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SUSITNA-WATANA HYDRO

September 30, 2014

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: Susitna-Watana Hydroelectric Project, Project No. 14241-000

Third Set of 2014 Technical Memoranda for Initial Study Plan Meetings

Dear Secretary Bose:

As the Alaska Energy Authority (AEA) explained in its September 17, 2014 filing with the Federal Energy Regulatory Commission (Commission or FERC) for the proposed Susitna-Watana Hydroelectric Project, FERC Project No. 14241 (Project), the June 3, 2014 Initial Study Report (ISR) provided for AEA to prepare certain technical memoranda and other information based on 2014 work. In accordance with Commission Staff direction, on September 17 and September 26, AEA filed and distributed the first and second sets of technical memoranda and other information generated during the 2014 study season.

With this letter, AEA is filing and distributing the third set of technical memoranda generated during the 2014 study season, as described below.

This third set of technical memoranda includes:

- Attachment A: *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*. This technical memorandum evaluates water quality data collected during 2013 and 2014 for adequacy in representation of current riverine conditions. This Technical Memorandum further includes an assessment of whether to extend the Water Quality Modeling Study's riverine model below PRM 29.9.

- Attachment B: *Mercury Assessment and Potential for Bioaccumulation Study (Study 5.7), Evaluation of Continued Mercury Monitoring Beyond 2014 Technical Memorandum*. This technical memorandum evaluates the need for continued monitoring of mercury data beyond 2014 and whether the existing data collection efforts are sufficient to satisfy objectives for characterizing baseline mercury conditions in the Susitna River and tributaries (Revised Study Plan (RSP) Section 5.7.1).

- Attachment C: *Groundwater Study (Study 7.5), Preliminary Groundwater and Surface-Water Relationships in Lateral Aquatic Habitats within Focus Areas FA-128 (Slough 8A) and FA-138 (Gold Creek) in the Middle Susitna River Technical Memorandum.* This technical memorandum provides an overview of the types of data and information that are being collected to support the Task 6 activities of the Groundwater Study, and describes the methods and techniques that are being applied in analyzing the data leading to development of response functions to be used for evaluating Project operational effects. The TM centers on the analysis for FA-128 (Slough 8A) and to a lesser extent FA-138 (Gold Creek) and represents an expansion of the presentation materials provided during the Proof of Concept meetings held on April 15-17, 2014.

- Attachment D: *Groundwater Study (Study 7.5), Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling Technical Memorandum*. This technical memorandum provides an overview of the types of data and information that are being collected to support the Task 5 activities within the Groundwater Study, and describes the methods and techniques that are being applied in analyzing the data leading to development of response functions for evaluating Project operational effects. The TM provides analysis objectives for FA-115 (Slough 6A) as a primary example of upland versus riverine dominated groundwater conditions. Additional examples are shown for FA-128 (Slough 8A) and FA-138 (Gold Creek).

- Attachment E: *Salmon Escapement Study (Study 9.7), 2014 Implementation and Preliminary Results Technical Memorandum*. This technical memorandum describes 2014 implementation (including methods and variances) of and preliminary results from the Salmon Escapement Study.

- Attachment F: *Cook Inlet Beluga Whale Study Plan (Study 9.17), 2015 Implementation Plan Technical Memorandum.* This implementation plan describes the methods for study activities proposed for 2015 that would implement the Cook Inlet Beluga Whale Study (instead of those described in RSP Section 9.17.1).

AEA appreciates the opportunity to provide this additional information to the Commission and licensing participants, which it believes will be helpful in determining the appropriate development of the 2015 study plan as set forth in the ISR. If you have questions concerning this submission please contact me at wdyok@aidea.org or (907) 771-3955.

