated Group Exposure Time (hours/day) Spent Outdoors During Beach and Boating Day Trips[a]

UCR Region	Age Group (years)	Sex	Beach Trips			Boat Trips		
			n[b]	Mean	P95	n[b]	Mean	P95
	17–45[c]	F	36	2.6	6.5	32	6.0	24.0
	Adult[d]		159	2.8	5.8	285	5.8	12.0
	Child[d]		37	2.6	5.8	11	4.4	7.4
Middle	0–6	F	13	1.9	6.9	6	3.3	12.0
		M	20	2.1	3.1	5	6.6	24.0
	7–17	F	35	1.9	3.5	23	3.8	7.6
		M	36	2.5	4.9	45	3.8	8.2
	18–54	F	77	2.3	4.2	53	4.0	8.5
		M	64	1.8	4.8	83	6.3	13.8
	55+	F	18	1.5	3.9	25	3.5	7.8
		M	17	1.5	3.5	73	4.8	9.6
	17–45[c]	F	67	2.3	4.7	38	4.2	8.5
	Adult[d]		247	2.0	4.4	303	4.7	9.3
	Child[d]		33	2.0	3.3	11	5.6	24.0
Upper	0–6	F	11	1.8	4.0	8	3.3	5.2
		M	14	2.8	4.7	5	5.0	7.8
	7–17	F	23	2.9	3.8	29	4.3	9.4
		M	19	2.6	4.7	56	4.4	7.4
	18–54	F	34	2.3	4.7	71	3.9	12.0
		M	33	2.2	4.3	129	5.2	9.8
	55+	F	19	1.9	3.8	23	5.2	24.0
		M	7	2.2	3.1	102	4.5	8.5
	17–45[c]	F	26	1.9	4.1	51	4.2	15.6
	Adult[d]		137	2.3	4.7	416	4.8	9.8
	Child[d]		25	2.3	4.5	13	3.9	7.8
All (UCR Reaches 1–6)	Adult[d]		543	2.3	5.2	814	6.1	12.0
	Child[d]		95	2.3	5.3	29	5.4	9.5

M = males; F = females; P95 = estimated 95th percentile of the hours/ day spent outdoors.
[a]Beach and boating trips represent the duration of the trip.
[b]Number of completed interviews for beach trips. For boat trips, "n" represents the number of river reaches visited rather than the number of completed boating interviews.
[c]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.
[d]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.2.3 Exposure Time Wading in Water Shallower than Waist Deep

Tables 16a and 16b contain the results of the calculations of group ET (hours/day) for time spent wading in the UCR in water less than waist deep. Sample size (n) and estimates of the mean and P95 are grouped by location, age, sex, and recreational exposure scenario. The four exposure scenarios were day trips to UCR day-use beaches, boat day trips to areas on the river, drive-in camping trips, and boating camping trips.[30] For each of these scenarios, the mean ET represents the estimated mean hours spent wading by people who wade (i.e., those who do not were omitted), the P95 characterizes the upper-end distribution of hours for time spent wading by the potentially exposed population, and the frequency is the weighted frequency of respondents who engaged in the activity.

[30] Drive-in and boat-in camping trips are combined in Table 16b.

TABLE 16a. Estimated Group Exposure Time (hours/day) Spent Wading (<waist deep) in the UCR by Region, Age, Sex, and Recreational Exposure Scenario for Beach and Boat Trips

UCR Region	Age Group (years)	Sex	Beach Trips								Boat Trips							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	10	0.7	0.4	1.1	2.0	.	.	49%	5	2.2	2.0	2.4	3.0	.	.	100%
		M	14	0.9	0.6	1.2	2.0	.	.	73%	3	0.5	0.3	0.7	1.0	.	.	90%
	7–17	F	19	0.4	0.2	0.5	1.0	0.5	2.4	72%	10	1.1	0.5	1.7	2.4	.	.	38%
		M	21	1.5	0.6	2.3	4.0	.	.	60%	21	0.9	0.7	1.1	1.5	.	.	39%
	18–54	F	26	0.6	0.4	0.8	1.6	.	.	52%	26	0.5	0.4	0.7	1.0	.	.	49%
		M	19	0.5	0.2	0.8	2.0	.	.	47%	22	0.9	0.6	1.3	2.3	.	.	22%
	55+	F	8	1.0	0.4	1.6	1.9	.	.	73%	13	0.6	0.3	0.9	2.5	.	.	64%
		M	3	0.8	0.0	1.6	1.8	.	.	15%	5	1.1	0	2.2	2.8	.	.	4%
	17–45[b]	F	22	0.6	0.4	0.8	1.8	.	.	45%	14	0.5	0.3	0.7	1.0	.	.	38%
	Adult[c]		99	0.7	0.5	0.9	2.0	1.8	2.8	58%	97	0.8	0.6	0.9	2.4	1.9	2.8	29%
	Child[c]		24	0.9	0.6	1.1	2.0	1.1	2.3	63%	8	1.8	1.4	2.3	2.5	.	.	98%
Middle	0–6	F	10	0.9	0.3	1.5	3.0	.	.	64%	3	1.4	0.1	2.7	3.0	.	.	51%
		M	19	0.8	0.5	1.2	2.0	.	.	91%	3	1.7	0.7	2.7	2.8	.	.	68%
	7–17	F	24	0.5	0.3	0.6	1.0	.	.	53%	13	0.7	0.4	1.1	1.3	.	.	41%
		M	26	0.8	0.4	1.1	2.5	.	.	83%	24	0.6	0.5	0.8	1.3	.	.	61%
	18–54	F	49	0.5	0.3	0.6	1.0	0.5	3.2	61%	29	0.5	0.4	0.6	0.9	.	.	48%
		M	38	0.5	0.3	0.6	1.0	0.5	1.4	55%	22	0.6	0.4	0.7	1.3	.	.	22%
	55+	F	9	0.5	0.2	0.8	2.4	.	.	38%	8	0.3	0.1	0.4	0.7	.	.	34%
		M	4	0.2	0.0	0.3	0.7	.	.	33%	8	0.2	0.1	0.4	0.5	.	.	6%
	17–45[b]	F	45	0.5	0.3	0.7	1.5	.	.	58%	21	0.5	0.4	0.6	0.9	.	.	49%
	Adult[c]		150	0.5	0.4	0.6	2.0	1.0	3.0	57%	104	0.5	0.4	0.6	1.3	1.0	1.4	30%
	Child[c]		29	0.9	0.6	1.2	2.0	.	.	81%	6	1.6	0.8	2.4	3.0	.	.	63%
Upper	0–6	F	9	1.7	0.7	2.6	3.3	.	.	65%	2	0.4	0.2	0.5	0.5	.	.	23%
		M	13	1.5	0.8	2.2	3.5	.	.	72%	3	2.0	1.0	3.1	3.7	.	.	82%
	7–17	F	12	0.6	0.4	0.8	1.0	.	.	75%	16	1.2	0.5	1.8	4.0	.	.	64%
		M	11	0.7	0.4	1.0	1.2	.	.	25%	21	0.8	0.4	1.2	1.5	.	.	31%
	18–54	F	12	1.0	0.2	1.8	3.0	.	.	16%	35	0.5	0.3	0.7	1.4	.	.	42%
		M	17	0.7	0.3	1.0	1.9	.	.	56%	28	0.7	0.4	1.0	1.5	.	.	18%
	55+	F	7	0.5	0.3	0.7	1.0	.	.	18%	5	0.7	0.4	1.0	1.7	.	.	9%
		M	4	0.6	0.4	0.9	0.9	.	.	71%	9	0.2	0.1	0.4	0.5	.	.	5%
	17–45[b]	F	13	1.0	0.3	1.7	3.0	.	.	41%	26	0.5	0.3	0.6	1.0	0.4	0.9	41%
	Adult[c]		64	0.7	0.5	0.9	1.9	.	.	34%	114	0.7	0.5	0.9	1.5	0.9	1.5	18%
	Child[c]		22	1.6	1.0	2.2	3.5	.	.	68%	5	1.4	0.6	2.2	3.7	.	.	42%

TABLE 16a. Estimated Group Exposure Time (hours/day) Spent Wading (<waist deep) in the UCR by Region, Age, Sex, and Recreational Exposure Scenario for Beach and Boat Trips

UCR Region	Age Group (years)	Sex	Beach Trips								Boat Trips							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
All (UCR Reaches 1–6)	Adult[c]		313	0.6	0.5	0.7	2.0	1.6	2.4	55%	244	0.8	0.7	0.9	2.3	1.9	2.5	25%
	Child[c]		75	0.9	0.7	1.1	2.9	2.0	3.3	73%	16	1.9	1.6	2.3	3.0	.	.	78%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours/day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engage in the activity.

[a]Number of participants who reported visiting the indicated lake region.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

TABLE 16b. Estimated Group Exposure Time (hours/day) Spent Wading (<waist deep) in the UCR by Region, Age, Sex, and Recreational Exposure Scenario for Camping Trips

UCR Region	Age Group (years)	Sex	Drive-in and Boat-in Camping Trips Combined							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	5	1.6	0.3	2.8	6.0	.	.	35%
		M	12	2.4	0.9	4.0	10.0	.	.	81%
	7–17	F	32	1.6	1.1	2.1	4.0	2.7	4.7	68%
		M	28	2.9	2.1	3.7	7.0	.	.	63%
	18–54	F	42	2.0	1.4	2.6	4.0	2.2	4.1	41%
		M	39	1.7	1.1	2.3	6.0	.	.	44%
	55+	F	16	1.5	0.9	2.0	4.0	.	.	32%
		M	18	1.5	1.0	2.0	3.0	.	.	18%
	17–45[b]	F	31	2.3	1.5	3.0	4.0	1.9	3.9	55%
	Adult[c]		177	1.9	1.6	2.2	6.0	4.1	6.0	41%
	Child[c]		17	2.2	1.0	3.4	10.0	.	.	61%
Middle	0–6	F	7	1.5	0.2	2.7	4.0	.	.	36%
		M	15	3.7	2.1	5.4	6.0	.	.	62%
	7–17	F	25	1.8	1.2	2.4	6.0	.	.	77%
		M	17	1.1	0.5	1.8	4.0	.	.	42%
	18–54	F	47	1.2	0.6	1.9	6.0	.	.	40%
		M	27	0.9	0.5	1.2	3.0	.	.	28%
	55+	F	2	0.5	0.2	0.7	1.0	.	.	9%
		M	15	1.1	0.4	1.9	3.0	.	.	7%
	17–45[b]	F	28	1.2	0.4	2.0	4.0	.	.	52%
	Adult[c]		135	1.3	1.0	1.6	4.0	3.2	6.2	31%
	Child[c]		22	2.9	1.3	4.4	6.0	.	.	49%
Upper	0–6	F	13	1.7	0.8	2.5	8.0	.	.	50%
		M	21	2.1	1.3	3.0	6.4	.	.	88%
	7–17	F	21	1.4	0.6	2.2	4.0	.	.	76%
		M	34	1.8	1.3	2.4	6.0	.	.	66%
	18–54	F	42	1.5	1.1	1.9	3.8	2.6	4.4	49%
		M	33	0.9	0.6	1.1	3.0	.	.	43%
	55+	F	6	0.5	0.1	1.0	2.0	.	.	14%
		M	21	0.6	0.3	0.9	3.0	.	.	25%
	17–45[b]	F	31	1.6	1.0	2.1	4.0	3.1	4.7	51%
	Adult[c]		161	1.3	1.0	1.5	4.0	2.9	4.0	44%
	Child[c]		34	2.0	1.3	2.7	8.0	.	.	72%
All (UCR Reaches 1–6)	Adult[c]		434	1.7	1.5	2.0	6.0	5.0	5.9	38%
	Child[c]		70	2.4	1.6	3.1	8.0	5.4	9.8	60%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours/day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engage in the activity.

[a]Number of participants who reported visiting the indicated lake region.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

For people who reported taking day trips to beaches in the Lower UCR, 63% of children (individuals younger than 7 years of age) reported wading in water shallower than waist deep for a mean ET of 0.9 hour/day, and adults had a mean ET of 0.7 hours/day with 58% of adults wading (see Table 16a). In the Middle UCR, 81% of this child population reported wading 0.9 hours/day on average, and 57% of adults waded 0.5 hours/day. In the Upper UCR, 68% of children on beach day trips reported wading an average of 1.6 hours/day, and 34% of adults reported wading 0.7 hours/day. Across beach trips, boat trips, drive-in camping trips, and boat-in camping trips, the percent of adults wading in water shallower than waist deep varied between 29 and 58% in the Lower UCR, 30 and 57% in the Middle UCR, and 18 and 44% in the Upper UCR (Tables 16a and 16b). Mean ETs for adult "waders" ranged from 0.5 to 1.9 hours/day (all adults combined). The percentage of children younger than 7 years old who reported wading in water shallower than waist deep across beach trips, boat trips, drive-in camping trips, and boat-in camping trips was 61–98% for the Lower UCR, 49–81% for the Middle UCR, and 42–72% for the Upper UCR, with mean ETs ranging from 0.9 to 2.9 hours/day (see Tables 16a and 16b).

5.4.2.4 Exposure Time Swimming and Wading in Water Deeper than Waist Deep

Tables 17a and 17b contain the results of the calculations for group ET (hours/day) for time spent swimming and wading in the UCR in water greater than waist deep. Sample size (n) and estimates of the mean and P95 are grouped by location, age, sex, and recreational exposure scenario. The four exposure scenarios were day trips to UCR day-use beaches, boat day trips to areas on the river, drive-in camping trips, and boating camping trips.[31] For each of these scenarios, the estimates of the mean and P95 are for the population who swims (i.e., "do-ers only" estimates). The frequency is an estimate of the proportion of the exposure scenario population who engage in the activity (e.g., proportion of drive-in campers who swim or wade in water over waist deep). The frequencies were estimated as the sum of the sample weights (trip weights) for participants who engaged in the activity divided by the sum of the trip weights for participants who were included in the exposure scenario.

Across exposure scenarios, the percent of adults swimming/wading in water over waist deep was 28–52% for the Lower UCR, 20–36% for the Middle UCR, and 18–40% for the Upper UCR. Mean ETs for all adult "swimmers" combined ranged from 0.5 to 1.9 hours/day. The percentage of children younger than 7 years old who swam/waded in water over waist deep was 17–58% for the Lower UCR, 10–48% for the Middle UCR, and 17–32% for the Upper UCR, with mean ETs ranging from 0.4 to 3.4 hours/day (see Tables 17a and 17b).

[31] Drive-in and boat-in camping trips were combined in Table 17b.

TABLE 17a. Estimated Group Exposure Time (hours/day) Spent Swimming and Wading (>waist deep) in the UCR by Region, Age, and Recreational Exposure Scenario for Beach and Boat Trips

UCR Region	Age Group (years)	Sex	Beach Trips								Boat Trips							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	6	1.1	0.7	1.6	2.8	.	.	30%	4	0.8	0.4	1.2	3.0	.	.	63%
		M	6	0.6	0.4	0.8	0.9	.	.	39%	1	0.1	0.1	0.1	0.1	.	.	44%
	7–17	F	20	1.0	0.7	1.4	2.1	.	.	88%	11	0.8	0.3	1.3	2.4	.	.	64%
		M	22	1.6	1.1	2.2	4.0	.	.	65%	23	0.6	0.5	0.8	1.3	.	.	46%
	18–54	F	18	0.9	0.7	1.1	2.3	.	.	42%	17	0.8	0.4	1.1	2.0	.	.	41%
		M	19	0.7	0.3	1.1	3.0	.	.	54%	24	0.5	0.3	0.7	1.3	.	.	30%
	55+	F	3	0.6	0.4	0.7	1.0	.	.	19%	4	0.4	0.3	0.6	0.8	.	.	11%
		M	2	1.4	0.0	2.9	2.6	.	.	12%	2	0.5	0.1	0.8	0.8	.	.	1%
	17–45[b]	F	16	0.9	0.6	1.1	2.3	.	.	49%	9	0.7	0.3	1.0	2.0	.	.	35%
	Adult[c]		86	1.0	0.8	1.2	3.0	2.1	3.0	52%	81	0.6	0.5	0.8	2.0	1.2	2.1	28%
	Child[c]		12	0.8	0.6	1.0	1.5	.	.	36%	5	0.7	0.3	1.0	3.0	.	.	58%
Middle	0–6	F	5	1.2	0.7	1.7	3.0	.	.	45%	1	1.0	1.0	1.0	1.0	.	.	20%
		M	11	1.0	0.8	1.3	1.4	.	.	49%	1	0.1	0.1	0.1	0.1	.	.	24%
	7–17	F	20	1.1	0.7	1.6	3.7	.	.	46%	16	0.8	0.3	1.2	2.2	.	.	62%
		M	22	0.8	0.4	1.2	3.0	.	.	67%	26	0.5	0.3	0.6	2.0	.	.	71%
	18–54	F	33	0.9	0.8	1.1	2.9	.	.	46%	24	0.4	0.2	0.5	0.7	.	.	41%
		M	26	0.6	0.4	0.8	1.5	0.8	1.6	23%	19	0.7	0.4	0.9	1.3	0.3	1.3	14%
	55+	F	2	0.4	0.01	0.7	1.0	.	.	4%	2	0.5	0.4	0.5	0.5	.	.	2%
		M	4	0.3	0.1	0.5	0.7	.	.	9%	7	0.2	0.0	0.3	0.7	.	.	5%
	17–45[b]	F	30	1.0	0.8	1.2	2.9	1.2	4.0	48%	17	0.4	0.2	0.6	0.7	.	.	42%
	Adult[c]		107	0.9	0.7	1.0	2.9	1.9	3.5	36%	94	0.5	0.4	0.6	2.0	1.3	2.2	24%
	Child[c]		16	1.1	0.9	1.3	1.5	.	.	48%	2	0.4	0.0	0.8	1.0	.	.	23%
Upper	0–6	F	4	0.5	0.4	0.6	1.2	.	.	47%	0	.	.	.	.	.	.	
		M	3	2.1	0.4	3.9	3.7	.	.	16%	3	0.9	0.2	1.6	3.0	.	.	68%
	7–17	F	16	2.0	1.5	2.5	3.0	.	.	67%	18	1.2	0.7	1.6	2.0	.	.	91%
		M	15	1.9	1.3	2.5	2.5	.	.	86%	30	0.6	0.4	0.8	2.0	.	.	38%
	18–54	F	10	0.7	0.3	1.2	1.5	.	.	14%	35	0.9	0.5	1.4	3.0	1.9	3.3	50%
		M	15	0.5	0.2	0.8	1.9	.	.	40%	24	0.6	0.5	0.8	1.5	.	.	10%
	55+	F	4	0.5	0.5	0.5	0.5	.	.	12%	4	0.9	0.7	1.0	1.0	.	.	13%
		M	2	0.5	0.4	0.5	0.5	.	.	19%	7	0.1	0.0	0.2	0.3	.	.	3%
	17–45[b]	F	11	0.7	0.3	1.1	1.5	.	.	33%	24	1.1	0.6	1.7	3.0	.	.	51%
	Adult[c]		64	1.4	1.0	1.9	2.6	.	.	40%	119	0.8	0.6	1.0	2.0	0.9	2.0	18%
	Child[c]		7	0.9	0.2	1.6	3.7	.	.	32%	3	0.9	0.2	1.6	3.0	.	.	22%

TABLE 17a. Estimated Group Exposure Time (hours/day) Spent Swimming and Wading (>waist deep) in the UCR by Region, Age, and Recreational Exposure Scenario for Beach and Boat Trips

UCR Region	Age Group (years)	Sex	Beach Trips								Boat Trips							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
All (UCR	Adult[c]		257	1.0	0.9	1.1	2.9	2.5	3.0	42%	221	0.8	0.7	0.9	2.0	2.0	2.6	23%
Reaches	Child[c]		35	1.0	0.8	1.2	2.8	.	.	42%	9	0.7	0.5	1.0	3.0	.	.	40%
1–6)	All Ages		292	1.0	0.9	1.1	2.9	2.5	3.0	42%	230	0.8	0.7	0.9	2.0	2.0	2.6	23%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours per day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq = estimated proportion of the population who engaged in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

TABLE 17b. Estimated Group Exposure Time (hours/day) Spent Swimming and Wading (>waist deep) in the UCR by Region, Age, and Recreational Exposure Scenario for Camping Trips

UCR Region	Age Group (years)	Sex	Drive-in and Boat-in Camping Trips Combined							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	1	0.5	0.5	0.5	0.5	.	.	7%
		M	6	0.8	0.3	1.2	2.0	.	.	25%
	7–17	F	25	2.3	1.5	3.1	6.0	3.1	7.1	53%
		M	25	2.1	1.5	2.7	6.0	.	.	54%
	18–54	F	30	2.0	1.1	3.0	6.0	4.0	7.9	35%
		M	33	1.7	1.2	2.1	4.0	2.0	6.6	40%
	55+	F	9	1.3	0.8	1.7	2.0	0.3	1.8	18%
		M	12	1.3	0.7	2.0	2.5	.	.	14%
	17–45[b]	F	24	2.0	1.0	3.0	6.0	.	.	53%
	Adult[c]		136	1.9	1.6	2.3	6.0	3.9	5.7	34%
	Child[c]		7	0.7	0.4	1.1	2.0	.	.	17%
Middle	0–6	F	3	2.1	0.0	4.3	4.0	.	.	16%
		M	1	10.0	10.0	10.0	10.0	.	.	3%
	7–17	F	18	1.8	1.2	2.4	4.0	.	.	58%
		M	10	2.2	0.9	3.5	6.0	.	.	12%
	18–54	F	24	1.0	0.7	1.4	2.0	.	.	17%
		M	22	0.8	0.5	1.1	3.0	.	.	24%
	55+	F	3	0.7	0.4	1.0	1.0	.	.	15%
		M	12	0.4	0.2	0.6	1.5	.	.	5%
	17–45[b]	F	15	1.1	0.6	1.5	2.0	.	.	22%
	Adult[c]		89	1.2	1.0	1.5	4.0	2.0	4.6	20%
	Child[c]		4	3.4	0.7	6.1	10.0	.	.	10%
Upper	0–6	F	4	0.6	0.2	1.0	1.0	.	.	13%
		M	9	0.9	0.3	1.5	4.0	.	.	20%
	7–17	F	19	1.1	0.7	1.5	3.0	.	.	59%
		M	35	2.2	1.7	2.7	5.0	.	.	70%
	18–54	F	29	1.3	0.8	1.7	3.8	.	.	28%
		M	27	1.0	0.5	1.5	4.0	.	.	31%
	55+	F	2	1.6	0.8	2.3	2.0	.	.	3%
		M	11	0.3	0.2	0.4	0.8	.	.	12%
	17–45[b]	F	22	1.4	0.8	2.1	3.8	.	.	27%
	Adult[c]		125	1.3	1.1	1.6	4.0	2.7	4.0	30%
	Child[c]		13	0.8	0.4	1.2	4.0	.	.	17%
All (UCR Reaches 1–6)	Adult[c]		324	1.8	1.5	2.0	6.0	4.7	5.7	29%
	Child[c]		24	1.3	0.6	2.0	4.0	.	.	15%
	All Ages		348	1.8	1.5	2.0	6.0	4.7	5.7	28%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours per day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq = estimated proportion of the population who engaged in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.2.5 Exposure Time Water-skiing and Tubing

For those survey respondents who went on boating day trips, drive-in camping trips, and boat-in camping trips, group ET (hours/day) spent water-skiing and tubing was estimated separately by UCR region, age, sex, and activity (Tables 18a and 18b).

The sample size for participants who reported water-skiing or tubing on the UCR was relatively small, particularly for those who skied during boat-in camping trips (n = 0–1 children across regions and 14–15 adults across regions for water-skiing during boat-in camping trips). For visitors who water-ski or tube during boating day trips, the estimated mean ET ranged from 0.5 to 1.2 hours/day for all children combined and 0.6 to 1.0 hours/day for all adults combined. Estimated mean ETs for visitors who water-ski or tube during drive-in camping trips ranged from 0.2 to 1.4 hours/day (all children combined) and from 2.1 to 2.6 hours/day (all adults combined). For visitors who water-ski or tube during boat-in camping trips, the estimated mean ET for all children was 0.3 hours/day (n = 1 for lower region only; no data for middle or upper regions), and mean ET for all adults ranged from 0.8 to 1.6 hours/day (see Tables 18a and 18b).

TABLE 18a. Estimated Group Exposure Time (hours/day) Spent Water-skiing and Tubing in the UCR by Region and Age for the Boating Recreational Exposure Scenario

UCR Region	Age Group (years)	Sex	Boat Trips							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	1	0.5	0.5	0.5	0.5	.	.	6%
		M	0	.	.	.	.	.	.	
	7–17	F	8	0.4	0.3	0.5	1.0	.	.	30%
		M	6	0.7	0.3	1.2	2.0	.	.	18%
	18–54	F	10	0.5	0.2	0.8	1.5	.	.	24%
		M	9	0.8	0.4	1.1	3.0	.	.	12%
	55+	F	1	1.2	1.2	1.2	1.2	.	.	1%
		M	0	.	.	.	.	.	.	
	17–45[b]	F	8	0.5	0.2	0.8	1.2	.	.	32%
	Adult[c]		34	0.6	0.5	0.8	1.9	.	.	12%
	Child[c]		1	0.5	0.5	0.5	0.5	.	.	4%
Middle	0–6	F	0	.	.	.	.	.	.	
		M	0	.	.	.	.	.	.	
	7–17	F	10	0.8	0.5	1.0	1.3	.	.	27%
		M	12	0.6	0.3	0.9	1.0	.	.	47%
	18–54	F	6	0.8	0.0	1.7	2.7	.	.	21%
		M	9	1.7	1.1	2.3	2.3	.	.	15%
	55+	F	1	0.8	0.8	0.8	0.8	.	.	2%
		M	5	0.9	0.3	1.5	1.6	.	.	4%
	17–45[b]	F	7	0.8	0.0	1.6	2.7	.	.	27%
	Adult[c]		43	1.0	0.6	1.4	2.3	.	.	16%
	Child[c]		0	.	.	.	.	.	.	
Upper	0–6	F	0	.	.	.	.	.	.	
		M	2	1.2	0.0	2.4	3.0	.	.	34%
	7–17	F	12	0.6	0.5	0.7	1.0	.	.	44%
		M	14	0.9	0.4	1.3	1.5	0.1	1.5	22%
	18–54	F	11	1.1	0.6	1.6	3.0	.	.	10%
		M	13	1.2	0.9	1.5	2.7	.	.	7%
	55+	F	3	0.8	0.1	1.4	1.7	.	.	15%
		M	4	0.6	0.0	1.1	2.0	.	.	2%
	17–45[b]	F	10	1.0	0.5	1.5	3.0	.	.	14%
	Adult[c]		57	0.9	0.7	1.1	2.0	1.5	2.5	9%
	Child[c]		2	1.2	0.0	2.4	3.0	.	.	11%
All (UCR Reaches 1–6)	Adult[c]		107	1.0	0.8	1.2	2.5	2.1	3.0	12%
	Child[c]		3	0.8	0.2	1.5	3.0	.	.	5%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours per day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engaged in the activity

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

TABLE 18b. Estimated Group Exposure Time (hours/day) Spent Water-skiing and Tubing in the UCR by Region and Age for the Drive-in and Boat-in Camping Recreational Exposure Scenarios

UCR Region	Age Group (years)	Sex	Drive-in Camping Trips								Boat-in Camping Trips							
			n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	0	.	.	.	.	.	.		0	.	.	.	.	.	.	
		M	1	0.5	0.5	0.5	0.5	.	.	6%	1	0.3	0.3	0.3	0.3	.	.	12%
	7–17	F	14	2.7	2.0	3.4	7.2	.	.	34%	5	1.3	0.8	1.7	3.0	.	.	86%
		M	12	3.1	2.3	3.9	5.0	.	.	34%	2	2.4	1.4	3.4	3.0	.	.	66%
	18–54	F	10	2.2	1.2	3.2	7.2	.	.	13%	2	2.1	0.7	3.5	3.0	.	.	7%
		M	12	2.2	1.4	2.9	4.0	0.9	4.7	23%	5	1.7	1.3	2.1	2.0	.	.	26%
	55+	F	3	2.0	2.0	2.0	2.0	2.0	2.0	6%	0	.	.	.	.	.	.	
		M	1	4.4	4.4	4.4	4.4	.	.	2%	0	.	.	.	.	.	.	
	17–45[b]	F	11	2.0	1.3	2.7	4.0	.	.	23%	1	3.0	3.0	3.0	3.0	.	.	18%
	Adult[c]		52	2.6	2.1	3.0	5.0	.	.	16%	15	1.6	1.2	2.1	3.0	.	.	34%
	Child[c]		1	0.5	0.5	0.5	0.5	.	.	3%	1	0.3	0.3	0.3	0.3	.	.	10%
Middle	0–6	F	0	.	.	.	.	.	.		0	.	.	.	.	.	.	
		M	3	1.4	0.6	2.1	2.0	.	.	10%	0	.	.	.	.	.	.	
	7–17	F	6	1.7	0.6	2.7	6.0	.	.	21%	3	0.6	0.5	0.7	0.6	.	.	88%
		M	5	2.3	1.1	3.4	6.9	.	.	11%	4	1.1	0.7	1.6	2.0	.	.	41%
	18–54	F	6	1.9	0.0	3.7	6.0	.	.	6%	4	0.8	0.4	1.3	2.0	.	.	13%
		M	11	3.4	2.5	4.2	6.0	.	.	14%	3	1.3	0.8	1.8	2.6	.	.	20%
	55+	F	0	.	.	.	.	.	.		0	.	.	.	.	.	.	
		M	1	6.0	6.0	6.0	6.0	.	.	1%	1	1.0	1.0	1.0	1.0	.	.	2%
	17–45[b]	F	4	1.5	0	3.4	6.0	.	.	8%	2	0.8	0.2	1.3	2.0	.	.	30%
	Adult[c]		29	2.5	1.7	3.3	6.0	3.9	6.0	7%	15	0.8	0.6	0.9	2.0	.	.	28%
	Child[c]		3	1.4	0.6	2.1	2.0	.	.	5%	0	.	.	.	.	.	.	
Upper	0–6	F	1	0.2	0.2	0.2	0.2	.	.	5%	0	.	.	.	.	.	.	
		M	0	.	.	.	.	.	.		0	.	.	.	.	.	.	
	7–17	F	8	2.4	0.8	4.0	5.0	.	.	30%	1	0.3	0.3	0.3	0.3	.	.	23%
		M	15	1.8	1.2	2.5	6.0	.	.	37%	3	1.2	0.6	1.7	2.0	.	.	86%
	18–54	F	10	2.7	1.5	4.0	6.0	.	.	15%	5	1.2	0.8	1.7	2.0	.	.	42%
		M	8	2.2	1.4	3.1	5.0	.	.	14%	4	1.4	0.9	1.9	2.0	.	.	49%
	55+	F	0	.	.	.	.	.	.		0	.	.	.	.	.	.	
		M	3	0.8	0.1	1.5	1.5	.	.	3%	1	1.0	1.0	1.0	1.0	.	.	9%
	17–45[b]	F	11	2.6	1.4	3.8	6.0	.	.	20%	2	1.6	1.4	1.8	2.0	.	.	41%
	Adult[c]		45	2.1	1.6	2.6	5.0	2.0	4.8	15%	14	1.3	1.0	1.5	2.0	.	.	36%
	Child[c]		1	0.2	0.2	0.2	0.2	.	.	2%	0	.	.	.	.	.	.	
All (UCR Reaches 1–6)	Adult[c]		126	2.5	2.2	2.8	5.0	3.9	5.0	13%	26	1.6	1.3	1.9	3.0	.	.	33%
	Child[c]		5	0.8	0.3	1.4	2.0	.	.	3%	1	0.3	0.3	0.3	0.3	.	.	4.9%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours per day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engaged in the activity

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.2.6 Exposure Time on the Sand/Beach

Tables 19a and 19b provide estimates of the mean and P95 for hours/day spent on the sand and/or at the beach along the UCR, which were estimated for each of the UCR regions (Lower, Middle, and Upper) by age, sex, and exposure scenario (i.e., beach trip, boating trip, drive-in camping trip, and boat-in camping trip).