Sincerely,

Wayne Dyok
Project Manager
Alaska Energy Authority

Attachments

cc: Distribution List (w/o Attachments)

Attachment E

Salmon Escapement Study (Study 9.7), 2014 Implementation and Preliminary Results Technical Memorandum

Susitna-Watana Hydroelectric Project (FERC No. 14241)

Salmon Escapement Study (Study 9.7)

2014 Implementation and Preliminary Results Technical Memorandum

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

LGL Alaska Research Associates, Inc.

September 2014

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Abbreviation	Definition
ADCP	Acoustic Doppler Current Profiler
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
ARIS	Adaptive Resolution Imaging Sonar
AUC	area under the curve
cfs	cubic feet per second
cm	Centimeter
CPUE	catch per unit effort
DIDSON	Dual Frequency Identification Sonar
FERC	Federal Energy Regulatory Commission
FOV	field-of-view
ft	Feet
GPS	global positioning system
ILP	Integrated Licensing Process
in	Inch
ISR	Initial Study Report
km	Kilometer
LZ	landing zone
m	Meter
mi	Mile
METF	mid-eye to fork
MHW	mean high water
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project
RPM	revolutions per minute
RSP	Revised Study Plan
SPD	study plan determination
TL	total length
USGS	United States Geological Survey

1. INTRODUCTION

This Technical Memorandum was prepared by AEA to describe part of the methods, variances, and preliminary results of the 2014 Salmon Escapement Study. The methods and variances described herein are focused on activities conducted in the Middle and Upper rivers, and preliminary results are focused on Chinook salmon. It is important to note that 2014 field activities were still underway at the time this document was prepared. As such, results presented here are subject to change as additional field data is collected and existing data is more thoroughly reviewed. The preliminary results presented in this Technical Memorandum will be updated and presented as a component of a larger Escapement Study Report once all of the third year of data has been collected, data QAQC and analysis has been completed.

At the time this document was prepared, the QC level of data review for various study components included:

- Middle River fishwheels and tagging – QC3 level review completed for data collected through August 11, QC2 level review for data collected from August 11 to September 7; operations are scheduled to continue through September.
- Curry sonar (at Site 1) – QC3 level review completed for all data collected through June 25; and QC2 level review for data collected in August and September.
- Fixed- and mobile-tracking telemetry data – QC2 level review for all data collected through August 31; telemetry operations are scheduled to continue into October.
- Indian River weir and video – QC3 level review for all data; operation ended June 26.
- Watana sonar – QC3 level review of sonar imagery through August 14 on the river right unit and August 22 on the river left unit, QC2 level review completed for all data; operations ended August 22.
- Turbid water sonar – QC3 level review for all data; operations ended July 25.

2. STUDY OBJECTIVES

The study objectives were established in RSP Section 9.7.1.2 and they remain unchanged and are indicated below in the Section 4 Methods.

3. STUDY AREA

As established by RSP Section 9.7.3, the study area encompasses the Susitna River from Cook Inlet upstream to the Oshetna River, or as far upstream as Chinook salmon are detected (Figure 3-1), with an emphasis on wherever salmon spawn in mainstem habitats of the Susitna River. The mainstem Susitna River was divided into three segments: the Lower River (Project River Mile [PRM] 33–102.4), Middle River (PRM 102.4–187.1), and Upper River (PRM 187.1–261.3). RSP section 9.7.3 used Historical River Miles (RM) which are: Lower River (RM 30–98), Middle River (RM 98–184), and Upper River (RM 184–260). Devils Canyon extends from approximately PRM 153.4 to PRM 166.1 (RM 150 to 163, respectively). Within Devils Canyon, the channel constricts and increases in vertical gradient to form three potential fish passage

impediments (referred to as Impediments 1, 2, and 3) that may block or delay fish passage (see Section 3.2 in AEA [2013] for more detail on the impediments).

4. METHODS

Descriptions of the study methods are organized below by objective. This is a multi-year study initiated in 2012 (AEA 2012, 2013, 2014). The methods below refer to research conducted in 2014.

4.1. Objective 1: Capture, radio-tag, and track adults of five species of Pacific salmon in the Middle and Upper Susitna River in proportion to their abundance. Capture and tag Chinook, coho, and pink salmon in the Lower Susitna and Yentna rivers.

In 2014, AEA implemented the methods with respect to Objective 1 as described in the Study Plan with the exception of variances explained below (Section 4.1.2). Tasks to address Objective 1 were listed in RSP Section 9.7.4.1.

4.1.1. Fish Capture

In the Middle River, three fishwheels and gillnets were used to capture adult Chinook salmon for tagging in 2014. Two of the fishwheels were operated at the same two locations used in 1981–1985, 2012, and 2013 (sites 1 and 2), and a third fishwheel was operated at a site that was first used in 2013 (site 3; Figures 3-1).

From June 6 to September 7, the Site 1 fishwheel operated for 1,371 hours (61.3 percent of the time it was in place) on the west bank of the Susitna River (PRM 124.1; Figure 4.1-1). Excluding the days it did not operate, daily fishing effort at Site 1 averaged 14.9 hours (range: 8.3–24 hours). The targeted amount of daily fishing effort at Site 1 varied by period: 13 hours from June 6–11, 15–17 hours from June 12–28, 24 hours from June 29 to July 28, 12 hours from July 29 to August 28, and 10 hours from August 29 to September 7. The Site 1 fishwheel did not operate during high water and heavy debris loads on June 26, June 27, and part of June 28 (Figure 4.1-2).

From June 12 to September 7, the Site 2 fishwheel operated for 1,270 hours (60.6 percent of the time it was in place) on the east bank of the river (PRM 123.0; Figure 4.1-1). Daily fishing effort averaged 14.8 hours (range: 8.8–24.0 hours). Targeted daily fishing effort varied at Site 2: 15–17 hours from June 12–29, 24 hours from June 30 to July 18, 12 hours from July 19 to August 29, and 10 hours from August 30 to September 7. The Site 2 fishwheel did not operate during high water and heavy debris loads on June 26, June 27, and part of June 28).

From June 9 to September 7, the Site 3 fishwheel operated for 1,302 hours (60.2 percent of the time it was in place) on the west bank of the Susitna River at PRM 126.0 (Figure 4.1-1). Daily fishing effort averaged 14.8 hours (range: 4.8–24.0 hours). Targeted daily fishing effort varied at Site 3: 15–17 hours from June 9–29, 24 hours from June 30 to July 18, 12 hours from July 19 to

August 29, and 10 hours from August 30 to September 7. The Site 3 fishwheel was not operational during high water from June 26–28.

During daylight operations, crews were never away from the fishwheels for more than one hour. From late June to mid-July, the fishwheels were left unattended overnight (~11:30 P.M. thru 9:00 A.M. the following morning).

On June 25, four sets were made using gillnets (60 ft long, 10 ft deep, 3.5 in. mesh [stretch]) in the vicinity of Curry. Total fishing time was 109 minutes (6–49 min. per set).

4.1.2. Variances

4.1.2.1. Fish Capture

As per Section 7.1.2.1.2 of the ISR, land access limitations prohibited operation of a fishwheel at Devils Canyon in 2013 (as proposed in the RSP). In response, AEA increased the tagging goal from 400 to 560 large Chinook salmon at Curry (ISR Section 4.1.4) to offset the loss of applying tags at Devils Canyon. In 2013, AEA demonstrated that it was feasible to capture and tag over 600 Chinook salmon with two Middle River fishwheels, and outlined a rationale for not tagging at Devils Canyon. It was decided that three Middle River fishwheels operating in 2014 would be sufficient to increase the sample size of radio-tagged Chinook salmon and provide sufficient opportunity to observe them ascend Devils Canyon. Specifically, AEA increased the tag goal from 400 (Curry plus Devils Canyon) to 650 fish at Curry (550 large and 100 small). AEA also increased fishing effort at the fishwheels (ISR Section 4.1.8.1). The Site 3 fishwheel operated over the entire Chinook salmon run past Curry in 2014. These changes in activities are a variance from the 2013 RSP, but are consistent with modifications stated in the ISR for 2014 study implementation.