For all children combined, mean ET for time spent in the sand along the Lower UCR ranged from 1.1 to 8.1 hours/day across exposure scenarios (i.e., beach trips, boat trips, drive-in camping trips, and boat-in camping trips); mean ET for adults in this region ranged from 0.8 to 7.2 hours/day across exposure scenarios. The mean ETs in the Lower Region of the UCR were substantially greater for boat-in campers. In the Middle UCR region, mean ET for time spent in the sand for all children combined ranged from 0.7 to 7.7 hours/day across exposure scenarios, while mean ET for adults in this region ranged from 1.0 to 4.1 hours/day. In the Upper UCR, mean ET for all children combined for time spent in the sand ranged from 0.5 to 3.1 hours/day across exposure scenarios, and mean ET for all adults combined ranged from 0.6 to 3.9 hours/day (see Tables 19a and 19b).

TABLE 19a. Estimated Group Exposure Time (hours/day) Spent on the Sand and/or Beach in the UCR by Region, Age, and Recreational Exposure Scenario for Beach and Boat Trips

UCR Region	Age Group (years)	Sex	Beach Trips								Boat Trips							
			n[a]	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	15	1.6	0.9	2.3	6.0	.	.	81%	5	2.0	1.9	2.1	3.0	.	.	100%
		M	16	0.8	0.5	1.0	2.0	.	.	79%	4	0.9	0.1	1.8	3.0	.	.	92%
	7–17	F	20	0.5	0.3	0.8	2.0	.	.	76%	12	2.2	0.8	3.6	5.6	.	.	63%
		M	24	0.8	0.6	1.1	2.5	.	.	85%	24	1.4	1.0	1.8	4.0	.	.	54%
	18–54	F	34	1.0	0.7	1.3	3.8	.	.	59%	29	1.8	1.2	2.4	5.0	.	.	53%
		M	26	0.8	0.5	1.2	2.0	0.4	2.0	55%	29	2.2	1.5	2.9	6.0	.	.	28%
	55+	F	10	0.9	0.4	1.4	2.0	.	.	85%	15	1.1	0.5	1.7	5.0	.	.	81%
		M	9	0.9	0.2	1.6	4.5	.	.	94%	7	1.9	0.4	3.4	4.0	.	.	6%
	17–45[b]	F	30	1.0	0.7	1.3	3.8	.	.	66%	18	1.7	0.9	2.5	4.8	.	.	49%
	Adult[c]		126	0.8	0.7	1.0	2.5	2.0	3.7	70%	116	1.7	1.4	2.0	5.6	4.9	6.0	37%
	Child[c]		31	1.1	0.8	1.4	2.5	.	.	80%	9	1.7	1.4	2.1	3.0	.	.	98%
Middle	0–6	F	13	0.7	0.4	1.0	1.9	.	.	100%	2	1.2	0.9	1.5	1.5	.	.	33%
		M	19	0.7	0.6	0.9	1.0	.	.	98%	3	1.7	0.2	3.2	4.5	.	.	68%
	7–17	F	31	0.6	0.4	0.9	2.5	.	.	88%	12	0.7	0.2	1.2	2.0	.	.	34%
		M	31	0.7	0.4	1.0	2.0	.	.	82%	24	1.0	0.6	1.3	2.7	.	.	60%
	18–54	F	73	1.2	0.9	1.5	3.0	.	.	92%	33	1.1	0.8	1.4	2.6	.	.	52%
		M	56	1.1	0.9	1.4	3.0	2.0	3.4	86%	26	2.1	1.2	3.1	4.7	.	.	27%
	55+	F	12	0.6	0.5	0.8	2.0	.	.	66%	6	0.5	0.3	0.8	1.3	.	.	31%
		M	12	1.5	0.6	2.5	3.0	.	.	67%	16	1.4	0.6	2.3	5.0	.	.	12%
	17–45[b]	F	62	1.2	0.8	1.5	3.9	.	.	90%	23	1.2	0.7	1.6	2.6	.	.	53%
	Adult[c]		215	1.0	0.9	1.2	3.0	2.0	3.1	84%	117	1.2	0.9	1.6	3.8	.	.	32%
	Child[c]		32	0.7	0.5	0.9	1.9	1.0	2.4	98%	5	1.6	0.4	2.8	4.5	.	.	58%
Upper	0–6	F	9	0.4	0.3	0.6	0.8	.	.	73%	1	1.5	1.5	1.5	1.5	.	.	10%
		M	13	0.6	0.4	0.8	1.0	0.2	1.0	93%	3	2.4	1.6	3.3	3.7	.	.	82%
	7–17	F	13	0.5	0.4	0.6	1.0	.	.	50%	14	0.8	0.2	1.3	4.0	.	.	84%
		M	7	0.5	0.3	0.7	1.0	.	.	31%	17	1.2	0.9	1.5	2.0	.	.	30%
	18–54	F	15	0.6	0.4	0.7	1.5	.	.	35%	36	1.1	0.6	1.5	2.6	.	.	52%
		M	19	0.8	0.6	1.0	1.5	.	.	71%	26	1.3	0.9	1.7	4.0	.	.	19%
	55+	F	13	0.5	0.4	0.6	1.0	.	.	85%	5	1.8	1.4	2.3	2.4	.	.	15%
		M	4	0.7	0.4	1.0	2.0	.	.	77%	11	1.0	0.5	1.4	3.0	.	.	5%
	17–45[b]	F	12	0.7	0.5	0.9	1.5	.	.	46%	27	0.7	0.5	1.0	1.5	0.8	1.7	57%
	Adult[c]		73	0.6	0.5	0.7	1.3	1.1	1.8	53%	109	1.2	1.0	1.4	3.0	2.4	3.9	21%
	Child[c]		22	0.5	0.4	0.6	1.0	0.4	1.4	95%	4	2.2	1.6	2.9	3.7	.	.	33%
All (UCR Reaches 1–6)	Adult[c]		414	0.9	0.8	1.0	3.0	2.3	3.1	76%	271	1.8	1.6	2.0	5.0	4.0	5.0	31%
	Child[c]		85	0.8	0.7	1.0	2.0	1.5	2.3	91%	16	1.9	1.6	2.3	4.5	.	.	76%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours per day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engaged in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

TABLE 19b. Estimated Group Exposure Time (hours/day) Spent on the Sand and/or Beach in the UCR by Region, Age, and Recreational Exposure Scenario for Drive-in and Boat-in Camping Trips

			Drive-in Camping Trips								Boat-in Camping Trips							
UCR Region	**Age Group (years)**	**Sex**	**n**	**Mean**	**LCL95**	**UCL95**	**P95**	**LTL95**	**UTL95**	**Freq.**	**n**	**Mean**	**LCL95**	**UCL95**	**P95**	**LTL95**	**UTL95**	**Freq.**
Lower	0–6	F	5	2.0	1.0	3.0	6.0	.	.	45%	1	1.0	1.0	1.0	1.0	.	.	100%
		M	13	2.7	0.6	4.8	11.5	.	.	100%	4	9.8	9.6	10.1	10.0	.	.	100%
	7–17	F	29	2.4	1.5	3.3	7.7	.	.	77%	7	4.6	3.0	6.2	10.0	.	.	100%
		M	30	3.0	2.3	3.7	6.0	3.5	9.9	79%	3	6.0	1.8	10.3	12.0	.	.	100%
	18–54	F	44	2.3	1.6	3.0	6.0	3.7	9.9	58%	12	6.4	3.5	9.3	16.0	.	.	54%
		M	41	3.4	2.4	4.4	9.0	.	.	75%	12	9.7	6.1	13.3	15.9	.	.	65%
	55+	F	17	3.8	2.4	5.3	12.0	.	.	42%	1	2.0	2.0	2.0	2.0	.	.	26%
		M	27	1.7	1.0	2.4	7.0	.	.	43%	2	2.3	1.1	3.6	3.2	.	.	6%
	17–45[b]	F	34	2.7	1.8	3.6	7.7	.	.	76%	6	7.0	3.5	10.4	16.0	.	.	100%
	Adult[c]		189	2.7	2.3	3.1	8.0	5.9	8.0	58%	39	7.2	5.0	9.4	15.9	.	.	65%
	Child[c]		18	2.5	0.9	4.1	11.5	.	.	76%	5	8.1	5.2	10.9	10.0	.	.	100%
Middle	0–6	F	6	1.9	0.8	3.0	5.0	.	.	15%	2	12.9	8.0	17.9	16.0	.	.	100%
		M	15	4.4	3.2	5.6	6.0	0.8	5.9	68%	3	5.6	1.1	10.1	12.0	.	.	100%
	7–17	F	23	4.0	2.1	6.0	11.3	.	.	64%	5	2.1	1.3	2.8	4.6	.	.	100%
		M	17	2.5	1.8	3.2	6.9	.	.	41%	5	4.1	2.5	5.8	6.9	.	.	45%
	18–54	F	44	2.7	1.4	4.0	14.6	.	.	56%	20	4.2	2.6	5.8	12.0	.	.	47%
		M	46	2.6	1.5	3.8	8.0	5.3	13.6	53%	9	6.9	2.9	11.0	20.0	.	.	45%
	55+	F	15	3.8	1.1	6.4	10.0	.	.	46%	1	2.5	2.5	2.5	2.5	.	.	89%
		M	30	1.5	1.0	2.0	4.0	1.3	4.0	38%	6	7.8	4.1	11.5	15.9	.	.	15%
	17–45[b]	F	29	3.0	1.2	4.8	14.6	.	.	66%	11	4.4	2.0	6.7	16.0	.	.	88%
	Adult[c]		175	2.7	2.1	3.3	10.0	7.2	12.1	49%	48	4.1	2.6	5.6	15.9	.	.	54%
	Child[c]		21	3.9	2.7	5.2	6.0	1.4	7.0	41%	5	7.7	2.8	12.6	16.0	.	.	100%
Upper	0–6	F	16	2.4	1.5	3.3	8.0	.	.	73%	2	1.5	0.4	2.6	6.0	.	.	100%
		M	22	1.7	1.3	2.2	3.0	.	.	80%	2	5.4	5.0	5.9	6.0	.	.	100%
	7–17	F	18	1.3	0.6	2.0	8.0	.	.	74%	2	1.9	0.3	3.5	3.3	.	.	46%
		M	32	2.7	1.9	3.5	9.0	.	.	76%	4	4.5	2.4	6.5	6.9	.	.	100%
	18–54	F	32	3.0	2.0	3.9	8.0	.	.	45%	15	3.9	2.2	5.6	9.0	.	.	78%
		M	38	2.1	1.5	2.8	8.0	.	.	63%	7	3.3	1.8	4.8	9.3	.	.	61%
	55+	F	11	1.1	0.8	1.3	2.0	.	.	33%	2	2.6	2.4	2.8	4.0	.	.	90%
		M	27	1.4	1.1	1.7	4.0	1.8	5.4	47%	4	5.3	2.3	8.3	9.3	.	.	50%
	17–45[b]	F	29	2.6	1.7	3.5	7.0	.	.	51%	7	3.8	1.3	6.3	9.0	.	.	75%
	Adult[c]		161	2.1	1.8	2.5	7.0	4.7	7.7	55%	35	3.9	2.8	4.9	9.3	.	.	71%
	Child[c]		38	2.0	1.5	2.4	6.0	3.4	7.8	77%	4	3.1	0.9	5.3	6.0	.	.	100%
All (UCR Reaches 1–6)	Adult[c]		525	2.6	2.4	2.9	8.0	6.0	7.9	55%	67	7.7	5.6	9.8	16.0	15.5	18.5	63%
	Child[c]		77	2.7	1.7	3.6	9.0	.	.	65%	8	6.0	2.2	9.7	18.0	.	.	100%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours per day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engaged in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.2.7 Exposure Time Inside a Tent, RV, or Camper

Table 20 presents estimates of the mean and P95 for time spent inside a tent, RV, or camper during a camping trip to the UCR, by region, age, sex, and exposure scenario (drive-in camping trip or boat-in camping trip).

The mean hours/day spent inside a tent, RV, or camper on drive-in camping trips was estimated as 8.6 for all adults combined and 9.0 for all children combined in the Lower UCR; 8.5 and 9.3 hours/day for all adults combined and all children combined, respectively, in the middle region; and 7.2 and 8.7 hours/day for all adults combined and all children combined, respectively, in the upper region. The sample sizes for boat-in camping trips were much smaller than drive-in camping. Estimates of the mean time spent inside for this population ranged from 4.1 to 7.5 hours/day for children and 3.7 to 7.3 hours/day for adults across the 3 UCR regions (see Table 20).

TABLE 20. Estimated Group Exposure Time (hours/day) Spent inside a Tent, RV, or Camper During a Camping Trip in the UCR by Region, Age, and Recreational Exposure Scenario

UCR Region	Age group (years)	Sex	Drive-in Camping Trips								Boat-in Camping Trips							
			n[a]	Mean	LCL95	UCL 95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
Lower	0–6	F	7	9.3	6.5	12.1	12.0	.	.	85%	0	.	.	.	.	.	.	
		M	12	8.8	7.4	10.2	12.0	.	.	70%	2	6.3	5.0	7.6	7.0	.	.	33%
	7–17	F	33	8.2	6.6	9.7	12.0	8.3	11.7	95%	6	6.7	5.5	8.0	10.0	.	.	98%
		M	30	8.0	7.1	9.0	12.0	.	.	79%	1	7.0	7.0	7.0	7.0	.	.	47%
	18–54	F	57	7.6	6.4	8.8	12.0	8.0	11.6	82%	6	7.6	6.9	8.3	9.0	.	.	40%
		M	58	7.2	6.2	8.3	13.0	.	.	94%	8	7.7	7.5	8.0	8.0	.	.	59%
	55+	F	34	10.0	7.4	12.5	23.0	.	.	94%	0	.	.	.	.	.	.	
		M	54	10.2	9.0	11.3	16.0	.	.	94%	1	4.0	4.0	4.0	4.0	.	.	2%
	17–45[b]	F	37	8.2	6.5	9.9	17.0	.	.	81%	3	7.4	6.7	8.1	8.0	.	.	68%
	Adult[c]		267	8.6	7.9	9.2	16.0	12.4	17.0	89%	23	7.3	6.6	7.9	10.0	.	.	53%
	Child[c]		19	9.0	7.4	10.6	12.0	7.7	11.7	77%	2	6.3	5.0	7.6	7.0	.	.	26%
Middle	0–6	F	9	6.6	2.3	11.0	20.0	.	.	48%	1	8.0	8.0	8.0	8.0	.	.	69%
		M	18	10.5	9.5	11.5	12.0	8.0	11.8	83%	2	2.7	1.8	3.5	4.0	.	.	75%
	7–17	F	24	9.3	7.8	10.8	20.0	.	.	86%	3	3.2	2.5	3.8	6.2	.	.	94%
		M	18	8.4	6.7	10.2	18.0	.	.	44%	3	4.1	3.1	5.0	5.3	.	.	30%
	18–54	F	61	7.8	7.1	8.6	11.0	9.8	15.7	76%	6	4.6	2.9	6.2	8.0	.	.	20%
		M	58	8.4	7.1	9.6	12.0	8.0	11.5	73%	4	4.1	3.3	4.9	5.8	.	.	14%
	55+	F	41	9.8	8.7	10.9	17.0	.	.	81%	0	.	.	.	.	.	.	
		M	81	8.3	7.4	9.2	15.0	11.9	15.9	79%	2	6.6	4.5	8.7	7.9	.	.	5%
	17–45[b]	F	37	8.0	7.3	8.7	12.0	.	.	75%	5	5.2	3.4	7.0	8.0	.	.	44%
	Adult[c]		283	8.5	8.0	9.0	14.5	11.9	15.8	75%	19	3.7	2.9	4.5	6.4	.	.	31%
	Child[c]		28	9.3	7.0	11.5	14.0	.	.	69%	3	4.1	1.6	6.6	8.0	.	.	73%
Upper	0–6	F	17	6.8	4.6	9.0	12.0	.	.	77%	1	8.0	8.0	8.0	8.0	.	.	89%
		M	21	9.8	9.3	10.3	12.0	.	.	92%	1	6.4	6.4	6.4	6.4	.	.	68%
	7–17	F	27	6.3	4.2	8.3	10.0	8.6	9.8	100%	0	.	.	.	.	.	.	
		M	34	8.3	7.4	9.1	12.0	9.5	13.7	81%	3	4.1	3.1	5.0	5.3	.	.	86%
	18–54	F	56	7.9	6.7	9.1	12.0	9.6	11.9	86%	2	5.4	4.3	6.4	6.0	.	.	15%
		M	48	6.3	4.4	8.1	12.0	.	.	77%	3	6.6	4.5	8.7	8.0	.	.	27%
	55+	F	35	7.9	6.5	9.3	14.0	11.6	15.2	95%	1	8.0	8.0	8.0	8.0	.	.	5%
		M	59	6.7	4.8	8.5	12.0	9.7	12.9	94%	0	.	.	.	.	.	.	
	17–45[b]	F	43	9.2	8.3	10.1	14.0	.	.	82%	2	5.4	4.3	6.4	6.0	.	.	23%
	Adult[c]		263	7.2	6.5	7.9	12.0	9.9	11.5	87%	9	5.7	4.3	7.1	8.0	.	.	19%
	Child[c]		38	8.7	7.7	9.6	12.0	9.9	11.9	86%	2	7.5	6.6	8.3	8.0	.	.	81%

TABLE 20. Estimated Group Exposure Time (hours/day) Spent inside a Tent, RV, or Camper During a Camping Trip in the UCR by Region, Age, and Recreational Exposure Scenario

UCR Region	Age group (years)	Sex	Drive-in Camping Trips								Boat-in Camping Trips							
			n[a]	Mean	LCL95	UCL 95	P95	LTL95	UTL95	Freq.	n	Mean	LCL95	UCL95	P95	LTL95	UTL95	Freq.
All (UCR Reaches 1–6)	Adult[c]		813	8.4	8.0	8.8	16.0	13.3	16.1	85%	30	6.7	6.0	7.5	12.4	.	.	41%
	Child[c]		85	9.0	8.0	10.0	12.0	9.3	11.5	76%	4	7.8	7.0	8.5	8.6	.	.	52%

For boat-in campers, time spent inside is assumed to be spent inside tents (i.e., not inside campers or RVs)

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; P95 = estimated 95th percentile of the hours per day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engaged in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from MeHg and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

5.4.3 Outlier Analysis

As part of the outlier analysis, responses that were identified as implausible were replaced with plausible values. This included one response (one participant) for the number of beach trips and one response (one participant) for the number of boating trips. One participant reported 150 beach trips which exceeded the time covered by the survey questionnaire (122 days); this response was revised to 122 trips. One participant reported a total of 640 boat trips in the previous year (160 boat trips in each of the 4 seasons). It is possible that this person was reporting they took more than one boat trip per day; however, for the purposes of the HHRA, each trip is considered a full day trip. Therefore, the 640 trips were replaced with 360 trips (reflecting one daily trip per 90-day quarter).

Responses that were considered plausible but potential statistical outliers (Section 4.4.3) were retained in the data. Participants who provide extreme but plausible observations may be unique or may represent a subset of the population (Brewer, 2002). As part of the uncertainty assessment related to potential statistical outliers, key parameters (parameters that have been or may be used in the HHRA) were estimated after using two alternate sample weights to evaluate the sensitivity of potential outliers on the parameter estimate. The two alternate sample weights that were used for potential outliers were 1.0 and the median of the sample weights. Changing the sample weights to 1.0 for participants who provide extreme responses is a standard method for treating extreme observations for participants who are unique (i.e., does not represent a small subset of the population) (Brewer, 2002). However, the median person weights (used to estimate EF) are approximately 7 for beach trips, 10 for boating trips, and 12 for camping trips;[32] and the median trip weights (used to estimate ETs) that are used to estimate hours spent swimming range from approximately 20 for beach trips to 51 for boating and camping trips. Substituting 1.0 for sample weights for potential statistical outliers represents a substantial reduction for some of the participants whose responses were identified as potential outliers; therefore, the sensitivity of the parameter estimate to the change in the sample weight(s) was assessed by substituting the median sample weights for responses that are considered plausible but potential outliers.

Substituting either 1.0 or the median sample weights for potential statistical outliers resulted in little to no changes to the EF and ET estimates. Substituting 1.0 for sample weights for potential statistical outliers resulted in a 0 to 5 day/year reduction in the EF for the RME (P95) scenario, depending on the exposure scenario (swimming during beach trips, boat day trips, and camping trips) and receptor (adult or child; Table 21). For the CTE (mean) scenario, EFs were reduced 0.1 to 1.3 days/year, depending on the exposure scenario and receptor (Table 21). Less of a reduction was seen when 1.0 was substituted for sample weight for potential statistical outliers in the ET data set. Within the RME (P95) scenario, the estimate was reduced by 0 to 1.3 hours/day (Table 21). Within the CTE (mean) scenario, the ET estimate was reduced by 0.02 to 0.3 hours/day.

[32] Person weights were used to estimate the number of trips/year (EF). The data were provided by the responses to the questions in Part C of the beach, boating, and camping questionnaires (the same questions are asked in each of the three questionnaires).

TABLE 21. Exposure Parameters for the Recreational Visitor Derived from the RecUse Survey Data

Exposure Scenario	Exposure Parameter	Units	Values to be Used in the HHRA				Outlier Sample Weights = 1[g]				Outlier Sample Weights = median[h]			
			RME Value		CTE Value		RME Value		CTE Value		RME Value		CTE Value	
			Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child
Swimming During Beach Trips	Exposure Frequency[a]	days/year	20	16	6.8	5.9	15	15	5.5	5.6	25	20	7.3	6.5
	Exposure Time[b]	hours/day	2.9	2.8	0.99	0.98	2.5	1.5	0.92	0.96	2.8	2.8	0.97	0.99
Swimming During Boat Day Trips	Exposure Frequency[c]	days/year	24	16	6.6	5.5	20	14	5.6	4.6	32	18	7.9	8.4
	Exposure Time[d]	hours/day	2.0		0.79		2.0		0.76		2.2		0.81	
Swimming During Camping Trips	Exposure Frequency[e]	days/year	20	10	6.3	4.3	16	10	5.3	4.2	20	11	6.3	4.7
	Exposure Time[f]	hours/day	6.0		1.8		4.8		1.5		5.0		1.6	

[a]RME values are P95 days/year for beach day trips for all UCR reaches combined; CTE values are mean days/year for beach day trips for all UCR reaches combined (children defined as 0–6 years old, adults defined as 7+ years old)

[b]RME values are P95 hours/day for swimming beach trips for all UCR reaches combined; CTE values are mean hours/day for swimming beach trips for all UCR reaches combined (children defined as 0–6 years old, adults defined as 7+ years old)

[c]RME and CTE values are P95 and mean days/year, respectively, for boat day trips for all UCR reaches combined (children defined as 0–6 years old, adults defined as 7+ years old)

[d]RME and CTE values are P95 and mean hours/day, respectively, for boat day trips for all UCR reaches combined (adults and children combined)

[e]RME and CTE values are P95 and mean days/year, respectively, for camping trips for all UCR reaches combined; boat-in and drive-in camping trips combined (children defined as 0–6 years old, adults defined as 7+ years old)

[f]RME and CTE values are P95 and mean hours/day, respectively, for camping trips for all UCR reaches combined. Boat-in and drive-in camping trips combined (adults and children combined)

[g]Sample weights for participants whose responses were flagged as potential statistical outliers were changed to 1.0; see Sections 4.4.3 and 5.4.3 for details.

[h]Sample weights for participants whose responses were flagged as potential statistical outliers were changed to the median of the sample weights; see Sections 4.4.3 and 5.4.3 for details.

Substituting the median sample weights for potential statistical outliers resulted in either no change or an increase in the EF estimates. Within the RME (P95) and CTE (mean) scenario, swimming during camping trip EF estimates did not change for the adult. Estimates for the other exposure scenario/receptor combinations increased from 1 to 8 days/year (Table 21) within the RME (P95) scenario. EF estimates for other exposure scenario/receptor combinations within the CTE (mean) scenario increased from 0.04 to 2.9 days/year depending on the exposure scenario and receptor (Table 21). ET estimates either did not change or changed slightly (0.1 to 1 hours/day) when median sample weights were substituted for potential statistical outliers within the RME (P95) scenario (Table 21). Within the CTE (mean) scenario, ET estimates changed slightly (0.01 to 0.2 hours/day; Table 21). The increase in the estimates for some parameters is due to the tendency for the higher responses to be from participants who have sample weights that are less than the median (Figure A-1, Appendix A).

5.4.4 Sources of Uncertainty in Exposure Frequency and Exposure Time Estimates

This section discusses uncertainty in key recreational use exposure parameters that may be used in the HHRA. Uncertainty in estimates of EF is quantified by confidence intervals for the means and tolerance intervals for the P95s that are presented in Tables 12–14. Estimates of the mean EF for adults for all regions of the UCR combined are very precise, with MEs (1/2 the confidence interval width) of ±1 day/year or less for all three trip types: beach, boating, and camping. MEs for the P95s for adults range from ±5.1 boating day trips/year, to ±2.5 days spent camping per year and ±4.7 beach trips per year. While the sample sizes for children are much smaller than adult sample sizes, the MEs for the estimated means for children are ±2.2 days/year or less for all three trip types. The MEs for the estimates of the P95s for children are similar to adults except for boating; the ME for the estimate of the P95 for annual boating day trips by children is 14.1, which corresponds to an RE of 88%. The estimates of the mean and P95 for number of trips per year, as well as their confidence intervals, are considered very reliable given the large sample sizes available, particularly for adults.

The estimates for the means and P95s for EF for individual lake regions are less precise as would be expected given the smaller sample sizes. The decrease in precision varies depending on the type of trip and the lake region. The MEs for the estimated mean and P95 for beach trips by adults to the lower region are substantially larger than the MEs for the middle and upper lake region. For children, the estimates to the upper region are more precise than the lower and middle regions. For each of the trip types, estimates of the mean and P95 are less precise in the lower lake region compared to the middle and upper regions, except for the number of boating trips per year to the lower lake region by children: the MEs for the mean and P95 are 2.5 and 48 days/year, respectively.