4.1.2.2. Assessing Any Stock- and Size-selective Capture

RSP Section 9.7.4.1.5 indicated that Chinook, sockeye, and chum salmon would be examined on selected spawning grounds to test whether fish were equally vulnerable to being captured and radio-tagged. However, results from spawning ground surveys in 2012 indicated that it was going to be difficult to achieve useful sample sizes from surveying spawning grounds on foot and from the water. Therefore, AEA determined that a floating picket weir and underwater video system on the lower Indian River would be a more effective means of examining a large number of fish in 2013. Results from the 2013 field season showed that operating a video weir in the lower Indian River was a highly effective method. The same two metrics (i.e., mark rate and size distribution of tagged/untagged fish) would be developed from fish counts at the weir that would have been developed from spawning ground surveys.

Unfortunately, the video weir installed in June 2014 was washed out during a higher water event and could not be salvaged prior to Chinook salmon passing the site (see Section 5.1.3.1 for more detail). In response, AEA increased the frequency of aerial spawner surveys and aerial telemetry surveys in Indian River, in the event that these additional data could be used in lieu of video weir data to develop mark rates (see Section 4.6.1 for more detail). Fish size distributions could not be developed using these methods.

4.2. Objective 2: Determine the migration behavior and spawning locations of radio-tagged fish in the Lower, Middle, and Upper Susitna River

AEA implemented the methods with respect to Objective 2 as described in the Study Plan with the exception of modifications described in Section 7 of the ISR. Tasks to address Objective 2 were listed in RSP Section 9.7.4.2.

4.3. Objective 3: Characterize adult salmon migration behavior and timing within and above Devils Canyon

AEA implemented the methods with respect to Objective 3 as described in the Study Plan with no variances. Tasks to address Objective 3 were listed in RSP Section 9.7.4.3.

4.3.1. Fixed-station Monitoring

A combination of aerial telemetry surveys and fixed stations below, within, and above Devils Canyon was used to determine the migration timing and behavior of radio-tagged salmon that passed into the Upper River (Figure 3-1). Fixed stations were deployed at locations where they had the highest probability of detecting radio-tagged salmon. The fixed stations deployed at the confluences with Kosina Creek and Oshetna River provided additional information that was used to assess the detection efficiencies for all mainstem fixed stations downstream from these sites. The data from these fixed stations was also used to guide the aerial and ground-based survey efforts needed to identify spawning areas in the Upper River.

4.3.2. Aerial Telemetry Surveys

Aerial telemetry surveys provided location data for radio-tagged fish in areas that were not directly monitored by fixed-station receivers (e.g., in the mainstem between receivers; within tributaries, etc.). These detections assisted with the successful tracking of fish movements within and above Devils Canyon, providing day-to-day locations, passage timing, and hold durations. The aerial telemetry data were critical for the identification of potential spawning behavior, and for detecting potential spawning locations. The goal of 300 m accuracy of geographic position when locating tagged fish, including spawning fish, (RSP Section 9.7.4.2.2) was achieved by the combined effect of airspeed, flight path, antenna direction, and receiver gain control. In addition, the aerial detections contributed to the estimation of detection efficiencies for each fixed station. The timing and proportion of all tagged salmon that passed Devils Canyon was calculated and compared to the remaining tagged population, and their final spawning locations were identified.

4.3.3. Aerial Spawner Surveys

Aerial visual-observation surveys to determine the distribution and relative abundance of adult salmon were conducted in Susitna River tributaries within and above Devils Canyon, upstream to and including the Oshetna River. A total of seven aerial spawner survey events were conducted at approximate weekly intervals from July 14 through August 19, 2014. The survey extent covered the same major tributaries and clear water areas of the Susitna River as during 2013.