Estimated means and P95s for time spent swimming are presented in Tables 17a and 17b. Estimates of the mean time spent swimming during beach trips are very precise for adults and children for all regions of the UCR combined. The MEs for the means are less than ±0.2 hours for adults and children. The ME for the P95 for adults is also small (±0.25 hours). A tolerance interval for the P95 is not available for children (Woodruff's method was not able to produce an estimate; SAS, 2017). However, the estimates of the mean and P95s for time spent swimming during beach trips are very similar between adults and children. Therefore, the estimates of the mean and P95 for adults and children are also considered reliable.

The estimates for the time spent swimming during boating trips for children are not considered reliable given the small sample size (n = 16).

Estimates of the mean time spent swimming during camping trips are very precise for adults for all regions of the UCR combined. The ME for the mean is approximately ±0.25 hours. The estimate for the P95 is 6.0 hours with 95% tolerance limits of [4.7, 5.7]. The sample size for children (n = 24) produces less precise estimate of the mean; the ME is 0.70 hours.

The MEs for the means and P95s for EFs and ETs presented in Section 5.4 do not consider the loss of interviews in the upper region of the UCR due to flooding of Black Sand Beach or the loss of interviews throughout the UCR due to inaccessible boat launches (Section 6.5; IEc, 2013b). The effects of the loss of interviews on the estimates for EF and ET are unknown; furthermore, the effect probably varies by trip type (beach, boating, or camping) and also among the regions. Considering the large sample sizes that are available for the EFs and ETs, estimates for the UCR (all regions combined) are considered reliable; however, considering the MEs for the EFs and ETs for individual regions, and the unknown effect of the loss of interviews on parameter estimates, the estimates by region are considered less reliable in general.

6.0 SUMMARY AND CONCLUSIONS

6.1 Overview

Replacing national defaults with site-specific information reduces uncertainties in the HHRA. As discussed previously, the RecUse Survey was designed to fill data gaps identified in the HHRA Work Plan (U.S. EPA, 2009) and provide site-specific information regarding use of the UCR Site by recreational visitors, with the goals of informing the selection of exposure factors and reducing uncertainty in the estimation of exposure for this population in the HHRA. The four major site-specific data needs stemming from the HHRA Work Plan for the Site (U.S. EPA, 2009) were:

1. Information on surface water activities and exposure that could be used to estimate frequency and duration of exposure to surface water.
2. Information on activities that bring people into contact with UCR beach sediment and soil, including the frequency and duration of exposure to these media (i.e., days/year and hours/day).
3. Information on the types, frequency, and duration of outdoor activities and time spent inside tents or RVs, to evaluate inhalation exposure, which is a complete but minor exposure pathway.
4. Information regarding the frequency of fish consumption and the size and type of UCR fish meals consumed by anglers and their families to support estimates of UCR fish consumption rates.

In the absence of site-specific data, preliminary risk estimates in the HHRA Work Plan were derived using standard default exposure parameters (e.g., U.S. EPA, 1989, 1991, 1997) or based on professional judgment. In the following sections, exposure factors estimated from the RecUse Survey data are compared to the exposure parameters used in the HHRA Work Plan (U.S. EPA, 2009). This

comparison can inform completeness of exposure pathways that were identified in the HHRA Work Plan (U.S. EPA, 2009) or identify more appropriate site-specific values for parameter estimates. Considerations such as the representativeness of the populations surveyed and the uncertainty around exposure estimates will be discussed in greater detail in the HHRA. Section 6.2 discusses the data to be used for the estimation of dietary exposure (i.e., fish consumption and surface water ingestion); Section 6.3 discusses data regarding exposure from non-dietary sources (i.e., contact with surface water, soil, and sediment during recreational activities); Section 6.4 discusses exposure to outdoor and indoor air; Section 6.5 discusses other sources of uncertainty; and Section 6.6 presents the conclusions of this evaluation.

6.2 Data Comparison: Exposure Factors for Dietary Sources

As described in the HHRA Work Plan (U.S. EPA, 2009), collection of site-specific data on dietary exposures from the UCR were sought to inform exposure pathway completeness and parameter estimates. Figure 8 illustrates the exposure pathways and receptor populations evaluated in the HHRA Work Plan (U.S. EPA, 2009). Figure 9 is an updated HHRA CSM based on the evaluation of the RecUse Survey data. The following sections discuss the data available from the RecUse Survey that inform this exposure pathway analysis and form the basis for deriving HIF values for dietary sources of exposure. RME parameters from the HHRA Work Plan are also compared to potential exposure parameters estimated using the RecUse Survey data.

6.2.1 Consumption of Freshwater Fish

For the fish consumption exposure scenario, the exposure factor (grams of fish consumed/day) derived from RecUse Survey data is based on those respondents who reported consuming freshwater fish ("consumers only") harvested from the UCR as described in Section 5.2.3. While the RecUse Survey includes information on the consumption frequency for various fish species (IEc, 2013b), the average and P95 consumption for *all species combined* is reported in Table 22 for comparison with the freshwater fish consumption estimates in the HHRA Work Plan (U.S. EPA, 2009).

To estimate exposure from freshwater fish consumption, exposure parameters in the HHRA Work Plan were based on CTE estimates of an evaluation of local anglers from the U.S. Department of Agriculture and the Washington Department of Health (Patrick, 1997) and professional judgment. They assume that all fish consumed while at the UCR were caught in the UCR. Using these judgment-based exposure parameters, initial risk estimates for the recreational visitor due to fish consumption were at or above the level of potential concern (LOPC) in one or more exposure reaches (U.S. EPA, 2009). The RecUse Survey collected age-specific information on the consumption of fish harvested from the UCR. In general, using site-specific information will reduce uncertainties in the HHRA. The information obtained from the RecUse Survey on the amount of fish consumed per day and the fraction of fish meals harvested from the UCR is considered adequate to establish a complete pathway for this route of exposure and provides site-specific parameter values for the adult age groups surveyed to support the next steps in the HHRA process. Child fish DCR for the HHRA will likely be estimated using regression models of estimated energy requirements for children and adults (IOM, 2005).

TABLE 22. Comparison of Estimated Daily Consumption Rates of Freshwater Fish from the HHRA Work Plan (U.S. EPA, 2009) and the RecUse Survey (IEc, 2013b)

	HHRA Work Plan (Recreational Visitor)[a]			RecUse Survey[b]					
Exposure Pathway	**Visitor Scenario**	**Child**	**Adult**	**0–6 years old**	**7–17 years old**	**18–54 years old**	**55+ years old**	**Child**	**Adult**
Ingestion of Fish (g/day)	Short-term[c]	3.26	4.35	3.5 (5.8)	6.4 (20)	4.7 (24)	7.8 (34)	-[e]	**6.3 (28)**
	Year-round[d]	26	65						

Exposure parameters that will be used in the HHRA are in bold text above.

[a]The HHRA Work Plan (U.S. EPA, 2009) exposure factors represent RME values based on the assumed fish intake rates of seven fish meals from the UCR, and a meal size of 8 and 6 ounces for adults and children, respectively (adult average intake rate [g/day] = 7 meals • 8 ounces • 28.35 g per ounce / 365 days per year = 4.35 g/day).

[b]The values report the mean (P95) daily consumption (g) of fish from the UCR (consumers only; mean values are from diary and questionnaire data combined; 95th percentile values are from diary data only) from IEc (2013b). These estimates are obtained from Table 9 in Section 5.2.3.

[c]HHRA values represent the RME for the Short-term Recreational Population. Includes individuals (both local and non-local) who visit the river as part of occasional recreational activities. Intake rates for fish and game are representative of a daily intake rate (g/day) averaged across a year; therefore, the EF is set to 365 days.

[d]HHRA values represent the RME for the Year-Round Recreational Population. Intake rates for fish and game are representative of a daily intake rate (g/day) averaged across a year; therefore, the EF is set to 365 days.

[e]The Data Analysis Report does not provide sufficient data to estimate a DCR for children. See Section 5.2.4 for additional discussion.

6.2.2 Intentional Consumption of Surface Water

For the intentional consumption of surface water exposure scenario, the exposure factor (liters of surface water ingestion/day) is based on those respondents who reported consuming surface water from the UCR as described in Section 5.3. Table 23 provides a comparison of the exposure parameters for surface water consumption presented in the HHRA Work Plan (U.S. EPA, 2009) to those based on data obtained from the RecUse Survey.

For exposure from intentional consumption of surface water, exposure parameters from the HHRA Work Plan (U.S. EPA, 2009) were based on U.S. EPA (1989, 1991) and U.S. EPA (2002) for adults and children, respectively. Using those default exposure parameters, initial risk estimates for the recreational visitor due to intentional ingestion of surface water as drinking water were below the LOPC in all exposure reaches and were below drinking water maximum contaminant levels (MCLs) for the seasonal and year-round visitor. The RecUse Survey collected age-specific information on the consumption of surface water from the UCR as drinking water. The RecUse Survey reported that consumption of UCR surface water during boating, camping, and beach visits was very rare. The survey data are considered adequate to establish that this route of exposure is incomplete for the recreational visitor population. Therefore, this exposure pathway will not be quantitatively evaluated in the HHRA for recreational exposure scenarios.

TABLE 23. Comparison of Estimated Daily Ingestion Rates of Drinking Water from the HHRA Work Plan (U.S. EPA, 2009) and the RecUse Survey (IEc, 2013b)

Exposure Pathway	HHRA Work Plan (Recreational Visitor)[a]	UCR Region	RecUse Survey[b] 0–6 years old	RecUse Survey[b] 7–17 years old	RecUse Survey[b] 18–54 years old	RecUse Survey[b] 55+ years old
Ingestion of Drinking Water (L/day)	2 (adults) 1.1 (children)	Lower	0 (0)	0 (0)	0.12[c] (0.12)	0 (0)
		Middle	0.12[d] (0.12)	0.038[c] (0.038)	0 (0)	0.038[c] (0.038)
		Upper	0.12[d] (0.12)	0.038[e] (0.038)	0.59[e] (0.59)	0.065[g] (0.12)

[a]The HHRA Work Plan values are intended to be RME values for Short-term and Year-Round Recreational Population (U.S. EPA, 2009). Short-term includes individuals (both local and non-local) who visit the river as part of occasional recreational activities; assumes exposure of 14 days/year. Year-Round includes individuals that reside locally and may engage in year-round recreational activities; assumes exposure occurs year-round at a frequency of 5 days/week (260 days) (U.S. EPA, 2009). Drinking water in the HHRA Work Plan was assumed to be either untreated groundwater or surface water. The HHRA Work Plan exposure factors for children were based on the RME value of 1.1 L/day as the 95th percentile drinking water intake rate for 1–10-year-olds (see Table 4-12 in U.S. EPA, 2002). Adult values were based on values described in U.S. EPA (1989, 1991).

[b]All estimates are based on the reported mean daily surface water consumed (intentional consumption) from the UCR as reported by IEc (2013b) and were converted to liters using the following conversion factor (one ounce = 0.0295735 liters).

[c]Values represent a sample size of one individual (male, boating trip).

[d]Values represent a sample size of one individual (male, beach trip).

[e]Values represent a sample size of two individuals (males only, boating trips).

[f]Values represent a sample size of one individual (male, drive-in camping trip).

[g]Values represent a sample size of three individuals (two males, one female, boating trips).

6.3 Data Comparison: Exposure Factors for Non-Dietary Pathways

As described in the HHRA Work Plan (U.S. EPA, 2009), site-specific data on non-dietary exposure pathways from the UCR were sought to inform exposure pathways and parameter estimates related to recreational activities for dermal contact and incidental consumption of surface water, soil, and sediment, as well as inhalation of outdoor and indoor air. Figure 8 illustrates the exposure pathways and receptor populations evaluated in the HHRA Work Plan, and Figure 9 is an updated HHRA CSM based on the evaluation of the RecUse Survey Data. Surface water exposures include those that occur during activities in and on the water (wading, swimming, water-skiing, and tubing). Soil and sediment exposure factors are related to activities on land where incidental contact and ingestion may occur (visiting the beach), and in shallow water where incidental contact and ingestion may occur during swimming and wading. Outdoor and indoor air exposures, discussed separately in Section 6.4, are related to the activities and time spent outside at UCR recreation areas, or while staying inside RVs, campers, or tents (i.e., indoors) at UCR campgrounds.

These exposures can occur during the four types of activities surveyed in the RecUse report: beach trips, boating, drive-in camping, and boat-in camping. The exposure factors derived from the RecUse survey for this type of exposure include EF (days/year) and ET (hours/day). In Table 24, EF default parameters used in the HHRA Work Plan (U.S. EPA, 2009) are compared with potential exposure frequencies estimated for adults and children for the UCR (all lake regions combined) for each of the four types of trip listed above (see Table 11).

TABLE 24. Comparison of Exposure Parameters for the Frequency (days/year) of Time Spent in Contact with Surface Water and Soil/Sediment During Recreational Activities from the HHRA Work Plan (U.S. EPA, 2009) and the RecUse Survey (IEc, 2013b)

	HHRA Work Plan (Recreational Visitor)				RecUse Survey[a]						
						Child			Adult		
Exposure Pathway	Visitor Scenario	Adult only	Child only	Adult & Child	UCR Region	Beach Trips	Boat Trips	Camping Trips[d]	Beach Trips	Boat Trips	Camping Trips[d]
Exposure Frequency (days/year)	Short-term[b]	7	14	14	All (UCR Reaches 1–6)	**5.9 (16.0)**	5.5 (16.0)	4.3 (10.3)	**6.8 (20.0)**	6.6 (23.8)	6.3 (19.9)
	Year-round[c]	25	50	260							

Exposure parameters that will be used in the HHRA are in bold text above.
[a]Values represent mean (P95) estimates for EF (days/year) of time spent in contact with surface water and soil/sediment.
[b]The HHRA Work Plan values represent RME values for Short-term use which includes individuals (both local and non-local) who occasionally visit the UCR for recreation.
[c]The HHRA Work Plan values represent RME values for Year-round use which includes individuals that reside locally and may engage in year-round recreational activities; assumes exposure occurs for 5 days/week (260 days/year).
[d]Values represent all camping trips taken in the 12 months preceding the RecUse Survey.
[e]RecUse exposure frequencies are from Table 11 (or beach exposure frequencies are from Table 12, RecUse camping exposure frequencies are from Table 13, and RecUse boating exposure frequencies are from Table 14).

The following sections discuss the data available from the RecUse Survey that inform the exposure pathway analysis and form the basis for deriving HIF values for exposures to surface water and soil/sediment. Inhalation is discussed separately in Section 6.4. ETs used in the HHRA Work Plan are compared to site-specific ETs estimated using the RecUse Survey Data.

6.3.1 Time Spent in Contact with Shallow Surface Water and Soil/Sediment while Engaging in Recreational Activities

Recreational visitors to the UCR may contact shallow surface water (less than waist deep) and soil/sediment when visiting the beach and wading during beach, boating, and camping trips. Exposure parameters needed to derive HIFs for this exposure scenario include body weight, exposure duration, EF, ET, incidental ingestion of surface water and sediment, dermal contact with soil/sediment (exposed skin surface area, adherence factor, dermal absorption fraction), and dermal contact with shallow surface water (exposed skin surface area and dermal permeability coefficient). Information was not collected in the RecUse Survey or otherwise to support site-specific estimates for the following variables: body weight, exposure duration over a lifetime, incidental ingestion of sediment or surface water, exposed skin surface area, adherence factor, dermal absorption fraction, and the dermal permeability coefficient for contaminants of potential concern (COPCs). However, these parameters are well-established and are not generally considered to vary widely on a site-specific basis. The exposure parameters evaluated based on RecUse Survey data for this exposure scenario are EF and ET.

Frequency for beach, boating, and camping trips (from Table 11) during which exposure to shallow surface water and soil/sediment could occur is given for both children and adults in Table 24, along with default exposure frequencies used in the HHRA Work Plan (U.S. EPA, 2009). Given the large number of interviews conducted along the UCR and the variety of trips that were captured, the RecUse survey data are considered adequate to demonstrate a complete pathway for these exposure scenarios and support the next steps in the HHRA process.

The RecUse Survey collected age-specific information on the time spent in contact with shallow surface water from the UCR, as discussed in Section 5.4.2.3 and Tables 16a and 16b. Table 25 presents the ETs for contact with shallow water (less than waist deep) during recreational activities from the HHRA Work Plan (U.S. EPA, 2009) in comparison with those based on data obtained from the RecUse Survey.

For the beach sediment exposure scenario (via dermal contact and incidental ingestion), the time spent in contact with beach sediment (hours/day) is based on respondents who reported spending time on the beach in the UCR as described in Section 5.4.2.6 and Tables 19a and 19b. The RecUse Survey collected age-specific information on the amount of time spent in contact with beach sediment (hours/day) from the UCR. Table 25 provides a comparison of the estimates presented in the HHRA Work Plan (U.S. EPA, 2009) with estimates that are based on data obtained from the RecUse Survey. The time spent in contact with beach sediment is not considered in the equations that will be used to estimate exposure in the HHRA; standard U.S. EPA equations for assessing exposure to sediment via incidental ingestion do not include a variable for ET. The estimates for ET for contact with beach sediment are presented here for informational purposes only.

For exposure from the time spent in contact with shallow surface water and soil/sediment, exposure parameters from the HHRA Work Plan (U.S. EPA, 2009) were based on U.S. EPA (1989, 2000) and professional judgment. In general, using site-specific information to estimate exposure factors is preferred over exposure factors that are based on guidance, literature, or professional judgment (U.S. EPA, 1989). The information obtained from the RecUse Survey on the amount of time spent engaging in recreational activities in contact with shallow surface water and soil/sediment from the UCR (i.e., while wading or spending time on the beach) is considered adequate to demonstrate a complete pathway for these exposure scenarios.

6.3.2 Time Spent in Contact with Surface Water Deeper than Waist Deep and Soil/Sediment During Recreational Activities

Recreational visitors to the UCR may contact surface water and soil/sediment when wading or swimming in water deeper than waist deep during beach, boating, and camping trips. They may also contact surface water on boating or camping trips when water-skiing or tubing. Exposure parameters needed to derive HIFs for these exposure scenarios include body weight, exposure duration, EF, ET, incidental ingestion of surface water, dermal contact with soil/sediment (exposed skin surface area, adherence factor, dermal absorption fraction), and dermal contact with surface water (exposed skin surface area and dermal permeability coefficient). Information was not collected in the RecUse Survey or otherwise to support site-specific estimates for the following variables: body weight, exposure duration over a lifetime, incidental ingestion of surface water, exposed skin surface area, adherence factor, dermal absorption fraction, and dermal permeability coefficient for COPCs. However, these parameters are well-established and are not generally considered to vary widely on a site-specific basis. The parameters evaluated based on RecUse Survey data for this exposure scenario are EF and ET.

Frequency of beach, boating, and camping trips (see Table 11) during which exposure to soil/sediment and surface water greater than waist deep could occur is given for both children and adults in Table 24, along with default exposure frequencies used in the HHRA Work Plan (U.S. EPA, 2009). Given the large number of surveys conducted along the UCR and the variety of trips that were captured,

the RecUse survey data are considered adequate to demonstrate a complete pathway for these exposure scenarios and support the next steps in the HHRA process.

The exposure factor for time spent in surface water deeper than waist deep is based on those respondents who reported swimming and wading in water over waist deep from the UCR on beach, boating, and camping trips as described in Section 5.4.2 and Tables 17a and 17b. A separate ET for exposure to water while water-skiing and tubing, described in Section 5.4.2.5 and Tables 18a and 18b, is also derived for boaters and campers. Table 25 provides a comparison of ETs presented in the HHRA Work Plan (U.S. EPA, 2009) and those based on data obtained from the RecUse Survey for the contact and incidental consumption of surface water while swimming or wading, or water-skiing and tubing, in water greater than waist deep at the UCR.

TABLE 25. Comparison of Exposure Parameters for the Exposure Time (hours/day) Spent in Contact with Surface Water and Soil/Sediment During Recreational Activities from the HHRA Work Plan (U.S. EPA, 2009) and the RecUse Survey (IEc, 2013b)

Exposure Pathway	HHRA Work Plan	UCR Region	RecUse Survey[a]					
			Child			Adult		
			Beach	Boating	Camping	Beach	Boating	Camping
Time spent outdoors during day trips (hours/day)[b]	14 (adult) 16 (child)	All (UCR Reaches 1–6)	2.3 (5.3)	5.4 (9.5)	–	2.3 (5.2)	6.1 (12.0)	–
Time spent indoors (hours/day)[c]	10 (adult) 8 (child)	All (UCR Reaches 1–6)	–	–	9.0 (12.0)[d] 7.8 (8.6)[e]	–	–	8.4 (16.0)[d] 6.7 (12.4)[e]
Time spent in contact with shallow surface water, wading in water less than waist deep (hours/day)[f,g]	2	All (UCR Reaches 1–6)	0.9 (2.9)	1.9 (3.0)	2.4 (8.0)	0.6 (2.0)	0.8 (2.3)	1.7 (6.0)
Time spent in contact with surface water while engaging in water-skiing and tubing activities (hours/day)[f,i]	NA	All (UCR Reaches 1–6)	–	0.8 (3.0)	0.8 (2.0)[d] 0.3 (0.3)[e]	–	1.0 (2.5)	2.5 (5.0)[d] 1.6 (3.0)[e]
Time spent in contact with soil/sediment (hours/day)[f,j]	2	All (UCR Reaches 1–6)	0.8 (2.0)	1.9 (4.5)	2.7 (9.0)[d] 6.0 (18.0)[e]	0.9 (3.0)	1.8 (5.0)	2.6 (8.0)[d] 7.7 (16.0)[e]

TABLE 25. Comparison of Exposure Parameters for the Exposure Time (hours/day) Spent in Contact with Surface Water and Soil/Sediment During Recreational Activities from the HHRA Work Plan (U.S. EPA, 2009) and the RecUse Survey (IEc, 2013b)

Exposure Pathway	HHRA Work Plan	UCR Region	RecUse Survey[a]					
			Child			Adult		
			Beach	Boating	Camping	Beach	Boating	Camping
Time spent in contact with surface water, swimming and wading in water greater than waist deep (hours/day)f,h	1 (adult) 2 (child)	All (UCR Reaches 1–6)	**1.0 (2.8)**	**0.7 (3.0)**	**1.3 (4.0)**	**1.0 (2.9)**	**0.8 (2.0)**	**1.8 (6.0)**

Exposure parameters that will be used in the HHRA are in bold text above.
[a]Values represent mean (P95) estimates for exposure time (hours/day).
[b]Values can be found in Table 15 of this report.
[c]Values can be found in Table 20 of this report and represent Short-Term Recreation at the UCR. Short-term use includes individuals (both local and non-local) who visit the river as part of occasional recreational activities. It is assumed that visitors are on-site 24 hours/day; "indoors" includes inside tents, campers, and RVs. For the long-term use scenario, it is assumed that visitors only use the site during the day but do not stay overnight (U.S. EPA, 2009). These values are based on professional judgment.
[d]Values represent the drive-in camping scenario.
[e]Values represent the boat-in camping scenario.
[f]Assumes the same exposed surfaces for residential adults and children: exposure of head, hands, forearms, and lower legs (U.S. EPA, 2009).
[g]All estimates represent the amount of time spent wading in water that is less than waist deep (this does not include water-skiing or tubing). Values are the estimated mean (and P95) for each recreational scenario and can be found in Tables 16a and 16b of this report.
[h]All estimates represent the amount of time spent swimming and wading in water that is deeper than waist deep (this does not include water-skiing or tubing). Values are the estimated mean (and P95) for each recreational scenario and can be found in Tables 17a and 17b of this report.
[i]Values can be found in Tables 18a and 18b of this report.
[j]Values can be found in Tables 19a and 19b of this report.

During swimming and wading in water deeper than waist deep, adults and children can be exposed to sediments via incidental ingestion as well as through dermal contact. The RecUse Survey collected age-specific information on the amount of time spent in contact with UCR sediments in different regions of the river on beach, boating, and camping trips. These data are discussed in Section 5.4.2.6 and Tables 19a and 19b. Table 25 compares default ETs used in the HHRA Work Plan (U.S. EPA, 2009) with ETs estimated using RecUse Survey data for time spent in contact with soil/sediment. The time spent in contact with sediment is not considered in the equations that will be used to estimate exposure in the HHRA; the estimates are presented here for informational purposes only.

For exposure to COPCs from the time spent in contact with sediment and surface water while swimming/wading in water deeper than waist deep, water-skiing, and tubing, exposure parameters from the HHRA Work Plan (U.S. EPA, 2009) were based on U.S. EPA (1989) and professional judgment. ET data for these exposure scenarios (swimming, wading, water-skiing, and tubing) collected in the RecUse Survey were both age-specific and location-specific (by UCR region). The information obtained from the RecUse Survey for ET for these exposure scenarios is considered adequate to support the next steps in the HHRA process. Given that exposures to surface water while swimming are expected to be much greater than exposures to surface water while water-skiing/tubing, time spent in contact with surface water while water-skiing/tubing will not be evaluated separately in the HHRA. The estimates for water-skiing/tubing are presented here for informational purposes only.

6.4 Data Comparison: Exposure to Outdoor and Indoor Air

As discussed in Section 2.3, exposure parameters needed to calculate HIFs for exposure to outdoor or indoor air include ET (hours/day), EF (days/year), and exposure duration (years). Inhalation rates and body weights are not used in these calculations. As described in the HHRA Work Plan (U.S. EPA, 2009), collection of site-specific data on inhalation exposures from the UCR were sought to inform exposure pathways and parameter estimates. Figure 8 illustrates the exposure pathways and receptor populations evaluated in the HHRA Work Plan, and Figure 9 is an updated HHRA CSM based on the evaluation of the RecUse Survey Data.

Recreational visitors to the UCR can be exposed to outdoor air, as well as air inside RVs, tents, and campers. Outdoor air exposures can occur during beach, boating, and camping trips, while indoor air exposures occur on camping trips. Information was not collected in the RecUse Survey or otherwise to support site-specific estimates for exposure duration over a lifetime. However, this parameter is well-established and not generally considered to vary widely on a site-specific basis. The parameters evaluated based on RecUse Survey data for these exposure pathways are EF and ET.

Exposure to outdoor air was evaluated using RecUse Survey data for respondents who took beach, boating, and camping trips to the UCR, while exposure to indoor air was evaluated for those who took camping trips to the UCR. The age-specific exposure frequencies for each type of trip, by UCR region, is given in Table 25 and compared to the default exposure frequencies used in the HHRA Work Plan (U.S. EPA, 2009).

For the inhalation of outdoor air exposure scenario, the exposure factor for the time spent outdoors (hours/day) is based on those respondents who reported spending time outside at the UCR as described in Section 5.4.2.2 and Table 15. For the inhalation of indoor air exposure scenario, the exposure factor for the time spent indoors (hours/day) is based on those respondents who reported spending time inside RVs, tents, or campers while in the UCR as described in Section 5.4.2.7 and Table 20. Table 25 compares the HHRA Work Plan (U.S. EPA, 2009) ETs spent outdoors and indoors at the UCR with those based on data obtained from the RecUse Survey.

EF and ET in the HHRA Work Plan (U.S. EPA, 2009) were based on professional judgment. The RecUse Survey collected age-specific information on the amount of time spent outdoors and indoors while recreating at the UCR. The information obtained from the RecUse Survey on the amount of time spent outdoors and indoors at the UCR is considered adequate to demonstrate a complete pathway for these exposure scenarios.

6.5 Other Sources of Uncertainty

Final sample weights for participants (person weights) were trimmed to reduce the potential for a limited number of observations to have a disproportionally large effect on estimates (IEc, 2013b). Sample weights were trimmed (truncated) at the median sample weight plus 6 times the interquartile range (IQR) (IEc, 2013b). The literature on weight trimming includes other approaches (e.g., Battaglia et al., 2004; Potter, 1988, 1990). ERM reported that trimming person weights at the median plus 9 times the IQR increased the maximum person weight by approximately 46% (ERM, 2017). However, the ERM analysis over-stated the effect on the sample weights (DOI, 2017). The untrimmed weights were not available to ERM at the time of their analysis. Since the method for trimming sample weights has a direct effect on

parameter estimates, weight trimming is a source of uncertainty in parameter estimates, but there is not a definitive approach available (IEc, 2013b).

To simplify the calculation of selection probabilities, the person sample weights assumed each visitor to the UCR took no more than five of the same type of UCR trip (i.e., beach, boat or camping) during a single temporal stratum (IEc, 2013b). Twenty-three percent of the respondents reported they took more than five past trips to the UCR (IEc, 2013b). ERM (2017) found, using a regression approach to predict the sample weight for visitors who took more than 5 trips, the average sample weight (person weight) for a subset of the survey participants was reduced from 7.98 to 4.27. However, their regression model explained just 15% of the variation in the sample weights (DOI, 2017). IEc (2013b) also evaluated the use of a regression model to predict sample weights for participants who reported more than five trips of the same type in the same temporal stratum. They found the estimated number of UCR fish meals for Lake Areas 1–8 declined from 7.5 meals/year to 6.7 meals per year (IEc, 2013b) and qualified that their regression model results did not consider the type or timing of the past trips to the UCR.

A second simplification to the calculation of the person sample weights was the random assignment of past trips reported by participants to a temporal stratum (IEc, 2013b). ERM proposed a Monte Carlo approach to estimating the mean person weight for each participant rather than using the single sample weight that was calculated using the random assignment of past trips (ERM, 2017). This level of effort, however, does not seem warranted given the results of a previous Monte Carlo analysis reported by TAI (TAI, 2013), which showed estimates for the number of trips to the UCR, fish meal sizes and average annual fish meals by species differed by less than ±5% from the estimates produced with the sample weights that were included with the survey data (TAI, 2013). The Monte Carlo approach showed more than 5% differences for some combinations of fish species and lake regions (e.g., Kokanee from the upper region; “other species” from the upper region) (TAI, 2013).

Other sources of uncertainty in estimates presented in this report include low water levels in Lake Roosevelt in late spring and early summer of 2011. Due to the high snowfall amounts experienced in portions of the UCR watershed, the average water elevation in Lake Roosevelt was less than 1,250 feet during the annual drawdown period in 2011 (IEc, 2013b; Appendix C). As a result, all boat launches operated by the NPS were not available for approximately two weeks and many were not available for over two months (IEc, 2013b). The extreme drawdown resulted in fewer interviews during the Spring 2011, and the higher than average snowfall flooded Black Sand Beach, which resulted in five survey shifts (during the peak season) being moved approximately 30 miles south to Evans, the only other beach interview location in the upper region. One of these five survey shifts fell on Memorial Day and another was on the Saturday of the July 4th weekend. The effect of the missed interviews, movement of interview locations and unavailable boat launches during Spring and Summer of 2011 likely introduced a low bias in the EF estimates for beach visits to the upper region of the UCR. Two of the missed Black Sand Beach survey shifts occurred during two (of the three) summer holiday weekends. The missed interviews at Black Sand Beach were not recovered as the survey included one summer season. The effect of the closed boat launches would likely have produced a low bias in the estimated number of boating trips and trips to boat-in campgrounds.

As a consequence of inaccessible boat launches during the 2011 drawdown period, the amount of fish consumption reported on questionnaires that were administered after the drawdown period are likely to be biased low. This is particularly true for questionnaires that were administered to boaters.

Other potential sources of uncertainty in the data are summarized in the IEc Survey Report and include the following (IEc, 2013b):

- Swimming at locations that were not considered in the sample design. For example, the relict floodplains may be included in this category;
- Fish consumption data from shoreline anglers; these data are available but lack sample weights that are required for reliable inference;
- Visitors to the UCR beaches that departed after 6 pm were not interviewed; available data from vehicle counters show 13–20% of the vehicles left after 6 pm (IEc, 2013b).

6.6 Conclusion

Exposure pathways for the recreational visitors were evaluated in the HHRA Work Plan (U.S. EPA, 2009) for the UCR Site using default or professional judgment-based exposure parameters. Preliminary risk estimates in the HHRA Work Plan were at or above LOPCs in one or more reaches of the river for the following recreational exposure pathways: exposure to sediment/soil via dermal contact and incidental ingestion, inhalation of outdoor air, inhalation of indoor air, and ingestion of fish. Exposure via intentional consumption of UCR surface water was identified as a data gap. The RecUse Survey provided data to refine exposure parameters based on site-specific information and to re-evaluate the CSM. Based on the analysis of RecUse Survey data described in this report, data are sufficient to update the exposure pathway analysis and produce reliable, site-specific estimates of the exposure factors listed in Table 1. The survey also provided enough data to develop reliable estimates of DCRs for the recreational visitor population.

While data were gathered for multiple scenarios that include potential exposure to surface water, sediment/soil, and air during recreational activities, some of these data will not be used in the HHRA. For example, exposure to UCR surface water while swimming is likely to lead to greater exposures than wading or water-skiing, due to the amount of skin exposed to water and greater potential for incidental surface water ingestion. Inhalation of indoor air in a tent, camper, or RV is expected to be encompassed in the outdoor air inhalation scenario: concentrations of COPCs are not expected to be substantially different inside or outside a tent, camper, or RV. As a result, this data analysis report presents and summarizes the data collected for some recreational exposure scenarios that will not be evaluated separately in the HHRA. The survey data also indicate that the intentional consumption of UCR water by recreational visitors is very rare and is not likely a significant source of exposure for most visitors; as such, it should be removed from the CSM for the HHRA.

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Figure 1. Recreational Use Survey Area: Lake Areas and River Reaches

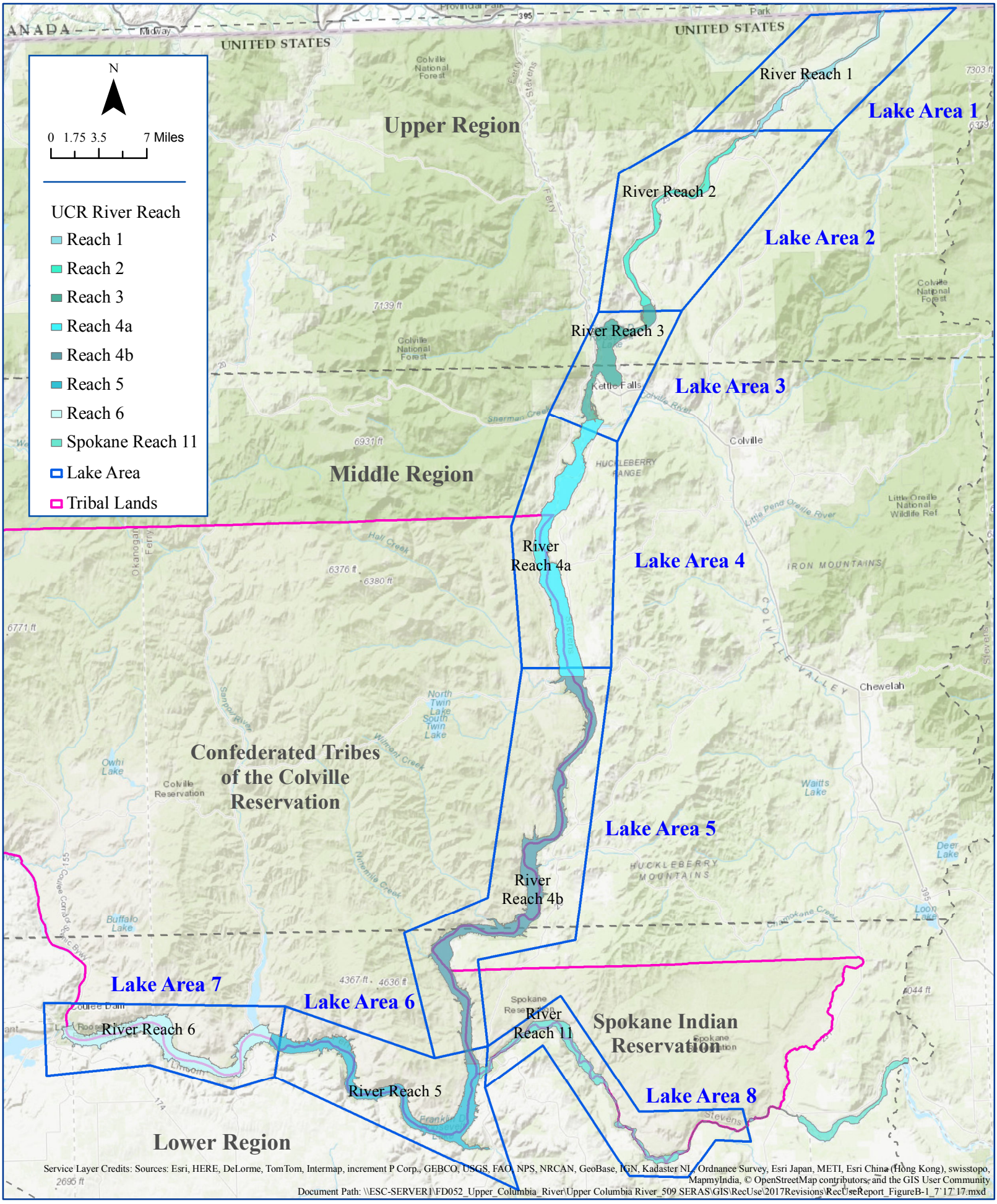

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Figure 2. Recreational Use Survey Area: Survey Interview Locations

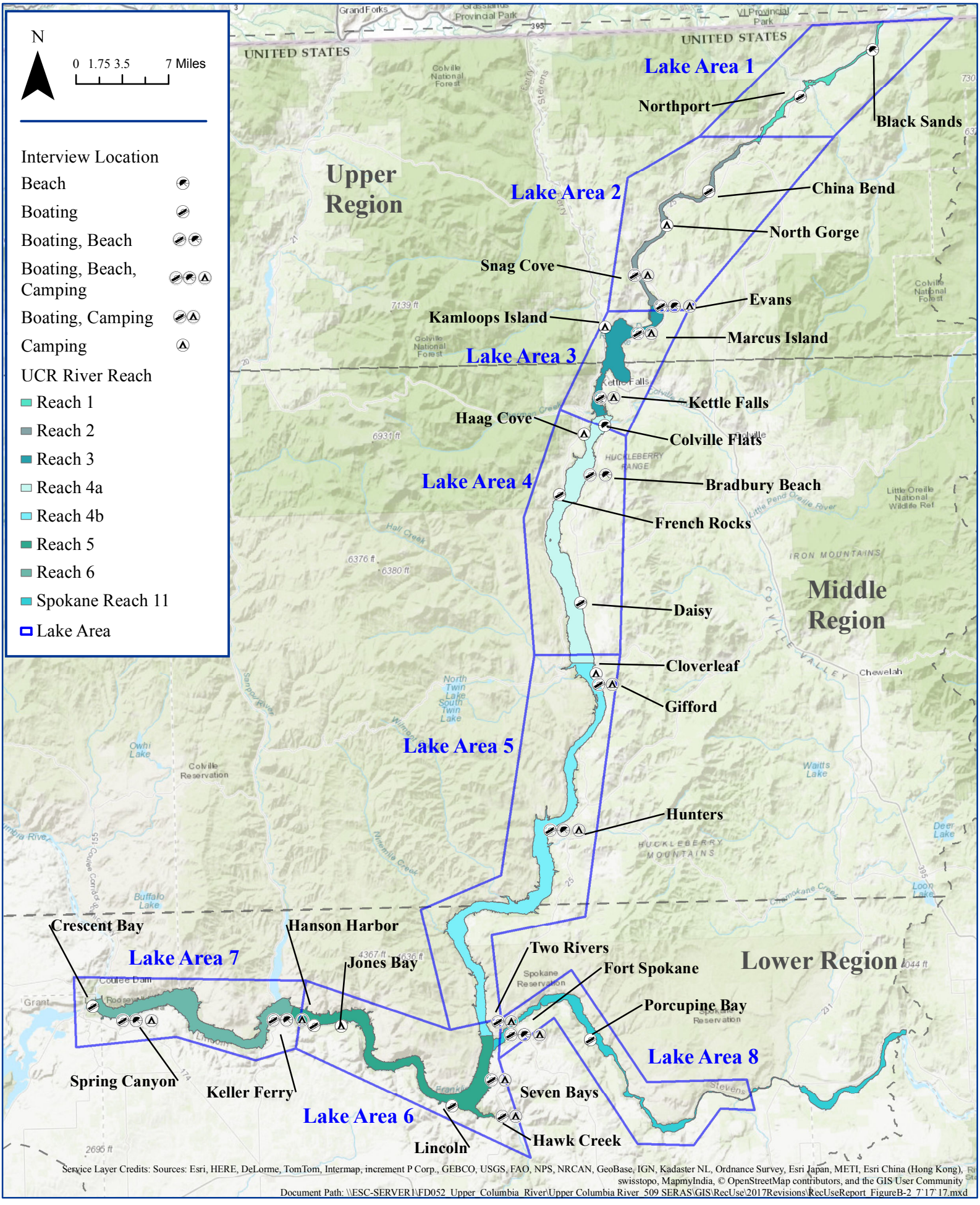

Figure 3. Beach Locations in the Upper Columbia River

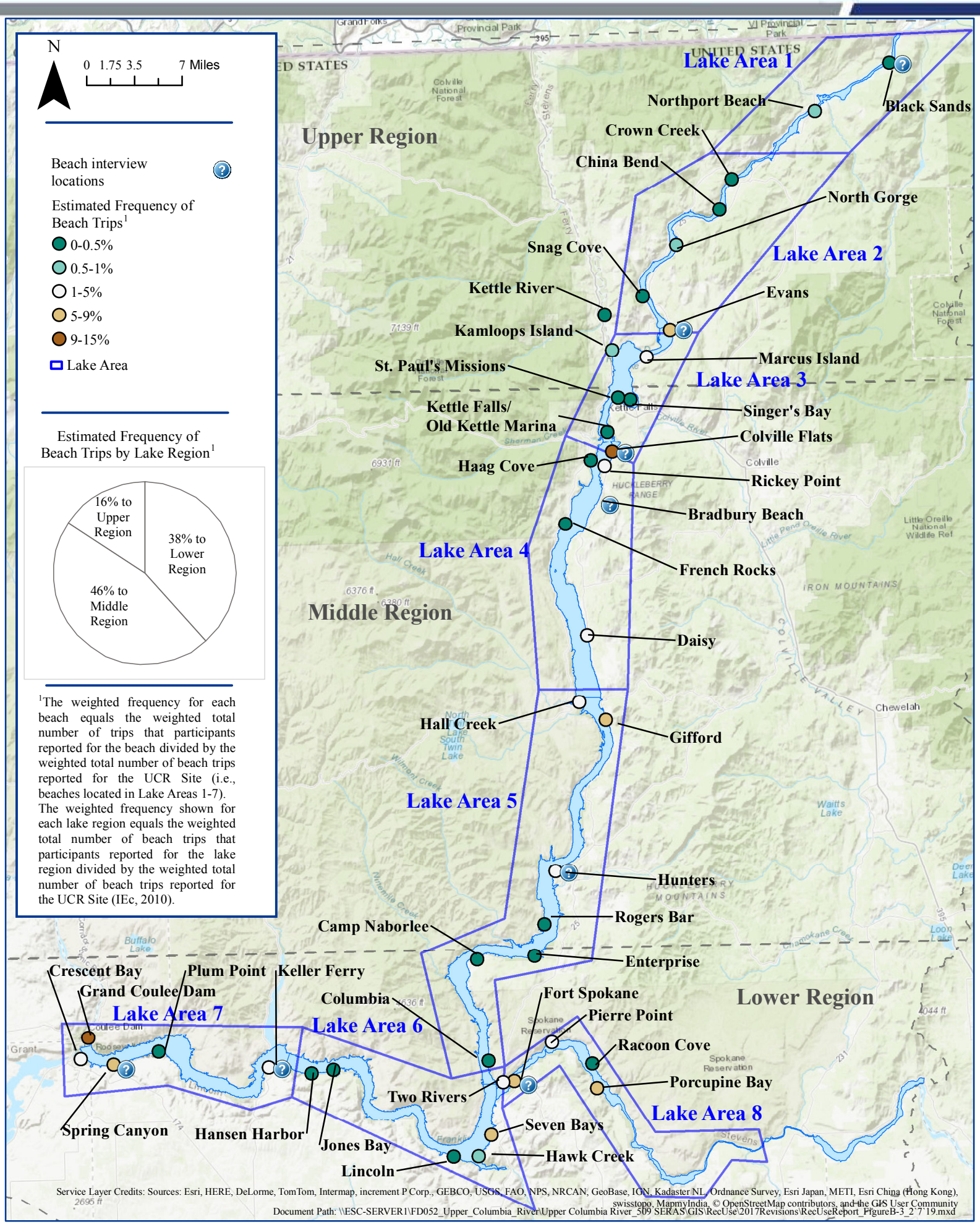

Figure 4. Camping Locations in the Upper Columbia River

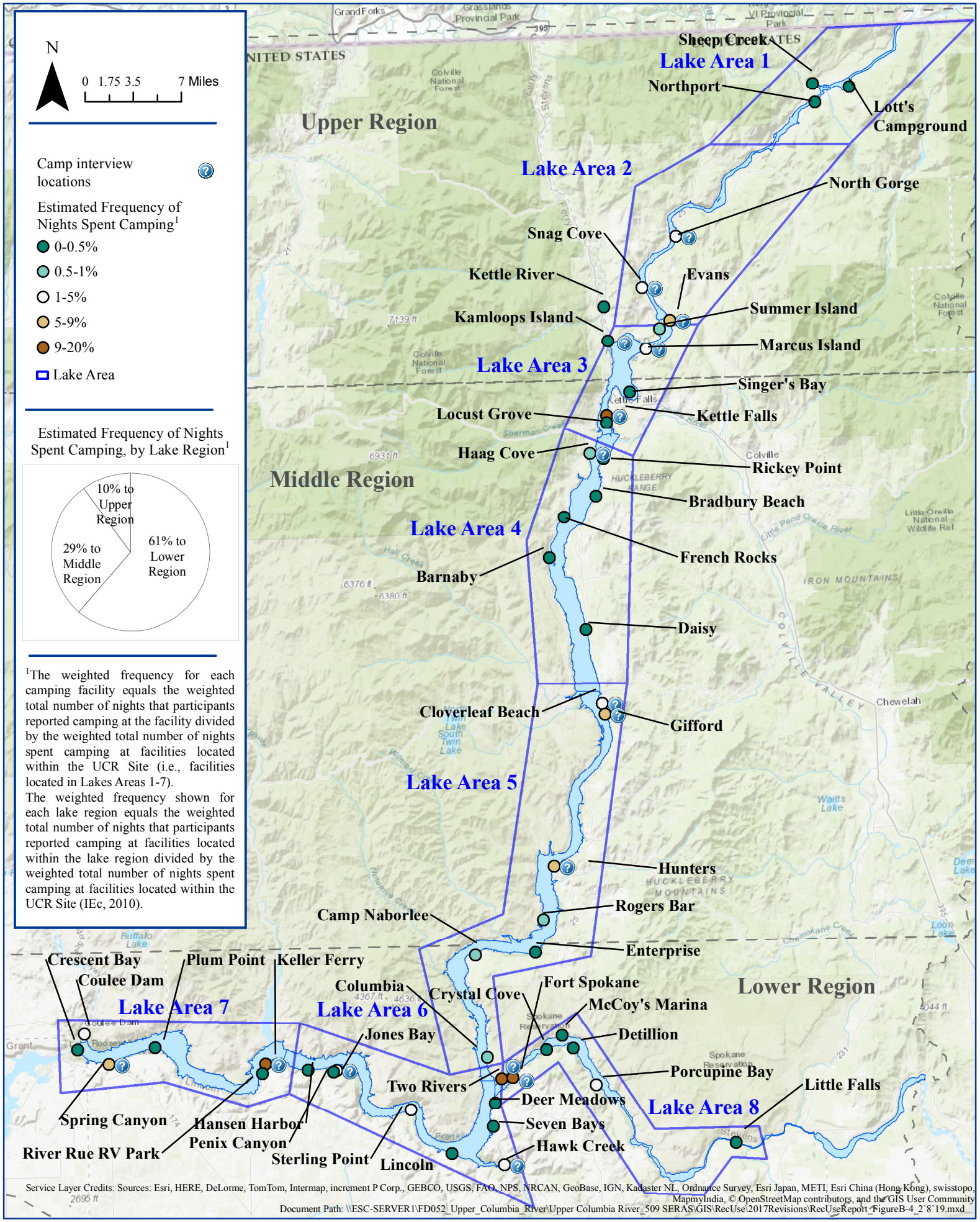

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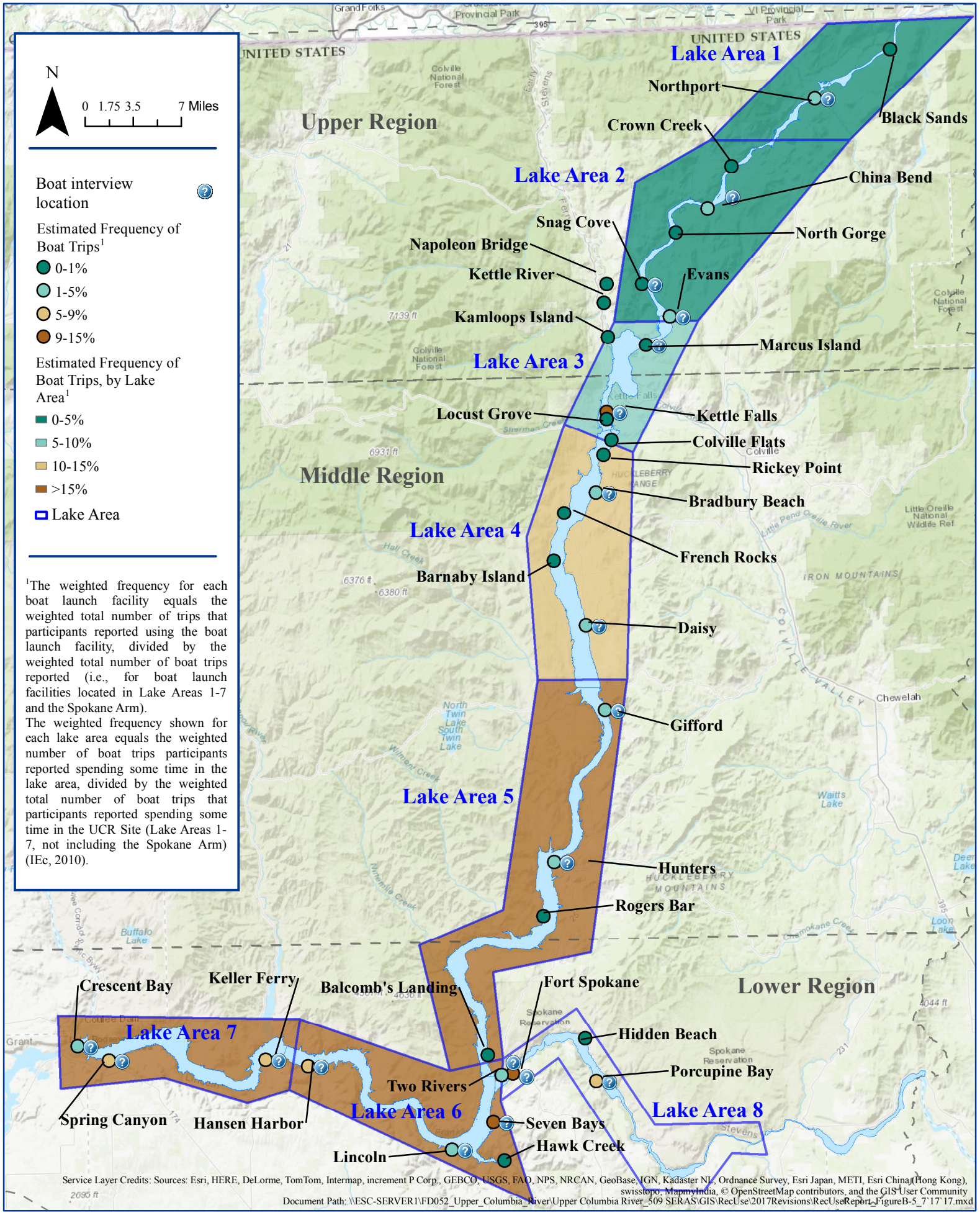
Figure 5. Boating Locations in the Upper Columbia River



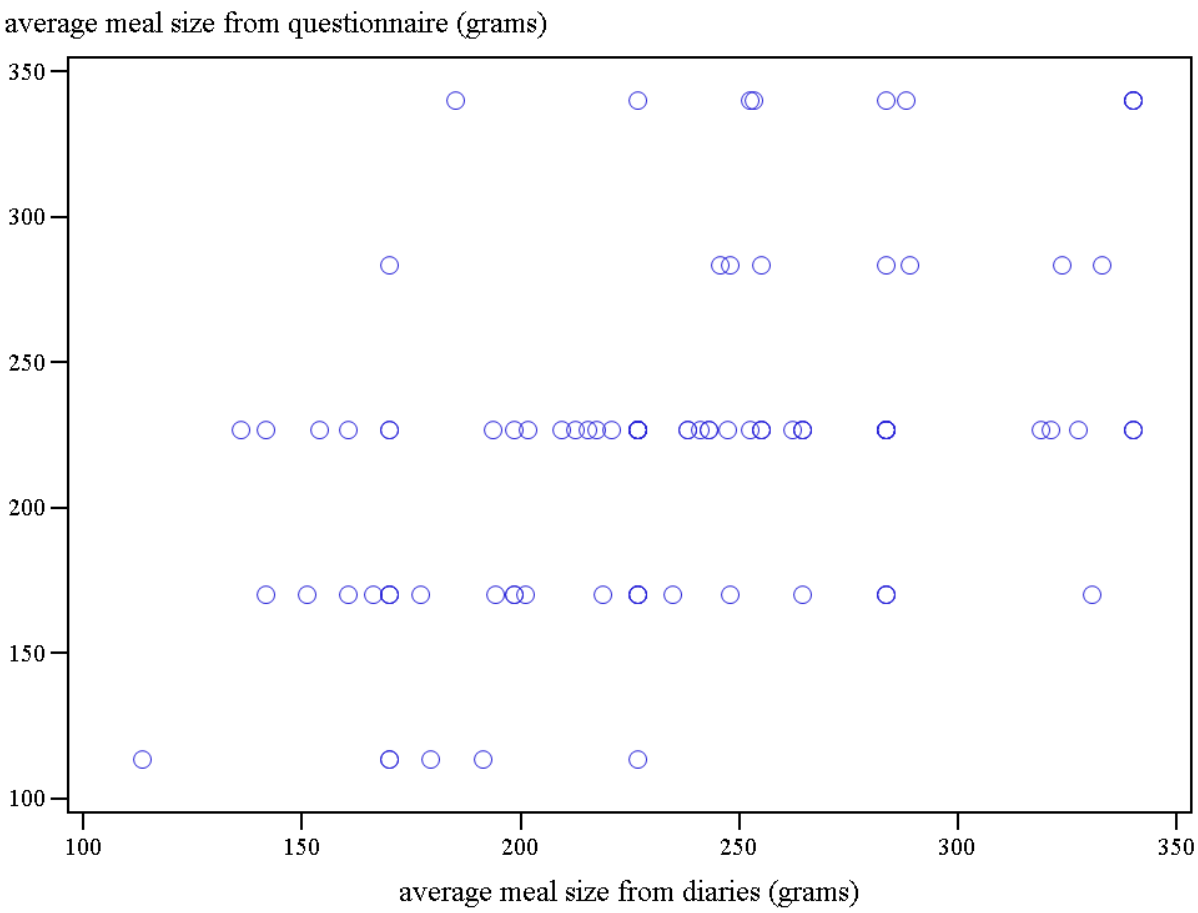


FIGURE 6. Fish Meal Sizes from Questionnaires and Diaries

Scatter plot of typical fish meal size (grams) reported on the questionnaire on the vertical axis vs. the average fish meal size reported on the diaries on the horizontal axis. Each symbol represents one participant who completed three fish diaries. The graph shows that the typical meal size reported on the questionnaire is not related to the average of the fish meal sizes that were reported in the fish diaries.