From Cheechako Creek to the Oshetna River, a total of 18 streams were surveyed; 15 tributaries to the Susitna River and three secondary tributaries. Additionally, two lakes in the Tsisi Creek drainage were surveyed during August specifically to look for spawning sockeye salmon. All streams were surveyed from their confluence up to 3,000 feet in elevation, or to a predetermined barrier to anadromous fish passage, or to the stream's headwater origin, whichever came first.

4.3.4. Using Sonar to Enumerate Salmon at the Proposed Dam Site

The FERC SPD recommended that AEA evaluate the feasibility of putting in a weir or operating a sonar counting station at or near the dam site in the next year of study to count fish migrating through Devils Canyon (FERC 2013). Prior to the 2013 field season, operation of a weir near the dam site was determined to be not feasible due to the physical impossibility of any structure handling the normal levels and range of discharge for the mainstem Susitna River. In 2013, AEA assessed the feasibility of placing a sonar counting station at or near the dam site (see Appendix G in AEA [2014]). In 2014, AEA implemented the methods for achieving the objectives of sonar monitoring near the proposed Watana Dam site as described in the ISR.

An initial feasibility study was conducted in July of 2013 to assess the suitability of different locations in the vicinity of the Watana Dam Site for applying Adaptive Resolution Imaging Sonar (ARIS) methods to estimate adult Chinook salmon passage. To find the optimal location for sonar sampling along the selected reach, an ARIS 1200 unit was used on July 6, 2014 to map the bathymetry along multiple transects from the right and left banks. Bottom-profiling allows for determination of optimal sonar alignment and aiming angles, and determination of the presence of depressions or troughs in the field-of-view (FOV) that would allow for fish to move past the sonar undetected (Maxwell and Smith 2007; Faulkner and Maxwell 2009). A single sonar location was established on each side of the river just below the proposed Watana Dam Site.

In 2014, data collection started at the left bank station at 4:51 P.M. on July 6 and at 12:12 P.M. on July 7 at the right bank station. Data were collected continuously in consecutive 10-minute files until the study period ended on August 22 (with the exception of the period 10:40 A.M. on July 30 through 1:45 P.M. on August 7 when the left bank station was shut down temporarily until an extension for CIRWG land access at this site could be obtained).

The maximum sample ranges used for analysis were based on the extent to which substrate was visible in the FOVs. The gradually sloping bottom along the left bank allowed for substrate to be evident out to 37 m (121.4 ft) in range, whereas the bottom dropped off at 16 m (52.4 ft) in range along the right bank. Seeing substrate throughout the FOV ensures that no depressions or troughs exist that would allow for fish to move past the ensonified area undetected. An aerial photograph of the sampling locations with depictions of the ensonified areas in plan-view is shown in Figure 4.3-1.

To support further assessment of the fish migration corridor, seven serial ADCP transects at approximately 80-foot intervals were conducted. To supplement the velocity transects, bathymetric data was collected using an Odom CV-100 echosounder and a TopCon GPS receiver. Information forthcoming from that data collection includes velocity profiles and bathymetric maps of the river channel in proximity to the sonar arrays.

Any fish targets measuring 50 cm or greater in estimated total length (TL) were classified as large Chinook salmon. For each Chinook salmon detected, the following parameters were recorded: estimated total length, range at first and last detection, and direction of travel. Any fish targets measuring less than 50 cm TL were not classified by species, and only their estimated total length was recorded. The accuracy of length measures from the sonar data is approximately ± 10 percent based on known targets. Level-three quality control on the data review process was conducted by a senior scientist with sonar expertise.

4.4. Objective 4: Use available technology to document salmon spawning locations in turbid water

AEA implemented the methods with respect to Objective 4 as described in the Study Plan with no variances.

4.5. Objective 5: Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon

AEA implemented the methods with respect to Objective 5 as described in the Study Plan with no variances.