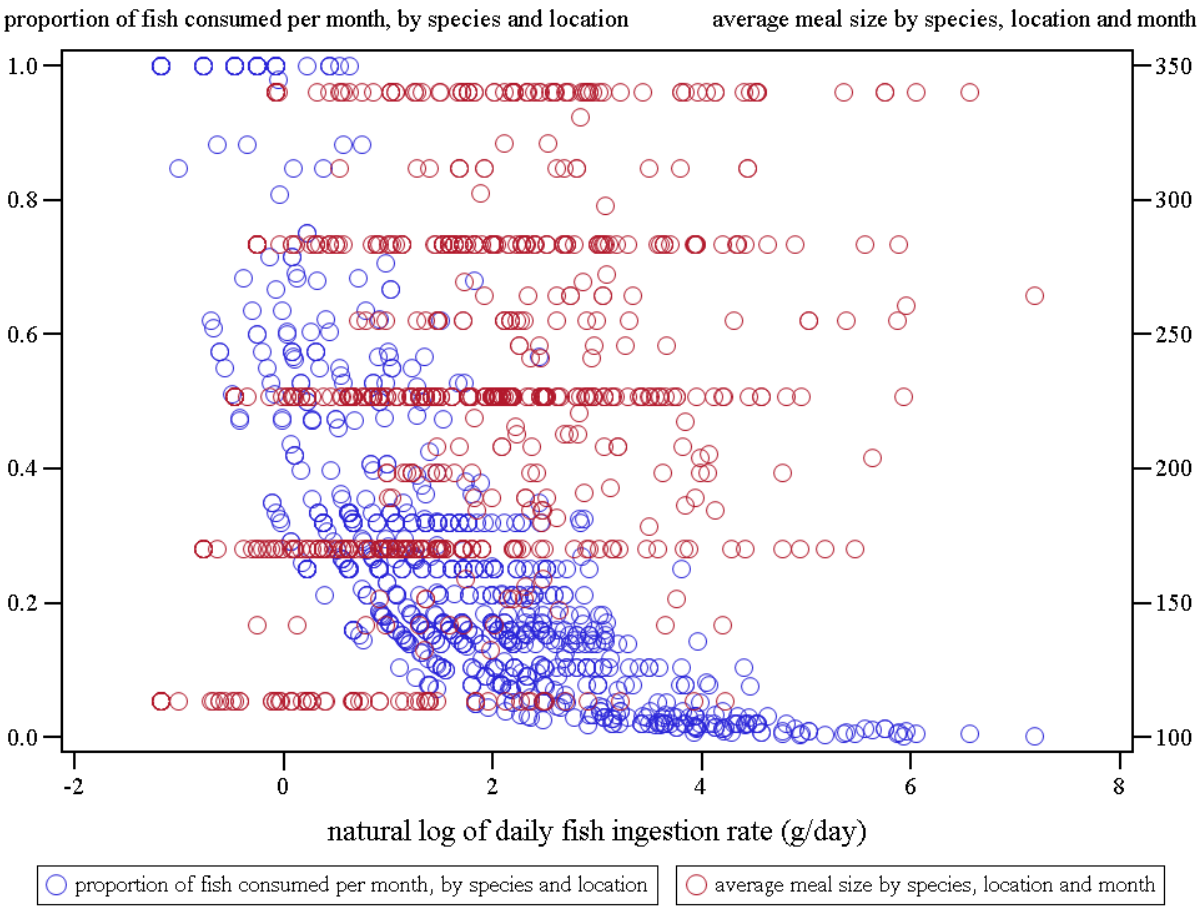


FIGURE 7. The Effect of the Proportion Parameter Estimate on the Estimated Daily Fish Consumption Rate by the SAP Method

Left vertical axis: proportion parameter calculated with Equation 5 of the RecUse SAP (IEc, 2010) for one species, one month, and one river reach. Right vertical axis: average meal size for one species, one month, and one river reach. Horizontal axis: natural logarithm of the daily fish ingestion rate estimated with Equation 4 of the RecUse SAP (IEc, 2010), for one species, one month, and one river reach. Each circle in the figure corresponds to all participants who reported consuming a given type of fish from a given river reach during a given month. The figure shows the non-linear relationship between the natural log of fish ingestion and the proportion parameter. The figure also shows that the fish ingestion rate varies widely for the same average meal size (e.g., for average meal size of 350 grams, the fish ingestion rate varies from <1 gram/day to over 150 grams/day).

Figure 8. Exposure Pathways and Receptor Populations Evaluated in the Human Health Risk Assessment Work Plan.

Exposure Media	Exposure Route	Exposed Populations: Recreational - Child & Adult (a)	Occupational - Adult (b) (4)	Subsistence - Child & Adult (c)	Resident - Child & Adult (d)
Primary Media:					
Sediment (13)	Ingestion	✓	✓	✓	
	Dermal (2)	✓	✓	✓	
Surface Water	Ingestion (18)	✓	✓	✓	? (19)
	Dermal (2)	✓	✓	✓	
Outdoor Air (directly impacted by emissions)	Inhalation	✓	✓	✓	✓
Secondary Media:					
Outdoor Air (impacted by windblown sediment/soil)	Inhalation (1)	✓	✓	✓	✓
Upland Soil	Ingestion	✓	✓	✓	✓
	Dermal (2)	✓	✓	✓	✓
Indoor Dust	Ingestion	✓ (3,7)			✓
Sweat Lodge Air	Inhalation (5)			✓	
Groundwater	Ingestion	?	?	?	?
	Dermal (2)	? (3,16)			? (16)
Terrestrial/ Aquatic Plants	Ingestion			✓ (11)	
	Dermal (2)			✓ (9)	
Birds/Mammals (12)	Ingestion	✓		✓	
	Dermal (2)			✓ (10)	
Amphibians/Reptiles	Ingestion			? (17)	
	Dermal (2)			? (10,17)	
Fish/Shellfish	Ingestion	✓		✓	
	Dermal (2)			✓ (10)	
Tertiary Media:					
Indoor Air	Inhalation	✓ (3,15)			✓? (20)
Smoke-filled Air	Inhalation (8)			✓	
Shower Air	Inhalation (6)	? (3)			?
Crops (14)	Ingestion			✓	
	Dermal (2)			✓ (9)	

LEGEND:

	Exposure pathway is not complete for this population or potential exposures are negligible
?	Exposure pathway is potentially complete for this population
✓	Exposure pathway is complete for this population

Receptor Population Descriptions:

(a) Recreational activities include fishing, hunting, swimming, camping, etc.
Three recreational visitor exposure scenarios will be evaluated --
Short-term: Individuals (both local and non-local) that visit the river as part of occasional recreational activities
Seasonal: Individuals that reside seasonally within the site boundary and frequently engage in recreational activitie
Year-round: Individuals that reside locally and may engage in year-round recreational activities

(b) Individuals that work along the river banks (e.g., park employees, construction workers, ferry boat workers, etc.).
Two worker exposure scenarios will be evaluated --
Contact Intensive: Workers that engage in activities with a high opportunity for contact with sediments
Non-contact Intensive: Workers that engage in activities that do not usually have extensive contact with sediments

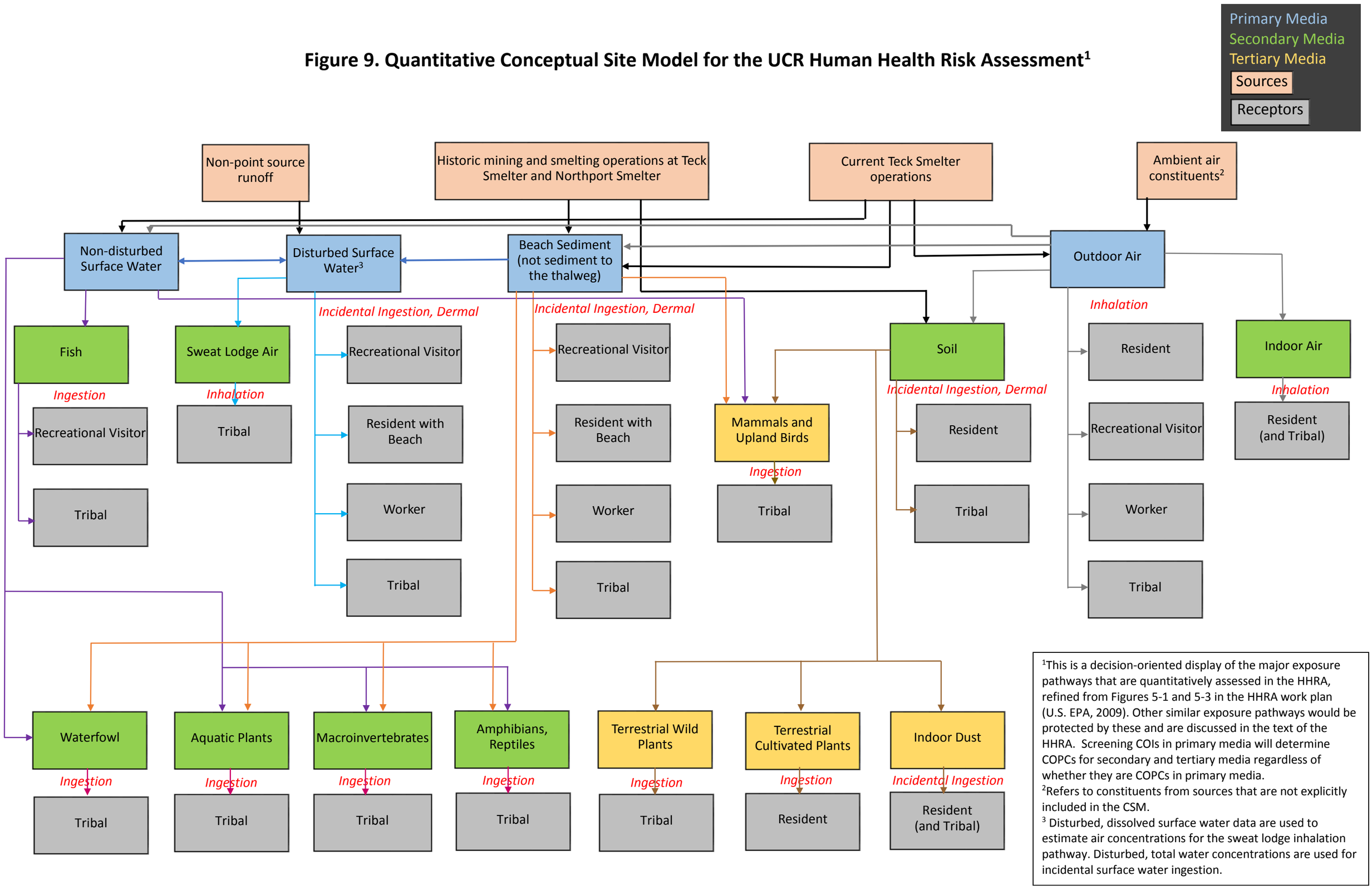
(c) Individuals that reside outside of the site boundary and fish/hunt/gather plants along the river.
Two subsistence exposure scenarios will be evaluated --
Modern: Intake and use rates represent modern subsistence scenarios
Traditional: Intake and use rates represent traditional subsistence scenarios

(d) Individuals that reside outside of the site boundary, but residence proximity to the river may result in site-related exposures (e.g., windborne impacts to indoor air, or sediment track-in into indoor dust, etc.)

Notes:

(1) includes both chronic exposure to long-term average concentrations and short-term exposures during windstorm events
(2) dermal exposures will be evaluated for COIs with dermal absorption coefficients
(3) evaluated for short-term and seasonal visitors staying within the site boundary during recreational activities
(4) it is expected that exposure is likely to be lower for indoor workers than for outdoor workers, therefore occupational exposures are assumed occur entirely outdoors
(5) exposure to aerosols and water vapor
(6) inhalation exposures during showering, will be evaluated for semi-volatile and volatile COIs only
(7) dust ingestion is included in the total ingestion rates for soil/sediment
(8) inhalation of smoke/ash particulates from burning plant materials
(9) dermal exposures from plants used medicinally and/or ceremonially and contact during basket weaving activities
(10) dermal exposures from animal tissues used medicinally and/or ceremonially and contact during preservation activities
(11) includes ingestion of gathered plants as food and incidental ingestion of plants during basket weaving activities
(12) wild game, waterfowl, and livestock that have been watered with UCR water and/or fed irrigated plants
(13) includes solid materials from beaches, wetlands, and riparian areas (i.e., within the current high water mark) that become exposed at some time during the year (e.g., during reservoir draw-down or low-flow conditions)
(14) crops that have been irrigated with UCR water
(15) indoor exposures (inside RVs, campers, tents) evaluated for short-term and seasonal visitors only; year-round visitors are assumed to reside off-site (evaluated under the residential scenario)
(16) during showering
(17) a determination of exposures to amphibians/reptiles will be based on site-specific survey results
(18) includes incidental ingestion exposures for on-site receptors (e.g., during swimming, wading, fishing, etc.) and ingestion of untreated surface water as drinking water
(19) assumes that untreated surface water is used as the source for residential drinking water
(20) inhalation of chemicals in indoor air derived from outdoor air and indoor dust is a complete exposure pathway; inhalation of chemicals in indoor air derived from groundwater (e.g., SVOCs released from residential water use) is a potentially complete pathway

Figure 9. Quantitative Conceptual Site Model for the UCR Human Health Risk Assessment[1]



[1]This is a decision-oriented display of the major exposure pathways that are quantitatively assessed in the HHRA, refined from Figures 5-1 and 5-3 in the HHRA work plan (U.S. EPA, 2009). Other similar exposure pathways would be protected by these and are discussed in the text of the HHRA. Screening COIs in primary media will determine COPCs for secondary and tertiary media regardless of whether they are COPCs in primary media.

[2]Refers to constituents from sources that are not explicitly included in the CSM.

[3] Disturbed, dissolved surface water data are used to estimate air concentrations for the sweat lodge inhalation pathway. Disturbed, total water concentrations are used for incidental surface water ingestion.

Appendix A: Outlier Analysis

Tables A-1 – A-7 and Figures A-1 – A-6

Table A-1: Evaluation of outlier detection methods using the exposure frequency data. The highlighted cells correspond to results for the approach that was used to identify potential statistical outliers: MM method, with the raw data (not log-transformed data) and without using the sample weights. The number (and percentage) of potential outliers identified with other combinations of method, use of sample weights (or not) and use of the raw or log-transformed data are also presented. Few outliers were identified with the log-transformed data, while very high numbers of potential outliers were flagged with raw data by the M, S and LTS methods.

Trans-formed	**Detection Method**[1]	**TripType**	**Outliers** (1=outlier)	**Frequency with Weighted Data**	**Frequency with Unweighted Data**	**Difference: Weight - Unweighted Frequencies**	**Percent Outliers Unweighted**	**Percent Outliers Weighted**
no	LTS	beach	0	579	579	0	13%	13%
no	LTS	beach	1	89	89	0		
no	LTS	boating	0	811	811	0	15%	15%
no	LTS	boating	1	147	147	0		
no	LTS	camping	0	735	735	0	12%	12%
no	LTS	camping	1	101	101	0		
no	M	beach	0	579	588	-9	12%	13%
no	M	beach	1	89	80	9		
no	M	boating	0	725	825	-100	14%	24%
no	M	boating	1	233	133	100		
no	M	camping	0	735	769	-34	8.0%	12%
no	M	camping	1	101	67	34		
no	MM	beach	0	611	611	0	8.5%	8.5%
no	MM	beach	1	57	57	0		
no	MM	boating	0	863	899	-36	6.2%	9.9%

[1] LTS = Least Trimmed Squares; see Chen (2002) for a complete description and definition of M, LTS, MM, and S outlier detection methods.

Table A-1: Evaluation of outlier detection methods using the exposure frequency data. The highlighted cells correspond to results for the approach that was used to identify potential statistical outliers: MM method, with the raw data (not log-transformed data) and without using the sample weights. The number (and percentage) of potential outliers identified with other combinations of method, use of sample weights (or not) and use of the raw or log-transformed data are also presented. Few outliers were identified with the log-transformed data, while very high numbers of potential outliers were flagged with raw data by the M, S and LTS methods.

Trans-formed	**Detection Method[1]**	**TripType**	**Outliers** (1=outlier)	**Frequency with Weighted Data**	**Frequency with Unweighted Data**	**Difference: Weight - Unweighted Frequencies**	**Percent Outliers Unweighted**	**Percent Outliers Weighted**
no	MM	boating	1	95	59	36		
no	MM	camping	0	811	788	23	5.7%	3.0%
no	MM	camping	1	25	48	-23		
no	S	beach	0	597	597	0	11%	11%
no	S	beach	1	71	71	0		
no	S	boating	0	845	845	0	12%	12%
no	S	boating	1	113	113	0		
no	S	camping	0	782	782	0	6.5%	6.5%
no	S	camping	1	54	54	0		
yes	LTS	beach	0	668	668	0	0.0%	0.0%
yes	LTS	boating	0	958	958	0	0.0%	0.0%
yes	LTS	camping	0	833	833	0	0.4%	0.4%
yes	LTS	camping	1	3	3	0		
yes	M	beach	0	668	668	0	0.0%	0.0%
yes	M	boating	0	958	958	0		
yes	M	camping	0	834	834	0	0.2%	0.2%
yes	M	camping	1	2	2	0		

Table A-1: Evaluation of outlier detection methods using the exposure frequency data. The highlighted cells correspond to results for the approach that was used to identify potential statistical outliers: MM method, with the raw data (not log-transformed data) and without using the sample weights. The number (and percentage) of potential outliers identified with other combinations of method, use of sample weights (or not) and use of the raw or log-transformed data are also presented. Few outliers were identified with the log-transformed data, while very high numbers of potential outliers were flagged with raw data by the M, S and LTS methods.

Trans-formed	**Detection Method**[1]	**TripType**	**Outliers** (1=outlier)	**Frequency with Weighted Data**	**Frequency with Unweighted Data**	**Difference: Weight - Unweighted Frequencies**	**Percent Outliers Unweighted**	**Percent Outliers Weighted**
yes	MM	beach	0	668	668	0	0.0%	0.0%
yes	MM	boating	0	958	958	0	0.0%	0.0%
yes	MM	camping	0	836	833	3	0.0%	0.4%
yes	MM	camping	1		3	-3		
yes	S	beach	0	668	668	0	0.0%	0.0%
yes	S	boating	0	956	956	0	0.2%	0.2%
yes	S	boating	1	2	2	0		
yes	S	camping	0	833	833	0	0.4%	0.4%
yes	S	camping	1	3	3	0		

Chen, C. 2002. Robust regression and outlier detection with the ROBUSTREG procedure. Paper 265-27, SUGI 27: Statistics and Data Analysis. SAS Institute, Inc., Cary, NC.

TABLE A-2. Outlier Analysis for Estimated Frequency (days/year) of Recreational Visits to the UCR (sample weights=1 for outliers)

River Region	Age Group (years)[a]	Gender	Beach Trips			Boat Trips			Camping Trips		
			n[b]	Mean	95%	n	Mean	95%	n	Mean	95%
Lower	17–45[c]	F	31	4.2	20	55	3.6	17	31	5.3	13
	Adult[d]		163	5.7	16	417	4.7	16	224	5.5	15
	Child[d]		29	6.1	12	34	3.5	14	18	4.8	10
Middle	17–45[c]	F	82	4.9	15	67	3.5	9	62	4.3	19
	Adult[d]		333	4.9	15	496	3.5	12	400	4.5	14
	Child[d]		48	3.7	15	42	3.4	8	33	4.2	10
Upper	17–45[c]	F	46	4.6	15	66	3.1	10	42	4.1	8.0
	Adult[d]		177	4.2	10	428	3.8	15	262	3.6	9
	Child[d]		30	4.6	15	37	3.0	6	37	3.1	8.1
All (UCR Reaches 1-6)	Adult[d]		582	5.5	15	883	5.6	20	759	5.3	16
	Child[d]		86	5.6	15	75	4.6	14	77	4.2	10.3

M = male; F = female; n = sample size; 95% = estimate of the 95th percentile

[a]The survey did not gather information on the number of past trips for children in the group. It was assumed that values for individuals less than 18 years of age accompanied the respondent on all other UCR trips within the past 12 months.

[b]Number of survey respondents.

[c]This age group will be used for estimating hazards from methyl mercury and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[d]Adults are defined as 18 years and older; children are defined as being younger than 18 years of age.

TABLE A-3. Outlier Analysis for Estimated Frequency (days/year) of Recreational Visits to the UCR (sample weights = median of the weights for outliers)

River Region	Age Group (years)[a]	Gender	Beach Trips			Boat Trips			Camping Trips		
			n[b]	Mean	95%	n	Mean	95%	n	Mean	95%
Lower	17–45[c]	F	31	5.5	20	55	3.9	19	31	5.3	13
	Adult[d]		163	6.8	20	417	6.2	22	224	6.1	17
	Child[d]		29	6.5	12	34	5.3	24	18	5.5	15
Middle	17–45[c]	F	82	6.6	25	67	4.3	10	62	5.1	19
	Adult[d]		333	6.9	24	496	4.6	18	400	5.5	19
	Child[d]		48	4.7	24	42	6.6	19	33	4.7	11
Upper	17–45[c]	F	46	5.9	20	66	3.4	11	42	5.2	23.3
	Adult[d]		177	5.7	20	428	6.9	27	262	4.9	17
	Child[d]		30	5.4	16	37	6.6	33	37	3.3	8.8
All (UCR Reaches 1-6)	Adult[d]		582	7.3	25	883	7.9	32	759	6.3	20
	Child[d]		86	6.5	20	75	8.4	18	77	4.7	11

M = male; F = female; n = sample size; 95% = estimate of the 95th percentile

[a]The survey did not gather information on the number of past trips for children in the group. It was assumed that values for individuals less than 18 years of age accompanied the respondent on all other UCR trips within the past 12 months.

[b]Number of survey respondents.

[c]This age group will be used for estimating hazards from methyl mercury and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[d]Adults are defined as 18 years and older; children are defined as being younger than 18 years of age.

Table A-4. Outlier Analysis for Estimated Group Exposure Time (hours/day) Spent Swimming and Wading (>waist deep) in the UCR for Beach and Boat Trips (sample weights = 1 for outliers)

River Region	Age group (years)	Sex	Beach trips							Boat trips						
			n[a]	mean	LCL95	UCL95	95%	LTL95	UTL95	n[a]	mean	LCL95	UCL95	95%	LTL95	UTL95
Lower	0-6	F	6	1.1	0.7	1.6	2.8	.	.	4	0.8	0.4	1.2	3.0	.	.
		M	6	0.6	0.4	0.8	0.9	.	.	1	0.1	0.1	0.1	0.1	.	.
	7-17	F	20	1.0	0.7	1.4	2.1	.	.	11	0.8	0.3	1.3	2.4	.	.
		M	22	1.4	0.9	1.9	3.0	2.0	3.0	23	0.6	0.5	0.8	1.3	.	.
	18-54	F	18	0.9	0.7	1.1	2.3	.	.	17	0.7	0.4	1.1	2.0	.	.
		M	19	0.7	0.3	1.1	3.0	.	.	24	0.5	0.3	0.7	1.3	.	.
	55+	F	3	0.6	0.4	0.7	1.0	.	.	4	0.4	0.3	0.6	0.8	.	.
		M	2	1.4	0.0	2.9	2.6	.	.	2	0.5	0.1	0.8	0.8	.	.
	17-45[b]	F	16	0.9	0.6	1.1	2.3	.	.	9	0.6	0.3	0.8	2.0	.	.
	Adult[c]		86	1.0	0.8	1.2	2.6	2.1	2.9	81	0.6	0.5	0.8	2.0	1.2	2.1
	Child[c]		12	0.8	0.6	1.0	1.5	.	.	5	0.7	0.3	1.0	3.0	.	.
Middle	0-6	F	5	1.2	0.7	1.7	3.0	.	.	1	1.0	1.0	1.0	1.0	.	.
		M	11	1.0	0.8	1.3	1.4	.	.	1	0.1	0.1	0.1	0.1	.	.
	7-17	F	20	0.8	0.5	1.0	2.0	.	.	16	0.8	0.3	1.2	2.2	.	.
		M	22	0.7	0.4	1.0	2.5	.	.	26	0.5	0.3	0.6	1.3	.	.
	18-54	F	33	0.9	0.7	1.1	2.2	.	.	24	0.4	0.2	0.5	0.7	.	.
		M	26	0.6	0.4	0.8	1.5	0.8	1.6	19	0.7	0.4	0.9	1.3	0.3	1.3
	55+	F	2	0.4	0.0	0.7	1.0	.	.	2	0.5	0.4	0.5	0.5	.	.
		M	4	0.3	0.1	0.5	0.7	.	.	7	0.2	0.0	0.3	0.7	.	.
	17-45[b]	F	30	0.9	0.7	1.1	2.9	.	.	17	0.4	0.2	0.6	0.7	.	.
	Adult[c]		107	0.8	0.6	0.9	2.0	1.4	2.6	94	0.5	0.4	0.6	1.8	1.3	2.2
	Child[c]		16	1.1	0.9	1.3	1.5	.	.	2	0.4	0.0	0.8	1.0	.	.
Upper	0-6	F	4	0.5	0.4	0.6	1.2	.	.	0	.	.	.	.	.	.
		M	3	0.9	0.0	1.7	3.7	.	.	3	0.9	0.2	1.6	3.0	.	.
	7-17	F	16	2.0	1.5	2.5	3.0	.	.	18	1.1	0.7	1.6	2.0	.	.
		M	15	1.9	1.3	2.5	2.5	.	.	30	0.6	0.4	0.7	2.0	.	.
	18-54	F	10	0.7	0.3	1.2	1.5	.	.	35	0.9	0.5	1.3	2.0	0.2	2.1
		M	15	0.5	0.2	0.8	1.9	.	.	24	0.6	0.5	0.8	1.5	.	.
	55+	F	4	0.5	0.5	0.5	0.5	.	.	4	0.9	0.7	1.0	1.0	.	.
		M	2	0.5	0.4	0.5	0.5	.	.	7	0.1	0.0	0.2	0.3	.	.
	17-45[b]	F	11	0.7	0.3	1.1	1.5	.	.	24	1.1	0.5	1.6	3.0	.	.
	Adult[c]		64	1.4	1.0	1.9	2.6	.	.	119	0.8	0.6	0.9	2.0	0.9	2.0
	Child[c]		7	0.5	0.4	0.7	1.2	.	.	3	0.9	0.2	1.6	3.0	.	.
All (UCR Reaches 1-6)	Adult[c]		257	0.92	0.8	1.0	2.5	2.0	2.8	221	0.76	0.6	0.9	2.0	1.3	2.0
	Child[c]		35	0.96	0.8	1.1	1.5	.	.	9	0.74	0.5	1.0	3.0	.	.
	All Ages		292	0.93	0.8	1.0	2.5	2.0	2.8	230	0.76	0.6	0.9	2.0	1.3	2.0

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; 95% = estimated 95th percentile of the hours/day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engage in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from methyl mercury and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

Table A-5. Outlier Analysis for Estimated Group Exposure Time (hours/day) Spent Swimming and Wading (>waist deep) in the UCR for Beach and Boat Trips (sample weights = median of the weights for outliers)

River Region	Age group (years)	Sex	Beach trips							Boat trips						
			n[a]	mean	LCL95	UCL95	95%	LTL95	UTL95	n[a]	mean	LCL95	UCL95	95%	LTL95	UTL95
Lower	0-6	F	6	1.1	0.7	1.6	2.8	.	.	4	0.8	0.4	1.2	3.0	.	.
		M	6	0.6	0.4	0.8	0.9	.	.	1	0.1	0.1	0.1	0.1	.	.
	7-17	F	20	1.0	0.7	1.4	2.1	.	.	11	0.8	0.3	1.3	2.4	.	.
		M	22	1.6	1.1	2.1	4.0	.	.	23	0.6	0.5	0.8	1.3	.	.
	18-54	F	18	0.9	0.7	1.1	2.3	.	.	17	0.8	0.4	1.2	2.0	.	.
		M	19	0.7	0.3	1.1	3.0	.	.	24	0.5	0.3	0.7	1.3	.	.
	55+	F	3	0.6	0.4	0.7	1.0	.	.	4	0.4	0.3	0.6	0.8	.	.
		M	2	1.4	0.0	2.9	2.6	.	.	2	0.5	0.1	0.8	0.8	.	.
	17-45[b]	F	16	0.9	0.6	1.1	2.3	.	.	9	0.7	0.3	1.1	2.0	.	.
	Adult[c]		86	1.0	0.8	1.2	3.0	2.1	3.0	81	0.6	0.5	0.8	2.0	1.2	2.1
	Child[c]		12	0.8	0.6	1.0	1.5	.	.	5	0.7	0.3	1.0	3.0	.	.
Middle	0-6	F	5	1.2	0.7	1.7	3.0	.	.	1	1.0	1.0	1.0	1.0	.	.
		M	11	1.0	0.8	1.3	1.4	.	.	1	0.1	0.1	0.1	0.1	.	.
	7-17	F	20	1.0	0.6	1.4	3.7	.	.	16	0.8	0.3	1.2	2.2	.	.
		M	22	0.8	0.4	1.1	2.5	.	.	26	0.5	0.4	0.7	2.0	.	.
	18-54	F	33	0.9	0.8	1.1	2.9	.	.	24	0.4	0.2	0.5	0.7	.	.
		M	26	0.6	0.4	0.8	1.5	0.8	1.6	19	0.7	0.4	0.9	1.3	0.3	1.3
	55+	F	2	0.4	0.0	0.7	1.0	.	.	2	0.5	0.4	0.5	0.5	.	.
		M	4	0.3	0.1	0.5	0.7	.	.	7	0.2	0.0	0.3	0.7	.	.
	17-45[b]	F	30	1.0	0.8	1.2	2.9	1.2	3.9	17	0.4	0.2	0.6	0.7	.	.
	Adult[c]		107	0.8	0.7	1.0	2.5	1.8	3.1	94	0.5	0.4	0.6	2.0	1.3	2.2
	Child[c]		16	1.1	0.9	1.3	1.5	.	.	2	0.4	0.0	0.8	1.0	.	.
Upper	0-6	F	4	0.5	0.4	0.6	1.2	.	.	0	.	.	.	.	.	.
		M	3	2.5	0.9	4.2	3.7	.	.	3	0.9	0.2	1.6	3.0	.	.
	7-17	F	16	2.0	1.5	2.5	3.0	.	.	18	1.3	0.9	1.7	3.3	.	.
		M	15	1.9	1.3	2.5	2.5	.	.	30	0.7	0.5	0.9	2.0	.	.
	18-54	F	10	0.7	0.3	1.2	1.5	.	.	35	1.0	0.6	1.5	3.0	.	.
		M	15	0.5	0.2	0.8	1.9	.	.	24	0.8	0.5	1.1	3.3	.	.
	55+	F	4	0.5	0.5	0.5	0.5	.	.	4	0.9	0.7	1.0	1.0	.	.
		M	2	0.5	0.4	0.5	0.5	.	.	7	0.1	0.0	0.2	0.3	.	.
	17-45[b]	F	11	0.7	0.3	1.1	1.5	.	.	24	1.2	0.7	1.8	3.3	.	.
	Adult[c]		64	1.4	1.0	1.9	2.6	.	.	119	0.9	0.7	1.1	3.0	1.9	3.3
	Child[c]		7	1.1	0.1	2.1	3.7	.	.	3	0.9	0.2	1.6	3.0	.	.
All (UCR Reaches 1-6)	Adult[c]		257	0.97	0.8	1.1	2.8	2.5	2.9	221	0.81	0.7	0.9	2.2	2.0	2.7
	Child[c]		35	0.99	0.8	1.2	2.8	.	.	9	0.74	0.5	1.0	3.0	.	.
	All Ages		292	0.97	0.9	1.1	2.8	2.5	3.0	230	0.81	0.7	0.9	2.2	2.0	2.8

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; 95% = estimated 95th percentile of the hours/day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engage in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from methyl mercury and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

Table A-6. Outlier Analysis for Estimated Group Exposure Time (hours/day) Spent Swimming and Wading (>waist deep) in the UCR for Camping Trips (sample weights = 1 for outliers)

River Region	Age group (years)	Sex	Drive-in and Boat-in Camping Trips Combined							
			n[a]	mean	LCL95	UCL95	95%	LTD95	UTL95	Freq.
Lower	0-6	F	1	0.5	0.5	0.5	0.5	.	.	7%
		M	6	0.8	0.3	1.2	2.0	.	.	25%
	7-17	F	25	1.6	0.9	2.3	4.0	.	.	49%
		M	25	1.7	1.2	2.1	4.0	1.5	4.7	51%
	18-54	F	30	1.5	0.7	2.4	5.0	.	.	32%
		M	33	1.5	1.1	2.0	4.0	.	.	40%
	55+	F	9	1.3	0.8	1.7	2.0	0.3	1.8	18%
		M	12	1.3	0.7	2.0	2.5	.	.	14%
	17-45[b]	F	24	1.7	0.8	2.6	5.0	.	.	51%
	Adult[c]		136	1.5	1.3	1.8	4.0	3.0	4.0	32%
	Child[c]		7	0.7	0.4	1.1	2.0	.	.	2%
Middle	0-6	F	3	2.1	0.0	4.3	4.0	.	.	16%
		M	1	10.0	10.0	10.0	10.0	.	.	0%
	7-17	F	18	1.8	1.2	2.4	4.0	.	.	58%
		M	10	1.8	0.6	2.9	4.0	.	.	11%
	18-54	F	24	1.0	0.7	1.4	2.0	.	.	17%
		M	22	0.8	0.5	1.1	3.0	.	.	24%
	55+	F	3	0.7	0.4	1.0	1.0	.	.	15%
		M	12	0.4	0.2	0.6	1.5	.	.	5%
	17-45[b]	F	15	1.1	0.6	1.5	2.0	.	.	22%
	Adult[c]		89	1.2	0.9	1.5	4.0	2.0	4.5	20%
	Child[c]		4	2.2	0.0	4.4	4.0	.	.	1%
Upper	0-6	F	4	0.6	0.2	1.0	1.0	.	.	13%
		M	9	0.9	0.3	1.5	4.0	.	.	20%
	7-17	F	19	1.1	0.7	1.5	3.0	.	.	59%
		M	35	2.0	1.5	2.4	4.0	2.3	3.9	69%
	18-54	F	29	1.3	0.8	1.7	3.8	.	.	28%
		M	27	1.0	0.5	1.5	4.0	.	.	31%
	55+	F	2	1.6	0.8	2.3	2.0	.	.	3%
		M	11	0.3	0.2	0.4	0.8	.	.	12%
	17-45[b]	F	22	1.4	0.8	2.1	3.8	.	.	27%
	Adult[c]		125	1.3	1.0	1.5	4.0	2.7	3.9	30%
	Child[c]		13	0.8	0.4	1.2	4.0	.	.	4%
All (UCR Reaches 1-6)	Adult[c]		324	1.5	1.3	1.7	4.8	3.7	4.9	28%
	Child[c]		24	0.99	0.5	1.5	4.0	.	.	2%
	All Ages		348	1.5	1.2	1.7	4.8	3.7	4.9	18%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; 95% = estimated 95th percentile of the hours/day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engage in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from methyl mercury and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

Table A-7. Outlier Analysis for Estimated Group Exposure Time (hours/day) Spent Swimming and Wading (>waist deep) in the UCR for Camping Trips (sample weights = median of the weights for outliers)

River Region	Age group (years)	Sex	Drive-in and Boat-in Camping Trips Combined							
			n[a]	mean	LCL95	UCL95	95%	LTD95	UTL95	Freq.
Lower	0-6	F	1	0.5	0.5	0.5	0.5	.	.	7%
		M	6	0.8	0.3	1.2	2.0	.	.	25%
	7-17	F	25	1.8	1.1	2.4	4.0	3.1	6.2	50%
		M	25	1.8	1.3	2.3	4.8	.	.	52%
	18-54	F	30	1.7	0.9	2.5	5.0	.	.	33%
		M	33	1.6	1.2	2.1	4.0	2.0	5.9	40%
	55+	F	9	1.3	0.8	1.7	2.0	0.3	1.8	18%
		M	12	1.3	0.7	2.0	2.5	.	.	14%
	17-45[b]	F	24	1.8	0.9	2.7	5.0	.	.	52%
	Adult[c]		136	1.7	1.4	1.9	5.0	3.6	5.7	33%
	Child[c]		7	0.7	0.4	1.1	2.0	.	.	2%
Middle	0-6	F	3	2.1	0.0	4.3	4.0	.	.	16%
		M	1	10.0	10.0	10.0	10.0	.	.	3%
	7-17	F	18	1.8	1.2	2.4	4.0	.	.	58%
		M	10	2.4	1.0	3.8	6.0	.	.	12%
	18-54	F	24	1.0	0.7	1.4	2.0	.	.	17%
		M	22	0.8	0.5	1.1	3.0	.	.	24%
	55+	F	3	0.7	0.4	1.0	1.0	.	.	15%
		M	12	0.4	0.2	0.6	1.5	.	.	5%
	17-45[b]	F	15	1.1	0.6	1.5	2.0	.	.	22%
	Adult[c]		89	1.2	1.0	1.5	4.0	2.0	4.6	20%
	Child[c]		4	3.4	0.7	6.1	10.0	.	.	1%
Upper	0-6	F	4	0.6	0.2	1.0	1.0	.	.	13%
		M	9	0.9	0.3	1.5	4.0	.	.	20%
	7-17	F	19	1.4	0.7	2.0	6.0	.	.	61%
		M	35	2.1	1.6	2.6	5.0	.	.	70%
	18-54	F	29	1.3	0.8	1.7	3.8	.	.	28%
		M	27	1.0	0.5	1.5	4.0	.	.	31%
	55+	F	2	1.6	0.8	2.3	2.0	.	.	3%
		M	11	0.3	0.2	0.4	0.8	.	.	12%
	17-45[b]	F	22	1.4	0.8	2.1	3.8	.	.	27%
	Adult[c]		125	1.4	1.1	1.6	4.0	2.6	4.0	30%
	Child[c]		13	0.8	0.4	1.2	4.0	.	.	4%
All (UCR Reaches 1-6)	Adult[c]		324	1.6	1.4	1.8	5.0	4.0	5.3	28%
	Child[c]		24	1.3	0.6	2.0	4.0	.	.	2%
	All Ages		348	1.6	1.4	1.8	5.0	4.0	5.2	19%

M = male; F = female; LCL95, UCL95 = lower and upper two-sided, 95% confidence limit for the mean; 95% = estimated 95th percentile of the hours/day spent engaging in the activity for the population who engage in the activity, on the days that they engage in the activity; LTL95, UTL95 = lower and upper 95% tolerance limits for the 95th percentile; Freq. = estimated proportion of the population who engage in the activity.

[a]Number of completed interviews.

[b]This age group will be used for estimating hazards from methyl mercury and lead, consistent with the population of the critical study and the NHANES age-grouping for women of childbearing potential.

[c]Adults are defined as 7 years and older; children are defined as being younger than 7 years of age.

Scatter plots for number of trips per year for beach, boating and camping trips

Beach trips:

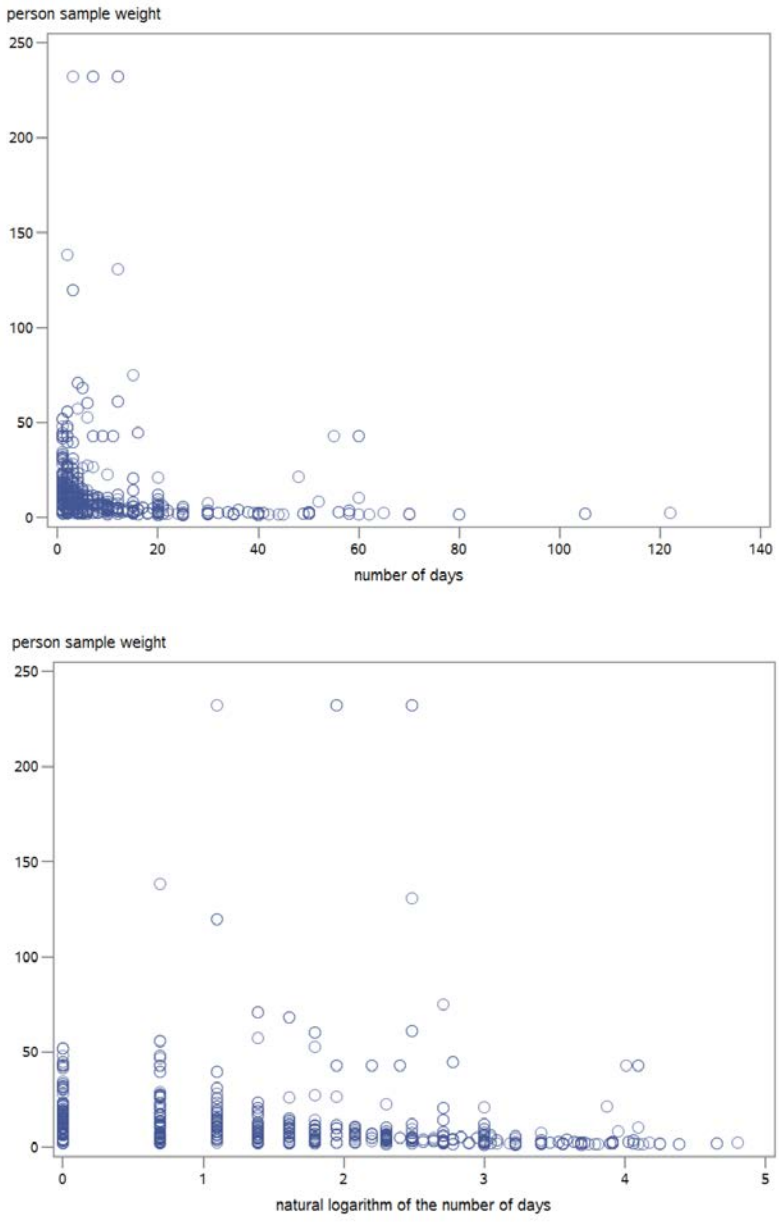


Figure A-1. The scatter plots of the number of beach trips and sample weights. The scatter plot of the number of day-trips to the beach (top graph) shows the majority (all but two) of the adjusted annual number of trips to the beach are less than 70. This is less clear in the scatter plot created with the natural logarithms of the adjusted annual number of trips (bottom graph). The MM algorithm (defined in Chen, 2002) flagged 51 adjusted responses (51 participants) of 34 trips or more as potential statistical outliers, while no potential outliers were identified with the log-transformed adjusted responses. Most of the flagged responses have small sample weights.

Boating trips:

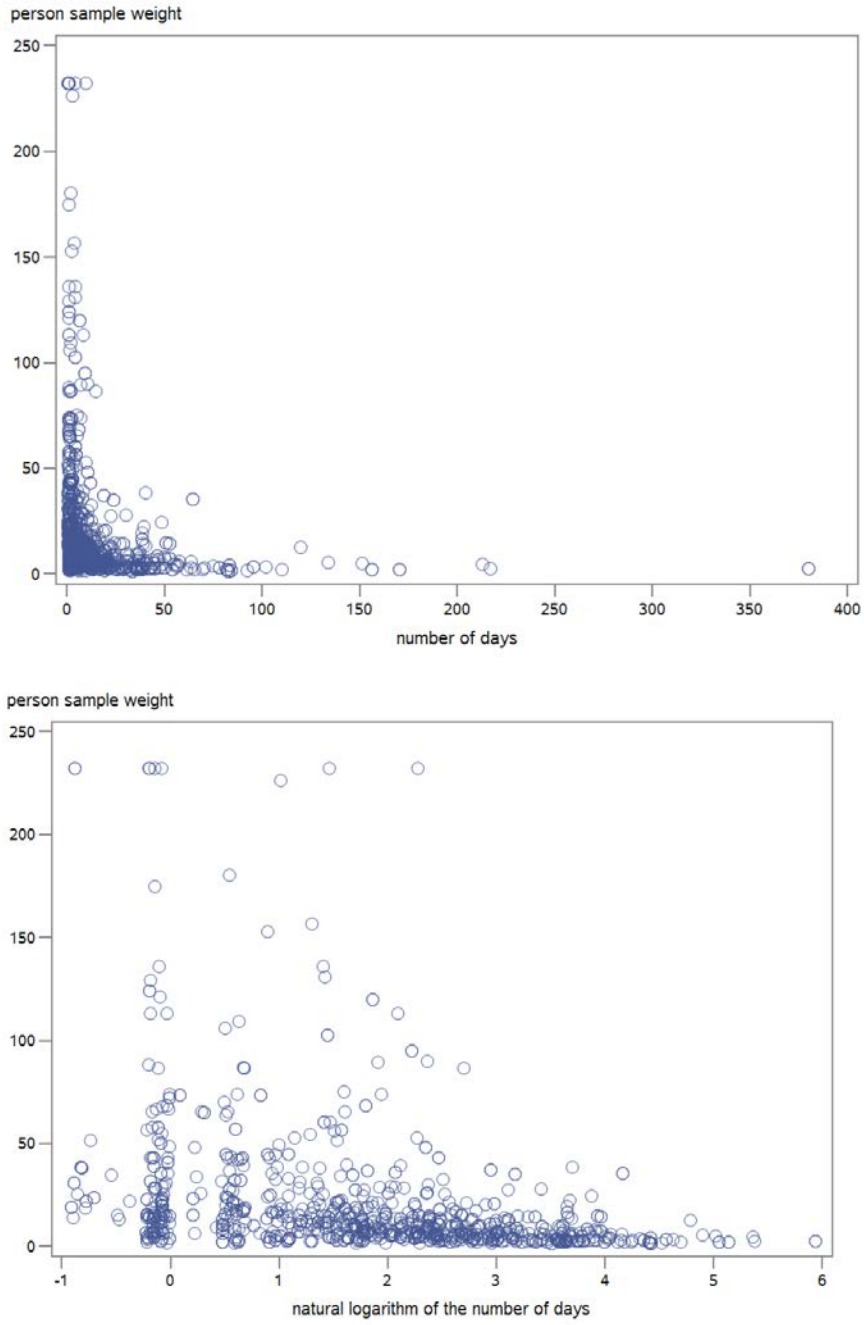


Figure A-2. The scatter plots of the number of boating trips and sample weights. The MM algorithm flagged 59 adjusted responses of 47 trips or more as potential statistical outliers. The potential outliers are not apparent in the scatter plot of the number of boating day-trips (top graph). The MM method (defined in Chen, 2002) did not identify any potential outliers with the log-transformed adjusted responses, which is consistent with the scatter plot for the log-transformed adjusted responses (bottom graph). potential outliers were identified with the log-transformed adjusted responses. Most of the flagged responses have small sample weights – this is clearer in the bottom graph (flagged responses have natural logarithms > 3.8).

Camping Trips (drive-in and boat-in camping)

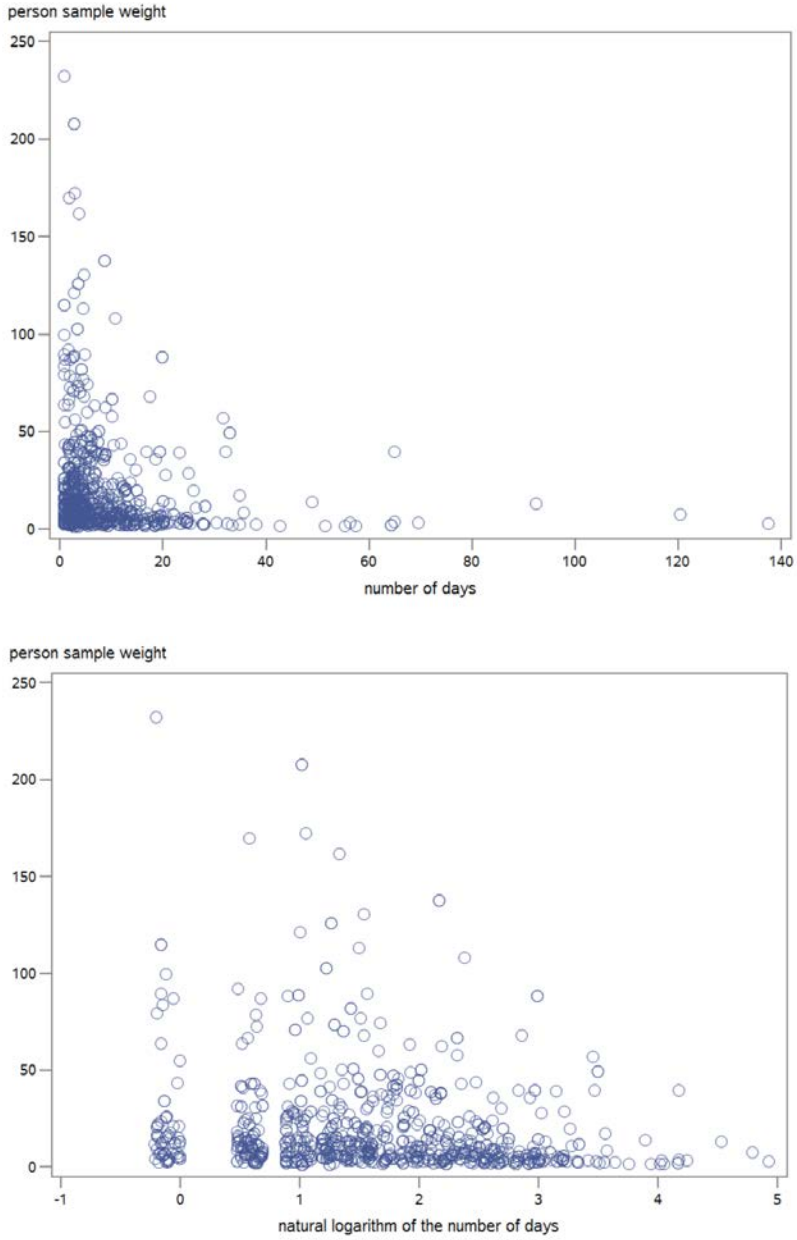


Figure A-3. The scatter plots of the number of nights spent camping and sample weights. The scatter plot of the number of nights spent camping (top graph) shows the majority (all but three) of the adjusted annual number of nights spent camping are 70 or less. This is less clear in the scatter plot created with the natural logarithms of the adjusted annual number of trips (bottom graph). With the log-transformed data, the MM algorithm (defined in Chen, 2002) confirmed the visual interpretation: adjusted nights spent camping that exceeded 70 were flagged as potential outliers. With the raw data, the MM algorithm flagged adjusted responses of 24 nights spent camping as potential statistical outliers, which represents 63 participants. The flagged responses do not have large sample weights.

Scatter plots for hours spent swimming during beach, boating and camping trips

Beach trips:

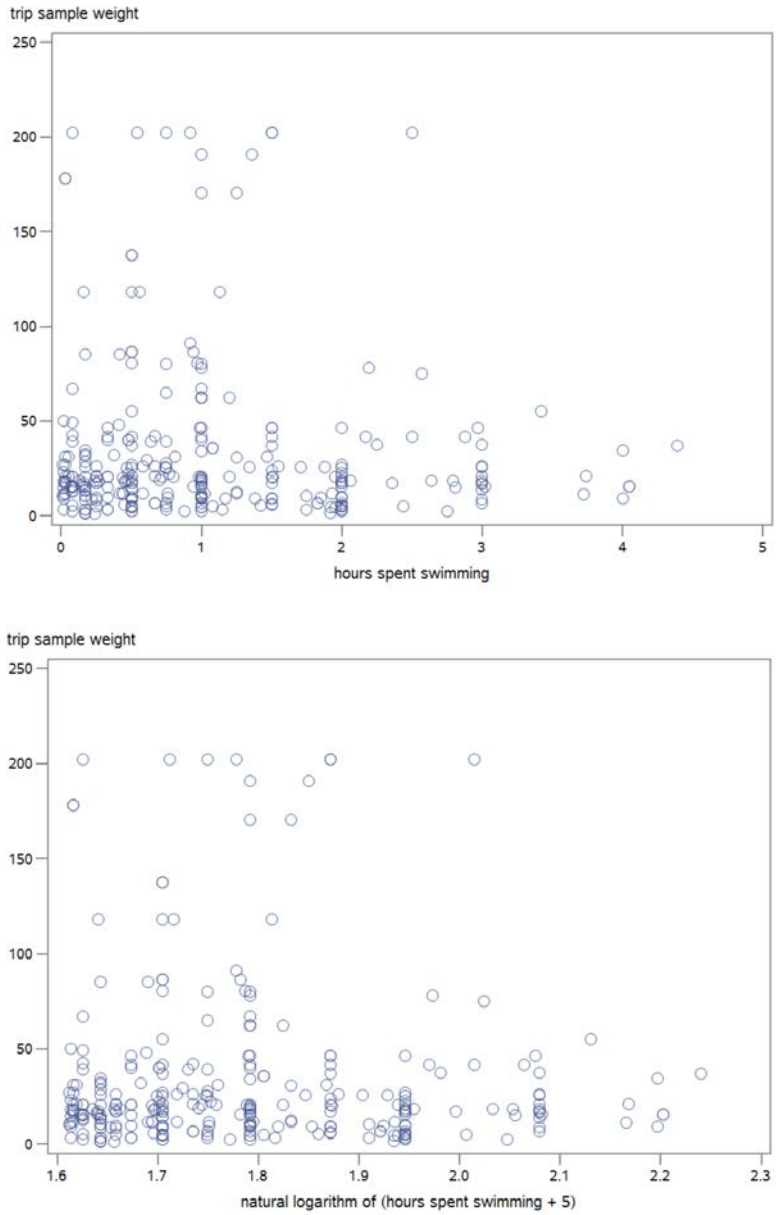


Figure A-4. The scatter plots of the hours spent swimming during beach day-trips. The MM method (defined in Chen, 2002) identified 9 responses (i.e., participants) that equal or exceed 3.4 hours as potential statistical outliers. The scatter plots of the raw data (top graph) and the log-transformed data (bottom graph) are show the majority of the participants reported swimming less than 3 hours per beach trip. Note to avoid negative log-transformed data, the swim times were adjusted by adding 5 prior to converting to natural logarithms (therefore, swim times of 3.4 hours correspond to 2.1 hours in the bottom figure).

Boating trips:

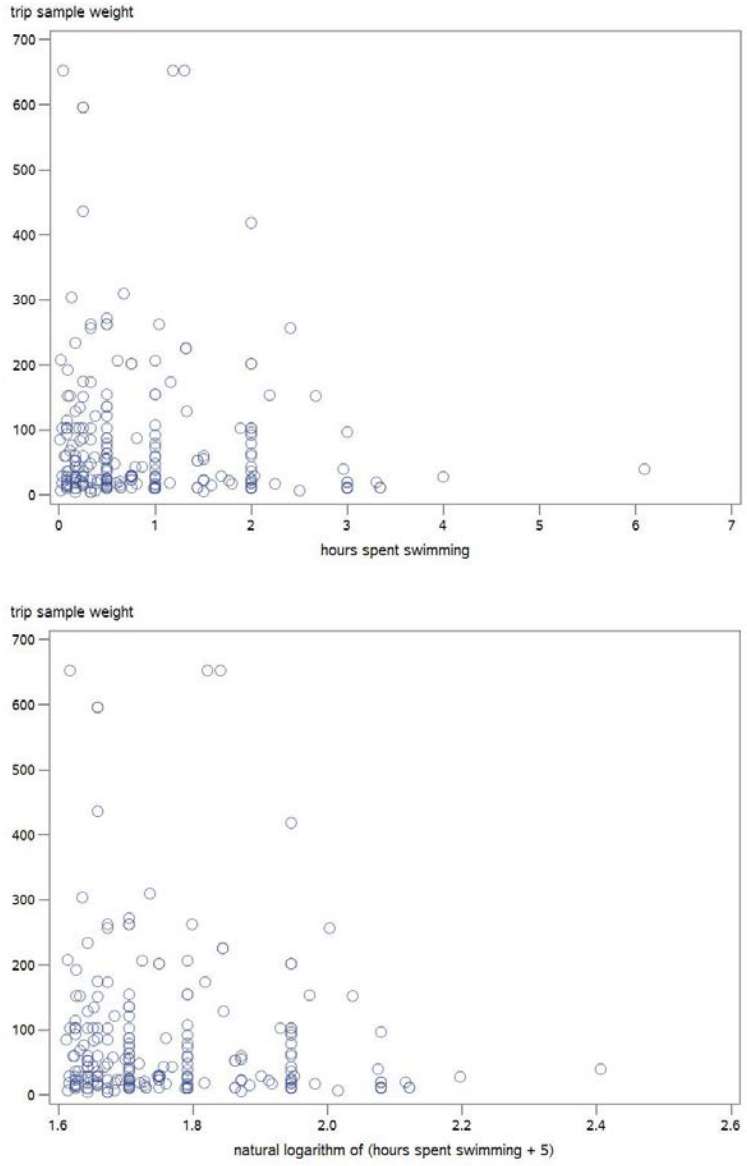


Figure A-5. The scatter plots of the hours spent swimming during beach day-trips. The MM method (defined in Chen, 2002) identified 5 responses (i.e., participants) that equal or exceed 3.3 hours as potential statistical outliers. The scatter plots of the raw data (top graph) and the log-transformed data (bottom graph) show the majority of the participants reported swimming less than 3 hours per beach trip. Note to avoid negative log-transformed data, the swim times were adjusted by adding 5 prior to converting to natural logarithms (therefore, swim times of 3.3 hours correspond to 2.1 hours in the bottom figure).

Camping Trips (drive-in and boat-in camping)

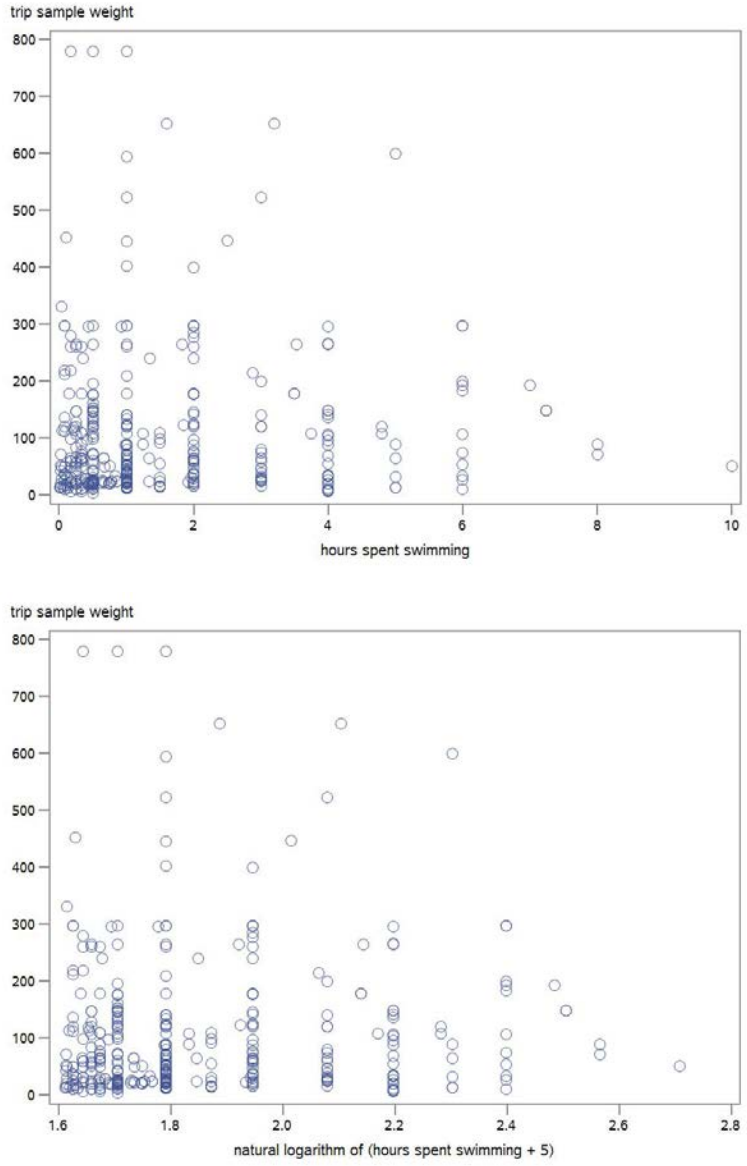


Figure A-6. The scatter plots of the hours spent swimming during camping trips. The MM method (defined in Chen, 2002) identified 17 responses (i.e., participants) that equal or exceed 6 hours spent swimming (over 24 hours prior to the survey interview) as potential statistical outliers. The scatter plots of the raw data (top graph) and the log-transformed data (bottom graph) show the 11 participants reported swimming 6 hours over the prior 24-hour period, while an additional 6 participants reported swimming between 7 and 10 hours during the prior 24-hours period. Note to avoid negative log-transformed data, the swim times were adjusted by adding 5 prior to converting to natural logarithms (therefore, swim times of 6 hours correspond to 2.4 hours in the bottom figure).

Appendix B – Data Reduction Steps

Notes for exposure frequency (EF) and exposure time (ET):

1. If one or more children accompanied the adult who was interviewed, the information for the child with the most recent birthday was collected. The variables for age and sex are as follows:
    a. Age: boating questionnaire (a7); camping questionnaire (a4); beach questionnaire (a6).
    b. Sex: boating questionnaire (a8); camping questionnaire (a5); beach questionnaire (a7).
2. To calculate population estimates for children, the sample weights (w_trip; w_person) for adults were also used for the accompanying child and the child was assigned a unique ID that equaled the adults ID + 0.1.

Beach EF:

1. Source of data: Questions C10: did the participant go on any beach day trips (yes/no; 1=yes, 0=no); C12: Number of day trips, per beach visited; Total trips were provided on questionnaire; the timeframe = June - September of preceding summer (122 days).
2. Variable names: c10, c11loc1-c11loc4 and c12trips1-c12trips4.
3. Children EF data (# trips) were assumed to be the same as the adult (i.e., if a child was present at the time of the interview, he or she was present during the other trips the adult reported).
4. The Lake region was assigned to each beach location using a recreation facilities location table (Table B-1).[1]
3. For each participant, the data were reduced to the total number of trips per lake region.
4. The total number of trips per lake region for each participant was used to estimate EF.

Camping EF:

1. Source of data: Questions C1: did the participant go on any overnight camping trips (yes/no; 1=yes, 0=no); C2-C4: Number of nights each season, per camp site location. For each camping location, provided the number of nights spent camping.
2. Variable names: c1, c2 (spyesno, uyesno, fayesno, wiyesno, cuyesno), c3 (culoc1 – culoc3, faloc1 – faloc3, sploc1 – sploc3, suloc1 – suloc3, wiloc1 – wiloc3), and c4 (unights1 – unights3, fanights1 – fanights3, spnights1 – spnights3, sunights1 – sunights3, winights1 – winights3).
3. Children EF data (# trips) were assumed to be the same as the adult (i.e., if a child was present at the time of the interview, he or she was present during the other trips the adult reported).
4. The Lake region was assigned to each camping location using SRC's recreation facilities location table (Table B-1).[1]
5. For each participant, the data were reduced to the number of nights spent camping in each lake region.

[1] SRC created a recreation facilities location table: RecUseRecSitesWithReachesLakeAreasLakeRegions_11-6-18.xlsx, (SAS file: RECSRC.RECSITES_UPDATED_11_6_18)

6. For each participant, the number of nights spent camping per lake region was adjusted to represent annual totals (the data includes responses for 4 seasons of prior year + 'current' season corresponding to the interview date)
    a. With the simple definition of seasons per the survey design[2];
    b. Current season includes the number of days into the 'current season';

        Example: Interview on September 2 = 2 days into current season (Fall); therefore, the denominator for the adjusted trips per year/lake region = 365 + 2 =367 days.

        For each participant, the adjusted nights per year/lake region = total number of nights per lake region/367.
7. The (adjusted) total number of nights spent camping per lake region was used to estimate EF.

Boating EF:

1. Source of data: Questions C5: did the participant go on any boating day trips (yes/no; 1=yes,0=no); C6-C9: Number of trips each season, per boat launch location. For each boat launch location-season, the number of lake areas visited was also provided.
2. Variable names: c5, c6 (cuyesno, fayesno, spyesno, suyesno, wiyesno), c7 (culoc1 – culoc3, faloc1 – faloc3, sploc1 – sploc3, suloc1 – suloc3, wiloc1 – wiloc3), c8 (cutrips1 – cutrips3, fatrips1 – fatrips3, sptrips1 – sptrips3, sutrips1 – sutrips3, witrips1 – witrips3), and c9 (cuarea1 – cuarea3, faarea1 – faarea3, sparea1 – sparea3, suarea1 – suarea3, wiarea1 – wiarea3).
3. Children EF data (# trips) were assumed to be the same as the adult (i.e., if a child was present at the time of the interview, he or she was present during the other trips the adult reported).
4. Number of trips to each lake area = number of trips/number of lake areas visited
    a. Notes:
        i. Based on limitations of the questionnaire design, for each combination of season and launch location, we had to assume the same lake areas were visited each time the participant launched from a particular location (for that particular season).
        ii. ID 1594 was an implausible response provider who reported launching his/her boat 60 times per season from Daisy and 100 times per season from Kettle Falls, for a total of 160 trips per season (640 per year). The lake areas visited varied by season and between the two boat launches. These responses were reduced to 90 per season/360 per year. Note the responses also applied to the accompanying child (ID=1594.1).
        iii. The number of trips to lake area 8 were removed from the data file because Lake Area 8 is not part of the UCR site (the site consists of Lake Areas 1-7).
5. Number of trips per year per person / lake region are calculated as the total of the trips/person/lake area across the lake areas (lake areas 1-7, per 4.a.iii).
6. Adjusted totals reflect annual totals as described above for camping data; i.e., to account for the data representing 5 seasons (4 seasons + 'current' season):
    a. Using simple definition of seasons per the survey design/questionnaire.

[2] Seasons were defined as: winter: December-February; spring: March-May; summer: June-August; fall: September-November.

b. Current season includes the number of days into the 'current season'; e.g. if an interview took place on Sep 2nd, which is 2 days into the current season, the denominator for the adjusted trips per year/lake region = 365 + 2 =367 days
c. The adjusted trips per participant/per year/lake region are used to estimate EF per lake region and for all three lake regions combined.

Notes for time spent swimming and other exposure time (ET) estimates:

1. All exposure time estimates used the variables that include the term ***'duration'*** in the variable name; e.g., with data from the beach questionnaire, the time adults spent swimming and wading in water deeper than waist deep used variable b3duration. The variables that include 'duration' in their names were adjusted by IEc such that the times add up to the duration of the trip (for overnight, the sum was adjusted by IEc to be less than or equal to 24 hours).
2. Exposure time estimates use data for participants who reported engaging in the activity. For example, for estimating the time spent swimming during beach trips, participants with b3duration or b7duration equal to zero were not included in the estimate of the time spent swimming (i.e., estimates are for 'doers only').

Time Spent Swimming:

1. **Beach Trips**
    a. Source of data for ***swimming:*** Questions B2-B3 (adults); B6-B7 (children). Have you/child spent any time in water (B2, B6)? How much of your/child's time in the water was spent swimming or wading in water over waist deep (B3, B7)?
    b. Variable names: b3duration (adults) and b7duration (children). The variables are the hours spent swimming.
    c. Time spent swimming during beach trips was estimated separately for adults and children, by lake region, using the data provided by variables listed in step (1.b.) (i.e., no data reduction was required), with the trip weights (w_trip).
    d. The time spent swimming in the UCR (all three lake regions) was estimated by first calculating the total time spent swimming in the UCR for each adult and child as the unweighted sum of the data provided by variables listed in step (1.b.). The time spent swimming in the UCR during beach trips was then estimated using the total time spent swimming in the UCR by each adult and child and the trip weights (w_trip).

2. **Boating day-trips – boating questionnaire**
    a. Source of data for ***swimming:***
        i. Question A3: Did you camp at the Upper Columbia River last night? Participants who reported not camping were selected (i.e., A3 not =1).
        ii. Question B2: What areas of the Upper Columbia River did you visit since you launched?
        iii. Questions B3.c (adults); B4.c (children). Since you launched your boat, have you or your child personally spent any time swimming or wading in water over waist deep?
    b. Variable names:

i. b3duration (adults) and b4duration (children). The variables are the hours spent swimming.

ii. b2a1-b2a8: Visited Lake Area during current trip? (1=yes, 0=no); e.g., b2a1=1 indicates the adult participant visited lake area 1 during the current trip. Children were assumed to visit the same lake areas as the parent participant.

c. Time adult spent swimming per lake area(s) visited = b3duration/number of lake areas visited (number of lake areas visited = sum of b2a1-b2a8). Time child spent swimming per lake area(s) visited = b4duration/number of lake areas visited. The calculation of the time spent swimming per lake area(s) visited assumes equal time spent in each of the lake areas that were visited. Note: Lake area 8 (Spokane River) was included in this step but was omitted in the estimate of swimming time (see next step).

d. The total time spent swimming in each lake region was calculated for each adult and child as the sum of time spent swimming per lake area(s) visited. If the participant reported visiting lake area 8, the time spent swimming in lake area 8 was removed prior to calculating the total time spent swimming in the lower lake region. Sample weights (w_trip) were not used in this step.

e. The time spent swimming per lake region during boating trips was estimated separately for adults and children, by lake region, using the data described in the previous step. The trip weights (w_trip) were used in this step.

i. The time spent swimming in the UCR (all three lake regions) during boating trips was estimated by first calculating the total time spent swimming in the UCR for each adult and child as the unweighted sum of the time spent swimming in each lake region. The time spent swimming in the UCR was then estimated using the total time spent swimming in the UCR by each adult and child and the trip weights (w_trip). Only lake areas 1-7 were included in the calculation because Lake Area 8 is not part of the UCR site (the site consists of Lake Areas 1-7).

3. Boat-in Camping Trips – boating questionnaire

a. Source of data for ***swimming:***

i. Question A3: Did you camp at the Upper Columbia River last night? Question A4: Is the camping site a drive-in campground? Participants who reported camping (A3=1) AND who reported the camping site was not a drive-in campground (A4=0) were selected.

ii. Question B2: What areas of the Upper Columbia River did you visit since you launched?

iii. Questions B5.c (adults); B6.c (children). Over the past 24 hours, have you or your child personally spent any time swimming or wading in water over waist deep? If yes, about how much time over the past 24 hours (reported in hours and minutes)?

b. Variable names:

i. B5cduration (adults) and b6cduration (children). The variables are the hours spent swimming.

ii. b2a1-b2a8: Visited Lake Area during current trip? (1=yes, 0=no); e.g., b2a1=1 indicates the adult participant visited lake area 1 during the current trip. Children were assumed to visit the same lake areas as the parent participant.

c. Time adult spent swimming per lake area(s) visited = b5cduration/number of lake areas visited (number of lake areas visited = sum of b2a1-b2a8). Time child spent swimming per lake area(s) visited = b6cduration/number of lake areas visited. The calculation of the time spent swimming per lake area(s) visited assumes equal time spent in each of the lake areas that were visited. Note: Lake area 8 (Spokane River) was included in this step but was omitted in the estimate of swimming time (see step d for boating day-trips).

d. The remainder of the steps are the same as steps d-f for boating day-trips.

4. Drive-in Camping Trips – camping questionnaire

a. Source of data for ***swimming:*** Questions B4.c (adults); B5.c (children). Over the past 24 hours, have you or your child personally spent any time swimming or wading in water over waist deep? If yes, about how much time over the past 24 hours?

b. Variable names:
   i. B4cduration (adults) and b5cduration (child). The variables are the hours spent swimming.

c. Time spent swimming during drive-in camping trips was estimated separately for adults and children, by lake region, using the data provided by variables listed in step (4.b.) (i.e., no data reduction was required), with the trip weights (w_trip).

d. The time spent swimming in the UCR (all three lake regions) was estimated by first calculating the total time spent swimming in the UCR for each adult and child as the unweighted sum of the data provided by variables listed in step (4.b.). The time spent swimming in the UCR during drive-in camping trips was then estimated using the total time spent swimming in the UCR by each adult and child and the trip weights (w_trip).

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SDE_Rec_Sites	Boat Launch	Northport	assumed it was the same as the boat launch	R-1	lakearea1	R1	upper	
RecUse survey	Campground	Northport	not sure that it is a drive-in campground too	R-1	lakearea1	R1	upper	Northport
SRC	Beach	Black Sand		R-1	lakearea1	R1	upper	
RecUse	Beach	Black Sands		R-1	lakearea1	R1	upper	
RecUse	Boat Launch	Black Sands		R-1	lakearea1	R1	upper	
SRC	Beach	Northport		R-1	lakearea1	R1	upper	
SRC	Beach	Northport Beach		R-1	lakearea1	R1	upper	
SRC	Beach	R.V. Park		R-1	lakearea1	R1	upper	
SRC	Beach	Swimming Hole		R-1	lakearea1	R1	upper	
SDE_Rec_Sites	Boat Launch	China Bend		R-2	lakearea2	R2	upper	
SDE_Rec_Sites	Boat Launch	Napoleon Bridge		R-2	lakearea2	R2	upper	
SDE_Rec_Sites	Campground	North Gorge		R-2	lakearea2	R2	upper	North Gorge
SDE_Rec_Sites	Beach	North Gorge		R-2	lakearea2	R2	upper	
SDE_Rec_Sites	Boat Launch	North Gorge		R-2	lakearea2	R2	upper	
SDE_Rec_Sites	Boat Launch	Snag Cove		R-2	lakearea2	R2	upper	
SDE_Rec_Sites	Beach	Snag Cove		R-2	lakearea2	R2	upper	
SDE_Rec_Sites	Campground	Snag Cove		R-2	lakearea2	R2	upper	Snag Cove
RecUse	Boat Launch	Crown Creek	Approximate	R-2	lakearea2	R2	upper	
FromIEc	Beach	Crown Creek	Approximate	R-2	lakearea2	R2	upper	
SRC	Beach	Bossburg Flat		R-2	lakearea2	R2	upper	
SRC	Beach	China Bend		R-2	lakearea2	R2	upper	
SRC	Beach	Dalles Orchard		R-2	lakearea2	R2	upper	
SRC	Beach	Flat Creek		R-2	lakearea2	R2	upper	
SDE_Rec_Sites	Boat Launch	Evans		R-3	lakearea3	R3	upper	
SDE_Rec_Sites	Campground	Evans		R-3	lakearea3	R3	upper	Evans
SDE_Rec_Sites	Campground	Kamloops Island		R-3	lakearea3	R3	upper	Kamloops Island
RecUse survey	Boat Launch	Kamloops Island		R-3	lakearea3	R3	upper	
RecUse survey	Campground	Kamloops		R-3	lakearea3	R3	upper	Kamloops
SDE_Rec_Sites	Boat Launch	Kettle Falls		R-3	lakearea3	R3	middle	
SDE_Rec_Sites	Campground	Kettle Falls		R-3	lakearea3	R3	middle	Kettle Falls
SDE_Rec_Sites	Campground	Kettle River		R-13		R13		Kettle River
RecUse survey	Beach	Kettle River		R-13		R13		
RecUse survey	Boat Launch	Kettle River		R-13		R13		
SDE_Rec_Sites	Boat Launch	Marcus Island		R-3	lakearea3	R3	upper	

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SDE_Rec_Sites	Beach	Marcus		R-3	lakearea3	R3	upper	
SDE_Rec_Sites	Beach	Marcus Island		R-3	lakearea3	R3	upper	
SDE_Rec_Sites	Campground	Marcus Island		R-3	lakearea3	R3	upper	Marcus Island
SDE_Rec_Sites	Campground	Sherman Creek		R-3	lakearea3	R3	middle	Sherman Creek
FromIEc	Campground	Locust Grove		R-3	lakearea3	R3	middle	Locust Grove
RecUse	Boat Launch	Locust Grove		R-3	lakearea3	R3	middle	
FromIEc	Beach	Singer's Bay		R-3	lakearea3	R3	upper	
FromIEc	Campground	Singer's Bay		R-3	lakearea3	R3	upper	Singer's Bay
SRC	Beach	St. Pauls Missions		R-3	lakearea3	R3	upper	
SRC	Beach	Evans		R-3	lakearea3	R3	upper	
SRC	Beach	Evans Campground		R-3	lakearea3	R3	upper	
SRC	Beach	Kamloops Island		R-3	lakearea3	R3	upper	
SRC	Beach	Kettle Falls		R-3	lakearea3	R3	middle	
SRC	Beach	Old Kettle Marina		R-3	lakearea3	R3	middle	
SRC	Beach	Summer Island		R-3	lakearea3	R3	upper	
SRC	Campground	Summer Island		R-3	lakearea3	R3	upper	Summer Island
SRC	Beach	Welty Bay		R-3	lakearea3	R3	upper	
SDE_Rec_Sites	Boat Launch	Barnaby		R-4a	lakearea4	R4A	middle	
RecUse survey	Campground	Barnaby		R-4a	lakearea4	R4A	middle	Barnaby
SDE_Rec_Sites	Boat-In Campsite	Barnaby Island		R-4a	lakearea4	R4A	middle	
RecUse survey	Campground	Bradbury		R-4a	lakearea4	R4A	middle	Bradbury
SDE_Rec_Sites	Boat Launch	Bradbury Beach		R-4a	lakearea4	R4A	middle	
SDE_Rec_Sites	Campground	Bradbury Beach		R-4a	lakearea4	R4A	middle	Bradbury Beach
RecUse survey	Beach	Daisy		R-4a	lakearea4	R4A	middle	
SDE_Rec_Sites	Boat Launch	Daisy		R-4a	lakearea4	R4A	middle	
SDE_Rec_Sites	Boat Launch	Daisy Boat Launch		R-4a	lakearea4	R4A	middle	
RecUse survey	Campground	Daisy		R-4a	lakearea4	R4A	middle	Daisy
SDE_Rec_Sites	Boat Launch	Daisy Boat Launch #2		R-4a	lakearea4	R4A	middle	
SDE_Rec_Sites	Boat Launch	French Rocks		R-4a	lakearea4	R4A	middle	
SDE_Rec_Sites	Beach	French Rocks		R-4a	lakearea4	R4A	middle	
RecUse survey	Campground	French Rocks		R-4a	lakearea4	R4A	middle	French Rocks
SDE_Rec_Sites	Campground	Haag Cove		R-4a	lakearea4	R4A	middle	Haag Cove
SDE_Rec_Sites	Beach	Haag Cove		R-4a	lakearea4	R4A	middle	
FromIEc	Campground	Chalk Creek		R-4a	lakearea4	R4A	middle	Chalk Creek

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
FromIEc	Campground	Ricky Point	Approximate	R-4a	lakearea4	R4A	middle	Ricky Point
FromIEc	Beach	Rickey Point	Approximate	R-4a	lakearea4	R4A	middle	
FromIEc	Boat Launch	Rickey Point	Approximate	R-4a	lakearea4	R4A	middle	
FromIEc	Boat Launch	Ricky Point	Approximate	R-4a	lakearea4	R4A	middle	
SRC	Beach	Sanpoil		R-10		R10		
SRC	Beach	Barnaby Island Campground		R-4a	lakearea4	R4A	middle	
SRC	Beach	Bradbury		R-4a	lakearea4	R4A	middle	
SRC	Boat Launch	Colville Flats		R-4a	lakearea4	R4A	middle	
SRC	Beach	Colville Flats		R-4a	lakearea4	R4A	middle	
SRC	Boat Launch	Colville Flats		R-4a	lakearea4	R4A	middle	
SRC	Beach	Colville River		R-4a	lakearea4	R4A	middle	
SRC	Beach	Lyons Island		R-4a	lakearea4	R4A	middle	
SDE_Rec_Sites	Campground	AA Encampment		R-4b	lakearea5	R4B	middle	AA Encampment
RecUse survey	Beach	Cloverleaf Beach		R-4b	lakearea5	R4B	middle	
SDE_Rec_Sites	Campground	Cloverleaf Beach		R-4b	lakearea5	R4B	middle	Cloverleaf Beach
RecUse survey	Beach	Columbia		R-4b	lakearea5	R4B	middle	
SDE_Rec_Sites	Campground	Columbia		R-4b	lakearea5	R4B	middle	Columbia
SDE_Rec_Sites	Campground	Corkscrew Canyon		R-4b	lakearea5	R4B	middle	Corkscrew Canyon
SDE_Rec_Sites	Campground	Enterprise		R-4b	lakearea5	R4B	middle	Enterprise
SDE_Rec_Sites	Beach	Gifford		R-4b	lakearea5	R4B	middle	
SDE_Rec_Sites	Campground	Gifford		R-4b	lakearea5	R4B	middle	Gifford
SDE_Rec_Sites	Boat Launch	Gifford		R-4b	lakearea5	R4B	middle	
SDE_Rec_Sites	Beach	Rogers Bar		R-4b	lakearea5	R4B	middle	
SDE_Rec_Sites	Campground	Rogers Bar		R-4b	lakearea5	R4B	middle	Rogers Bar
RecUse survey	Boat Launch	Roger Bar		R-4b	lakearea5	R4B	middle	
SDE_Rec_Sites	Campground	Wilmont Bay		R-4b	lakearea5	R4B	middle	Wilmont Bay
FromIEc	Beach	Cam Neighborly	Coordinates for Camp Naborlee	R-4b	lakearea5	R4B	middle	
FromIEc	Campground	Eberly	assumed the respondent meant "Camp Naborlee"	R-4b	lakearea5	R4B	middle	Eberly
FromIEc	Beach	Hall Creek	Approximate	R-4b	lakearea5	R4B	middle	
SRC	Beach	AA Campground		R-4b	lakearea5	R4B	middle	
SRC	Beach	AA Encampment		R-4b	lakearea5	R4B	middle	
SRC	Beach	Enterprise		R-4b	lakearea5	R4B	middle	
SRC	Beach	Hunters		R-4b	lakearea5	R4B	middle	

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SRC	Campground	Hunters		R-4b	lakearea5	R4B	middle	Hunters
SRC	Boat Launch	Hunters		R-4b	lakearea5	R4B	middle	
SRC	Beach	McGuires		R-4b	lakearea5	R4B	middle	
SRC	Beach	Mitchell Point		R-4b	lakearea5	R4B	middle	
SRC	Beach	Naborlee		R-4b	lakearea5	R4B	middle	
SRC	Beach	Nez Perce		R-4b	lakearea5	R4B	middle	
SRC	Beach	Wilmont Creek		R-4b	lakearea5	R4B	middle	
SDE_Rec_Sites	Boat-In Campsite	Goldsmith		R-5	lakearea6	R5	lower	
SDE_Rec_Sites	Boat Launch	Hanson Harbor		R-5	lakearea6	R5	lower	
RecUse survey	Campground	Hanson Harbor		R-5	lakearea6	R5	lower	Hanson Harbor
SDE_Rec_Sites	Boat Launch	Hawk Creek		R-5	lakearea6	R5	lower	
SDE_Rec_Sites	Campground	Hawk Creek		R-5	lakearea6	R5	lower	Hawk Creek
SDE_Rec_Sites	Boat Launch	Jones Bay		R-5	lakearea6	R5	lower	
SDE_Rec_Sites	Campground	Jones Bay		R-5	lakearea6	R5	lower	Jones Bay
SDE_Rec_Sites	Boat Launch	Lincoln Mill Boat Ramp	assumed it was the same as the Lincoln Mill boat ramp	R-5	lakearea6	R5	lower	
RecUse survey	Campground	Lincoln		R-5	lakearea6	R5	lower	Lincoln
RecUse survey	Boat Launch	Lincoln		R-5	lakearea6	R5	lower	
RecUse survey	Beach	Lincoln		R-5	lakearea6	R5	lower	
RecUse survey	Campground	Penix Canyon		R-5	lakearea6	R5	lower	Penix Canyon
SDE_Rec_Sites	Boat-In Campsite	Penix Canyon		R-5	lakearea6	R5	lower	
SDE_Rec_Sites	Boat Launch	Seven Bays		R-5	lakearea6	R5	lower	
SDE_Rec_Sites	Campground	Seven Bays		R-5	lakearea6	R5	lower	Seven Bays
RecUse survey	Campground	Sterling Point		R-5	lakearea6	R5	lower	Sterling Point
SDE_Rec_Sites	Boat-In Campsite	Sterling Point		R-5	lakearea6	R5	lower	
FromIEc	Campground	Goldsmith		R-5	lakearea6	R5	lower	Goldsmith
FromIEc	Beach	Hansen Harbor		R-5	lakearea6	R5	lower	
SRC	Beach	Hawk Creek		R-5	lakearea6	R5	lower	
SRC	Beach	Jones Bay		R-5	lakearea6	R5	lower	
SRC	Beach	Seven Bays		R-5	lakearea6	R5	lower	
SRC	Beach	Whitestone Campground		R-5	lakearea6	R5	lower	
SDE_Rec_Sites	Boat Launch	Crescent Bay		R-6	lakearea7	R6	lower	
RecUse survey	Campground	Crescent Bay		R-6	lakearea7	R6	lower	Crescent Bay
SDE_Rec_Sites	Campground	Keller Ferry		R-6	lakearea7	R6	lower	Keller Ferry

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SDE_Rec_Sites	Boat Launch	Keller Ferry		R-6	lakearea7	R6	lower	
SDE_Rec_Sites	Beach	Keller Ferry		R-6	lakearea7	R6	lower	
SDE_Rec_Sites	Campground	Keller Park		R-10		R10		Keller Park
SDE_Rec_Sites	Boat Launch	Keller Park		R-10		R10		
FromIEc	Beach	Plum Beach		R-6	lakearea7	R6	lower	
SDE_Rec_Sites	Boat-In Campsite	Plum Point	not sure that it is a drive-in campground too	R-6	lakearea7	R6	lower	
RecUse survey	Beach	Plum Point		R-6	lakearea7	R6	lower	
RecUse survey	Campground	Plum Point		R-6	lakearea7	R6	lower	Plum Point
SDE_Rec_Sites	Boat Launch	Spring Canyon		R-6	lakearea7	R6	lower	
SDE_Rec_Sites	Campground	Spring Canyon	not sure that it is a drive-in campground too	R-6	lakearea7	R6	lower	Spring Canyon
SRC	Campground	Coulee Dam		R-6	lakearea7	R6	lower	Coulee Dam
SRC	Beach	Grand Coulee Dam		R-6	lakearea7	R6	lower	
SRC	Beach	Crescent Bay		R-6	lakearea7	R6	lower	
SRC	Beach	Spring Canyon		R-6	lakearea7	R6	lower	
SRC	Beach	Swawilla Basin		R-6	lakearea7	R6	lower	
SDE_Rec_Sites	Boat-In Campsite	Crystal Cove		R-11	lakearea8	R11		
RecUse survey	Campground	Crystal Cove		R-11	lakearea8	R11		Crystal Cove
SDE_Rec_Sites	Boat-In Campsite	Detillion		R-11	lakearea8	R11		
RecUse survey	Campground	Detillion		R-11	lakearea8	R11		Detillion
SDE_Rec_Sites	Campground	Fort Spokane Visitor Center		R-11	lakearea8	R11		
SDE_Rec_Sites	Boat Launch	Fort Spokane Visitor Center		R-11	lakearea8	R11		Fort Spokane Visitor Center
RecUse survey	Campground	Fort Spokane		R-11	lakearea8	R11		Fort Spokane
RecUse survey	Beach	Fort Spokane		R-11	lakearea8	R11		
RecUse survey	Boat Launch	Fort Spokane		R-11	lakearea8	R11		
SDE_Rec_Sites	Campground	Little Falls		R-11	lakearea8	R11		Little Falls
SDE_Rec_Sites	Campground	Pierre		R-11	lakearea8	R11		Pierre
SDE_Rec_Sites	Beach	Pierre Point		R-11	lakearea8	R11		
SDE_Rec_Sites	Beach	Peer's Point	assumed respondent meant Pierre Point	R-11	lakearea8	R11		
SDE_Rec_Sites	Campground	Peer's Point	assumed respondent meant Pierre Point	R-11	lakearea8	R11		Peer's Point
SDE_Rec_Sites	Boat-In Campsite	Ponderosa		R-11	lakearea8	R11		
SDE_Rec_Sites	Boat Launch	Porcupine Bay		R-11	lakearea8	R11		
SDE_Rec_Sites	Beach	Porcupine Bay		R-11	lakearea8	R11		
SDE_Rec_Sites	Campground	Porcupine Bay		R-11	lakearea8	R11		Porcupine Bay

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SDE_Rec_Sites	Campground	Two Rivers		R-11	lakearea8	R11		Two Rivers
SDE_Rec_Sites	Beach	Two Rivers		R-11	lakearea8	R11		
SDE_Rec_Sites	Boat Launch	Two Rivers		R-11	lakearea8	R11		
FromIEc	Boat Launch	Hidden Beach		R-11	lakearea8	R11		
FromIEc	Beach	Racoon Cove		R-11	lakearea8	R11		
SRC	Campground	Area	could not locate					Area
SRC	Campground	Area 1		R-1	lakearea1	R1	upper	Area 1
SRC	Campground	Area 2		R-2	lakearea2	R2	upper	Area 2
SRC	Campground	Area 2 & 3		R-2	lakearea2	R2	upper	Area 2 & 3
SRC	Campground	Area 2 & 3 & 4		R-3	lakearea3	R3	upper	Area 2 & 3 & 4
SRC	Campground	Area 2 & 3 & 4 & 5 & 6	regions are approximate, they were based on the river reach	R-4a	lakearea4	R4A	middle	Area 2 & 3 & 4 & 5 & 6
SRC	Campground	Area 2 & Area 5		R-4a	lakearea4	R4A	middle	Area 2 & Area 5
SRC	Campground	Area 3		R-2	lakearea2	R2	upper	Area 3
SRC	Campground	Area 3 & 4 & 5		R-4a	lakearea4	R4A	middle	Area 3 & 4 & 5
SRC	Campground	Area 4		R-4a	lakearea4	R4A	middle	Area 4
SRC	Campground	Area 4 & 5		R-4a	lakearea4	R4A	middle	Area 4 & 5
SRC	Campground	Area 5		R-4b	lakearea5	R4B	middle	Area 5
SRC	Campground	Area 5 & 6 & 7		R-5	lakearea6	R5	lower	Area 5 & 6 & 7
SRC	Campground	Area 5 & 6 & 8		R-5	lakearea6	R5	lower	Area 5 & 6 & 8
SRC	Campground	Area 6		R-5	lakearea6	R5	lower	Area 6
SRC	Campground	Area 6 & 7		R-5	lakearea6	R5	lower	Area 6 & 7
SRC	Campground	Area 6 & 8		R-5	lakearea6	R5	lower	Area 6 & 8
SRC	Campground	Area 7		R-6	lakearea7	R6	lower	Area 7
SRC	Campground	Area 7 & 6		R-6	lakearea7	R6	lower	Area 7 & 6
SRC	Campground	Area 8		R-11	lakearea8	R11		Area 8
SRC	Campground	Areas 2 & 3		R-2	lakearea2	R2	upper	Areas 2 & 3
SRC	Campground	Barnaby Creek		R-4a	lakearea4	R4A	middle	Barnaby Creek
SRC	Campground	Beach	could not locate					Beach
SRC	Campground	Beach Camped	could not locate					Beach Camped
SRC	Campground	Bill's Beach	could not locate					Bill's Beach
SRC	Campground	Cabin (Private)	could not locate					Cabin (Private)
SRC	Campground	Camp Naborlee		R-4b	lakearea5	R4B	middle	Camp Naborlee
SRC	Campground	Champion	Could refer to Champion Lakes Provincial Park near Trail, BC			Champion		

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SRC	Campground	Cloverleaf		R-4b	lakearea5	R4B	middle	Cloverleaf
SRC	Campground	Deer Meadows						Deer Meadows
SRC	Campground	Grand Coulee		R-6	lakearea7	R6	lower	Grand Coulee
SRC	Campground	Lake Terrance Estates						Lake Terrance Estates
SRC	Campground	Little Dalles	assumed to be near Dalles Orchard	R-2	lakearea2	R2	upper	Little Dalles
SRC	Campground	Lotts Campground						Lotts Campground
SRC	Campground	McCoy's Marina						McCoy's Marina
SRC	Campground	River Rue						River Rue
SRC	Campground	Section 6	assumed to refer to lake area 6	R-5	lakearea6	R5	lower	Section 6
SRC	Campground	Sheep Creek	located in Google Search	R-1	lakearea1	R1	upper	Sheep Creek
SRC	Campground	Unknown						Unknown
SRC	Campground	Upper Columbia	assumed to be referring to upper lake region	R-2	lakearea2	R2	upper	Upper Columbia
SRC	Campground	Barnaby Island	revised to address IEC comments	R-4a	lakearea4	R4A	middle	Barnaby Island
SRC	Campground	China Bend	revised to address IEC comments	R-2	lakearea2	R2	upper	China Bend
SRC	Campground	Colville Flats	revised to address IEC comments	R-4a	lakearea4	R4A	middle	Colville Flats
IEC	Campground	Rickey Point	revised to address IEC comments	R-4a	lakearea4	R4A	middle	Rickey Point
SRC	Boat-In Campsite	Area 2	revised to address IEC comments	R-2	lakearea2	R2	upper	
SRC	Boat-In Campsite	Area 2 & 3	revised to address IEC comments	R-2	lakearea2	R2	upper	
SRC	Boat-In Campsite	Area 3	revised to address IEC comments	R-3	lakearea3	R3	upper	
SRC	Boat-In Campsite	Area 4	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Boat-In Campsite	Area 5	revised to address IEC comments	R-4b	lakearea5	R4B	middle	
SRC	Boat-In Campsite	Area 6	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Boat-In Campsite	Area 6 & 8	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Boat-In Campsite	Area 7	revised to address IEC comments	R-6	lakearea7	R6	lower	
SRC	Boat-In Campsite	Area 8	revised to address IEC comments	R-11	lakearea8	R11		
SRC	Boat-In Campsite	Bills Beach	revised to address IEC comments; could not locate					
SRC	Boat-In Campsite	Chalk Creek	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Boat-In Campsite	Champion Beach	revised to address IEC comments; Could refer to Champion Lakes Provincial Park near Trail, BC					
SRC	Boat-In Campsite	Deer Meadows	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Boat-In Campsite	Enterprise	revised to address IEC comments	R-4b	lakearea5	R4B	middle	
SRC	Boat-In Campsite	Kettle River	revised to address IEC comments	R-13		R13		

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SRC	Boat-In Campsite	North Lake Resort	revised to address IEC comments	R-3	lakearea3	R3	upper	
SRC	Boat-In Campsite	Peer's Point	revised to address IEC comments; assumed respondent meant Pierre Point	R-11	lakearea8	R11		
SRC	Boat-In Campsite	Private	revised to address IEC comments					
SRC	Boat-In Campsite	RV Park in Kettle Falls	revised to address IEC comments	R-3	lakearea3	R3	middle	
SRC	Boat-In Campsite	River Rue	revised to address IEC comments	R-6	lakearea7	R6	lower	
SRC	Boat-In Campsite	Roper Creek	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Boat-In Campsite	Unknown	revised to address IEC comments					
SRC	Beach	Area 2	revised to address IEC comments	R-2	lakearea2	R2	upper	
SRC	Beach	Area 3	revised to address IEC comments	R-3	lakearea3	R3	upper	
SRC	Beach	Area 3 & 4 & 5	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Beach	Area 4	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Beach	Area 4 & 5	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Beach	Area 5	revised to address IEC comments	R-4b	lakearea5	R4B	middle	
SRC	Beach	Area 6	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Beach	Area 6 & 7	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Beach	Area 6 & 8	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Beach	Area 7	revised to address IEC comments	R-6	lakearea7	R6	lower	
SRC	Beach	Area 8	revised to address IEC comments	R-11	lakearea8	R11		
IEC	Beach	Balcomes	revised to address IEC comments; Spokane Reservation Campground: Balcomb's Landing	R-11	lakearea8	R11		
IEC	Beach	Bar 41	revised to address IEC comments; Defunct Bar-41 Dude Ranch near Wilbur, WA					
SRC	Beach	Bradbury Beach	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
IEC	Beach	Cam Neighborly	revised to address IEC comments; Assumed to be Camp Naborlee	R-4b	lakearea5	R4B	middle	
SRC	Beach	Cloverleaf	revised to address IEC comments	R-4b	lakearea5	R4B	middle	
SRC	Beach	Eden's Harbor	revised to address IEC comments	R-6	lakearea7	R6	lower	
SRC	Beach	Hanson Harbor	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Beach	Kamloops	revised to address IEC comments	R-3	lakearea3	R3	upper	
SRC	Beach	Peach Tree	revised to address IEC comments					
SRC	Beach	Private Beach	revised to address IEC comments					
SRC	Beach	Rotors Bay Canon Bluff	revised to address IEC comments					
SRC	Boat Launch	Area 3	revised to address IEC comments	R-2	lakearea2	R2	upper	

TABLE B-1. List of Recreation Facility Locations[a]

Source	Label	Name	Comment	Zone	Lake Area	River Reach	Lake Region	Camp Location
SRC	Boat Launch	Area 3 & 4	revised to address IEC comments	R-2	lakearea2	R2	upper	
SRC	Boat Launch	Area 4	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Boat Launch	Area 6	revised to address IEC comments	R-5	lakearea6	R5	lower	
SRC	Boat Launch	Area 7	revised to address IEC comments	R-6	lakearea7	R6	lower	
SRC	Boat Launch	Area 8	revised to address IEC comments	R-11	lakearea8	R11		
IEC	Boat Launch	Balcomes	revised to address IEC comments; Spokane Reservation Campground: Balcomb's Landing	R-11	lakearea8	R11		
SRC	Boat Launch	Barnaby Island	revised to address IEC comments	R-4a	lakearea4	R4A	middle	
SRC	Boat Launch	Low Ferry Landing	revised to address IEC comments					
SRC	Boat Launch	Rants Marina	revised to address IEC comments					

[a]This list of recreation facility locations was used as a lookup table to facilitate estimating the number of beach trips per year, boat day-trips per year, and nights spent camping per year by lake region. It was developed from responses to question C11 on the beach, boating and camping questionnaires. Participants entered the name of the recreation facility or the location of the facility by hand (i.e., the locations were not selected from a list of options). When participants could not recall the specific location of a past trip, they were allowed to enter a lake area as an approximate location. In contrast, the exposure time data pertained only to the interview locations and the survey data included the locations (lake area, lake region) for all interviews; therefore, a lookup table was not required for the exposure time data (e.g., time spent swimming).

Notes for daily fish consumption rate (DCR) estimates:

1. The questionnaires did not provide data that could be used to estimate fish DCRs for children.

Daily fish consumption rates:

1. **Questionnaire fish consumption data**
    a. Source of data: Questions D1-D6 and D9 (adults).
    b. Variable names: d1, d2, d3<fish>yesno, d4<fish>meals, d4<fish>mealsnum d5<fish>area, d6<fish>fillet, d9.
    c. Participants who reported eating fish from the UCR were selected (i.e., where d2=1).
    d. The number of source areas (lake areas) for each species was determined for each participant (including lake area 8 – Spokane river). Participants who responded "don't know" for the source of a fish species were assumed to source that fish species from all 8 lake areas.
    e. Typical fillet sizes (question and variable d9) were converted to grams as shown in Table 3 of the DAR.
    f. Total daily fish intake for each fish species the participant reported catching was calculated for each participant as follows: number of fish meals (d4<fish>mealsnum) x typical fillet size (grams) / 365.
    g. The daily fish intake per fish species, per lake area source was calculated as follows for each participant: the total daily fish intake (see previous step) / number of lake areas the participant reported catching the fish species in (calculated in step 1.d).
    h. The daily fish intake per fish species, per lake region was calculated for each participant as the unweighted sum of the daily fish intake per lake area source, with all daily intakes attributed to lake area 8 omitted. This variable was used to estimate the daily fish consumption rate for the population of fish consumers for participants who did not provide at least 3 complete fish diaries (see #2 Diary data and #3 Estimating daily fish consumption rates below). The number of meals per participant, fish species and lake region was also calculated for each participant.
    i. Table *NumMealsPerIDFishTypeRegion* contains one record for each unique combination of participant (adults only) – fish species – lake area source. This table is used (with table *FishIngestion_11_20_18*, see below) to estimate daily fish consumption rates with the combined questionnaire and diary data.
2. **Fish consumption diary data**
    a. Source of data**:** Questions E6-E7; Appendix E,
    b. Variable names:
        1. Boat, Camp, and Beach tables - e6, e7
        2. DiaryMeals table - q1, month, q2<fish>, q3<source>; q5_1 – q5_5; q6; q6size;
        3. DiaryParticipants table – childage, diarymonth1-diarymonth3, month1complete, month2complete, month3complete

c. Convert meal sizes (q5_1-q5_5; q6size) were converted to grams as shown in Table 3 of the DAR.

d. Assign lake areas, lake region, river reach to each meal reported using source location table[3] (Table B-2). SRC created the source location table because some fish meal sources were entered 'free-form' rather than selected from a list – i.e., the sources were not limited to the UCR, while the questionnaire location were limited to Lake Areas 1-8. Also create variable locationcategory with the following possible values: UCR, local-not UCR, outside local area, restaurant, store or unknown.

j. For each participant, calculate unweighted total fish consumption for each combination of fish type – location category – month to create table *FishIngestion_11_20_18,* which is used (with table *NumMealsPerIDFishTypeRegion,* see above*)* to estimate daily fish consumption rates with the combined questionnaire and diary data.

3. Daily fish consumption rate with combined questionnaire and diary data

a. With diary data, *FishIngestion_11_20_18,* retained data only for participants who completed 3 diaries. Created an 'other' fish type category for all fish that are not one of the following: bass, burbot, kokanee, perch, rainbow trout, walleye. Calculate unweighted total grams of the three months of fish consumption for each participant (all species combined). Calculated unweighted daily ingestion rate (grams/day) for each participant as the total grams of fish consumed for 3 diaries/90 days. Retain only data where the LocationCategory='UCR'.

b. With questionnaire data, NumMealsPerIDFishTypeRegion, created an 'other' fish type category for all fish that are not one of the following: bass, burbot, kokanee, perch, rainbow trout, walleye. Calculate unweighted daily ingestion rate for each participant (all species combined; the questionnaire data were previously converted to daily ingestion rates for each fish type in step 1.f.).

c. The diary and questionnaire data were combined. Daily ingestion rates calculated with diary data were used for participants when available; otherwise the questionnaire data were used. Children's daily ingestion rates were only available from diaries.

d. Fish daily consumption rates were estimated using the daily ingestion rates for each participant and their person sample weights (w_person).

[3] SRC created a source location table: sourcesoffish_11_4_13.xlsx, (SAS file: RECSRC. SOURCESOFFISH_11_4_13)

TABLE B-2. List of Fish Sources Reported by Participants who Completed Three Monthly Diaries[a]

Source of Fish	River Reach[b]	Lake Area[c]	Lake Region[d]	Location Category[e]
Above Rookey Beach Dam				Outside local area
Alaska				Outside local area
Ashley Lake; Montana				Outside local area
Banks Lake				Outside local area
Blue Lake				Outside local area
Brownlee Reservoir; Idaho				Outside local area
Cathlamet; Washington				Outside local area
Chalk Grade (south of Kettle Falls)	R4A	4	Middle	UCR
Columbia River below Coulee Dam	R9			Outside local area
Confluence-Snake/Clearwater				Outside local area
Couer d'Alene Lake				Outside local area
Did not record				Unknown
Do not know				Unknown
Electric City Fish Pens				Fish farms
Fish Pens				Fish farms
Jumpoff Joe Lake				Local – not UCR
Kalamit River				Unknown (could have meant Kalama, WA?)
Lake Chelan				Outside local area
Lake Spokane				Unknown (somewhere on the Spokane reservation?)
Longview; WA-ocean				Outside local area
Loon Lake				Local – not UCR
Medow Lake				Local – not UCR (probably should be Meadow)
Mexico				Outside local area
Mill Creek				Outside local area
Moses Lake				Outside local area
Ocean				Outside local area
Oregon Coast				Outside local area
Oregon Coast/Alaska				Outside local area
Pend Oreille				Outside local area
Pierre Lake				Local – not UCR
Priest Lake				Local – not UCR
Puget Sound				Local – not UCR
Restaurant				Restaurant
Rimrock Lake				Outside local area
Rock Lake (Cheney WA Area)				Outside local area
Rock Lake; Washington				Outside local area

TABLE B-2. List of Fish Sources Reported by Participants who Completed Three Monthly Diaries[a]

Source of Fish	River Reach[b]	Lake Area[c]	Lake Region[d]	Location Category[e]
Sanpoil River				Outside local area
Sekiu; Washington				Outside local area
Selven Oale				Outside local area
Silver Lake				Outside local area
Snake River				Outside local area
Spirit Lake; Idaho				Outside local area
Spokane River				Outside local area
Sprague Lake				Outside local area
Store				Store
Tennessee				Outside local area
Twin Lakes Idaho				Outside local area
Twin Lakes Inchileon				Local – not UCR
UCR Area 1	R1	1	Upper	UCR
UCR Area 2	R2	2	Upper	UCR
UCR Area 3	R3	3	Upper	UCR
UCR Area 4	R4A	4	Middle	UCR
UCR Area 5	R4B	5	Middle	UCR
UCR Area 6	5	6	Lower	UCR
UCR Area 7	6	7	Lower	UCR
UCR Area 8	R11	8		Local – not UCR
Unknown				Unknown
Waitts Lake				Local – not UCR
Wallowa Lake				Outside local area
Washington Coast				Outside local area
West Medical Lake				Outside local area
Westport; Washington				Outside local area
Williams Lake				Outside local area
Other				Unknown
Other non-local fishing site				Unknown

[a]This file was used as a lookup table to map sources of fish provided in diaries to one of the following categories: UCR, local-not UCR, outside local area, restaurant, or stores. The locations were provided in response to question 3 of the diary, which required participants to provide the source of each fish meal by selecting (circling) one or more of several options, including: lake areas (1-8), the Sanpoil River, the Columbia River below Coulee Dam, store, restaurant, or non-local fishing site; or, the participants could write the name of another source. They could also report that they didn't know the source of the fish meal. A lookup table was not required for the sources of fish reported on the survey questionnaires. The possible sources of fish reported on the survey questionnaires were limited to lake areas 1-8, which were readily converted to one of the lake regions when necessary (note that lake areas 1-7 are considered part of the UCR site; lake area 8 is not part of the UCR site).
[b]Reaches are 1-3, 4a, 4b, 5-13; blank if none of the above
[c]Lake areas 1-8; blank if not in the UCR
[d]Upper, middle, or lower; blank if not in the UCR
[e]Location categories = UCR, local area-not UCR, outside local area, restaurant, store, fish farm, or unknown

APPENDIX C: LAKE ROOSEVELT DRAWDOWN DURING THE SURVEY PERIOD

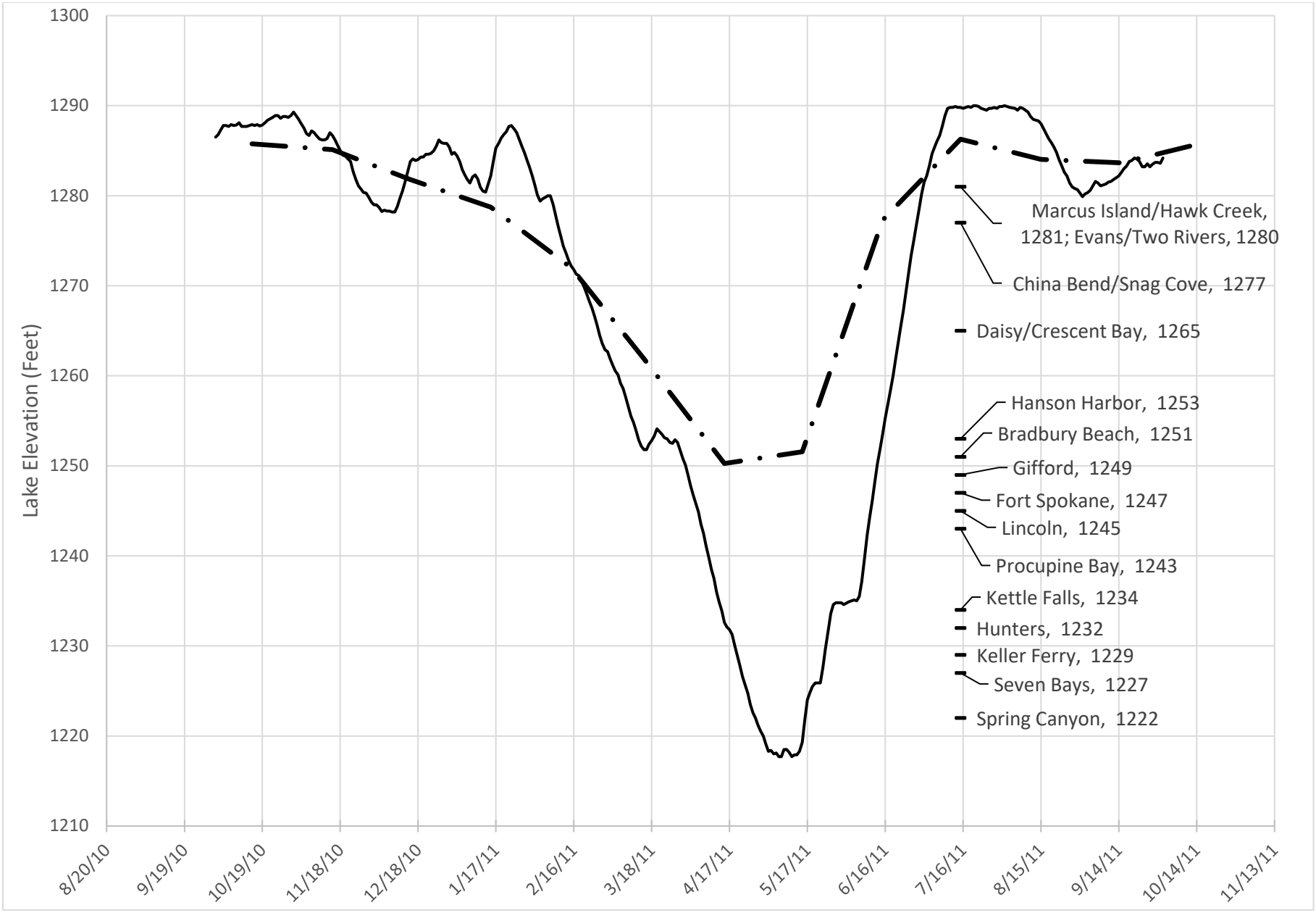


Figure C-1. Roosevelt Lake water elevations during the Recreational Use Survey interviews. The solid line shows the daily lake elevation (feet) during the survey interview period. The dashed line shows the average monthly lake elevation, in feet, based on water elevation data for 1979-2018. The minimum water elevations required to maintain access to boat launches are shown on the right of the graph; for example, when the lake elevation is below 1277 feet, the boat launches at China Bend and Snag Cove are no longer available.

Table C-1. Monthly Water Elevation of Lake Roosevelt (feet), 1979-2018[a]

Month	Variable	Minimum	Median	Mean	Maximum
January	minimum	1241	1278	1274	1286
	median	1245	1282	1279	1289
	mean	1246	1282	1279	1288
	maximum	1252	1286	1283	1290
February	minimum	1225	1266	1267	1287
	median	1231	1272	1272	1288
	mean	1231	1273	1272	1288
	maximum	1240	1281	1277	1290
March	minimum	1221	1253	1255	1283
	median	1223	1258	1262	1286
	mean	1223	1259	1262	1286
	maximum	1226	1266	1269	1289
April	minimum	1211	1243	1242	1279
	median	1215	1251	1250	1283
	mean	1216	1253	1250	1282
	maximum	1223	1257	1260	1285
May	minimum	1209	1241	1243	1283
	median	1219	1247	1250	1285
	mean	1221	1248	1252	1285
	maximum	1235	1267	1265	1288
June	minimum	1235	1269	1265	1289
	median	1254	1281	1278	1290
	mean	1255	1279	1277	1290
	maximum	1275	1286	1285	1290
July	minimum	1272	1284	1283	1290
	median	1275	1288	1287	1290
	mean	1275	1287	1286	1290
	maximum	1276	1290	1288	1290
August	minimum	1275	1280	1281	1289
	median	1277	1283	1284	1290
	mean	1277	1283	1284	1290
	maximum	1279	1287	1287	1290
September	minimum	1277	1280	1281	1287
	median	1279	1283	1284	1289
	mean	1280	1283	1284	1288
	maximum	1282	1287	1286	1290
October	minimum	1276	1284	1284	1287
	median	1279	1286	1286	1289
	mean	1279	1286	1286	1288
	maximum	1283	1288	1288	1290
November	minimum	1265	1283	1282	1287
	median	1273	1286	1285	1289
	mean	1273	1286	1285	1288
	maximum	1281	1288	1288	1290
December	minimum	1252	1280	1278	1286
	median	1258	1284	1282	1288
	mean	1260	1284	1282	1287
	maximum	1273	1286	1285	1290

[a]Statistics for the minimum, median, mean and maximum water level elevation for Lake Roosevelt are presented for each month using data recorded from 1979-2018. For example, the first row of the table presents statistics that describe the range in the minimum water elevation in the month of January, for 1979 and 2018, inclusive; specifically (from left to right), between 1979-2018 the lowest water elevation recorded (1241 feet), the median of the minimum water elevation in January (1278 feet), the average of the minimum (1274 feet) and the highest minimum water elevation in January (1286 feet). The range in the minimum water elevation between 1979-2018 was greater in April and May than it was in July-September.

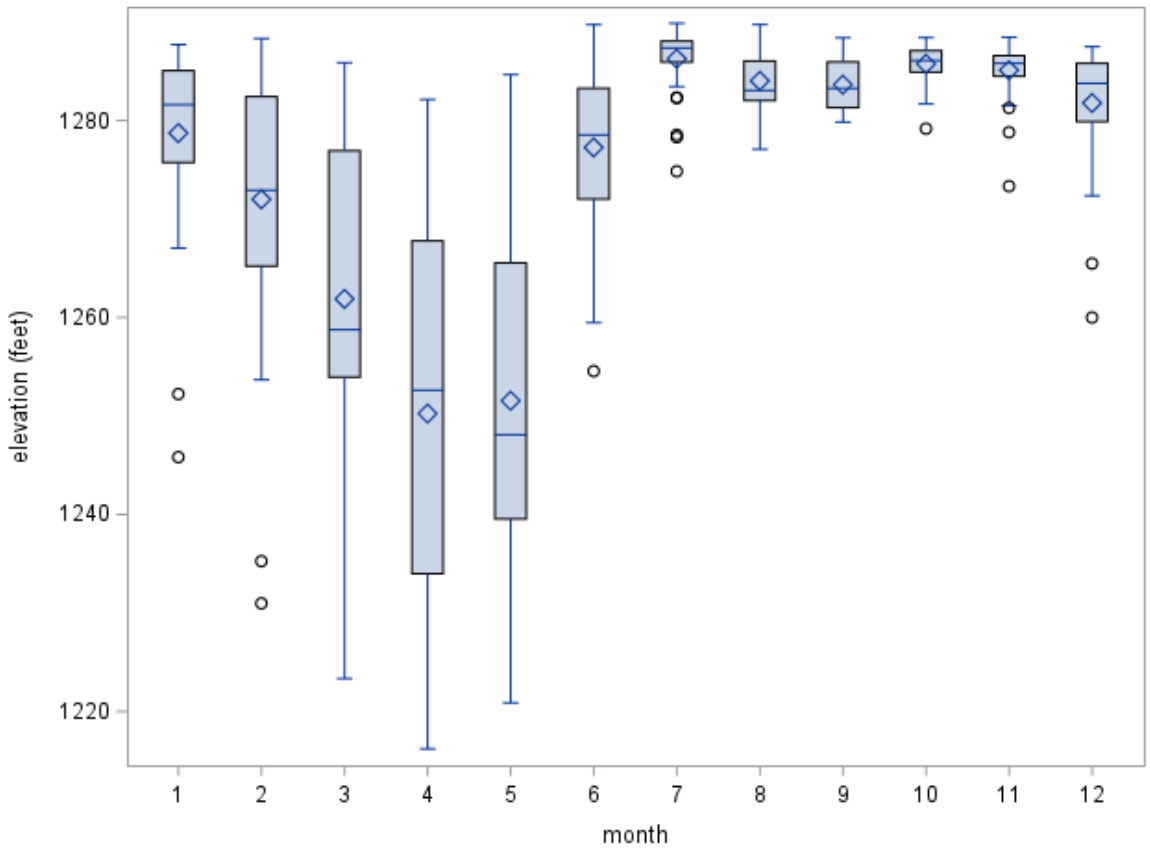


Figure C-2. Mean of Monthly Elevation of Lake Roosevelt, 1979-2018. The variation in the monthly average water elevations for Lake Roosevelt for 1979-2018. The box plots show the following for each month of the year: the ends of the box correspond to the 25th and 75th percentile (the interquartile range, IQR); the line and diamond within the box show the location of the median and mean, respectively; the box plot whiskers correspond to the 25th percentile minus 1.5 times the IQR (lower whisker) and the 75th percentile plus 1.5 times the IQR (upper whisker); and the circles show average monthly water elevations that exceed the box plot whiskers. The box plots show the greater range in the mean water elevation in March-May for 1979-2018.