4.6. Objective 6: Generate counts of adult Chinook salmon spawning in the Susitna River and its tributaries

AEA implemented the methods with respect to Objective 6 as described in the Study Plan with the exception of variances explained below (Section 4.6.1). This objective was addressed by attempting to operate a weir on the Indian River and conducting aerial spawner surveys in the Indian River (see Section 4.3.3) in 2014. The purpose of this work was to establish survey-area mark rates (proportion of fish tagged in different areas) that would support inferences about the representativeness of tagging across spawning stocks. In addition, mark rates from these areas could be used to estimate the abundance of salmon passing the tagging sites.

For the aerial spawner surveys conducted in the Indian River, Chinook salmon counts were stratified into three river sections. Section 1 included the clear water plume at the Indian River mouth up to Bridge 1 in the lower river; Section 2 extended from Bridge 1 to the power line crossing; and Section 3 extended from the power line crossing to the Forks. These aerial spawner surveys did not provide a direct estimate of the total Chinook salmon abundance. Instead, they provided a minimum count, and then helped to establish minimum and likely tributary-specific mark rates, as was done for Portage Creek (2012) and the Indian River (2012 and 2013).

Concurrent aerial telemetry surveys were conducted in the Indian River in July and August 2014 to determine the number of live radio-tagged Chinook salmon present. Protocols developed based on 2012 and 2013 experiences were implemented in 2014 to survey the Indian River. Multiple aerial telemetry surveys were flown bracketing the entire spawning period of Chinook

salmon. Survey aircraft were equipped with telemetry receivers and GPS to identify positions of radio-tagged fish.

4.6.1. Variances

Results from the 2012 escapement study indicated that it would be unlikely to obtain sufficient numbers of fish samples through spawning ground surveys to provide a robust mark rate, and in-turn, an estimate of the numbers of fish above Devils Canyon (as established during the FERC Study Dispute process). Therefore, a decision was made to replace spawning ground surveys with operation of a weir and an underwater video system on the Indian River to enumerate tagged and untagged fish, and establish mark rates. The methods and approach of using weirs to obtain this information is consistent with RSP Sections 9.7.4.1.5 and 9.7.4.6. However, as described in Section 4.1.2.2 and Section 5.1.3.1, the Indian River weir was washed out during a high water event prior to the onset of the Chinook salmon run in 2014.

As a result, at the end of June 2014, AEA considered alternative methods for estimating the mark rate of Chinook salmon in the Indian River to ensure the study objective was met. One option AEA considered was to install a sonar unit at or near the weir site to count passing fish. However, the advantages of being able to install a sonar unit soon after the weir was blown out were outweighed by the fact that multiple salmon species would be present in the river by mid-July, and thus Chinook salmon could not be reliably counted (since sonar cannot distinguish between species). AEA considered conducting a gillnet operation below the Indian River weir site to capture and sample Chinook salmon. Although physically handling fish is a reliable method of collecting mark-rate and length data, physical conditions in the lower river were not suitable for gillnetting, so it was unlikely crews could capture a sufficient number of fish. Also, there may be negative impacts on fish health due to the capture and handling process. AEA also considered stream walks to count Chinook salmon, but their experiences in 2012 proved this method was unlikely to succeed.

Since Chinook salmon were already staging at the mouth of the Indian River, AEA decided that the best available option was to increase the frequency (every 3rd day during the spawning period) of aerial spawner surveys and aerial telemetry surveys in the event that these additional data could be used in lieu of video weir data to develop mark rates. In theory, fish counts from aerial spawner surveys and area-under-the-curve (AUC) methods (Ames and Phinney 1977; English et al. 1992) could be used to generate an escapement estimate for Chinook salmon returning to the Indian River in 2014. The marked fraction of Chinook salmon present in the Indian River, as well as estimates of residence time (i.e., the length of time Chinook salmon are present in the river) could be estimated from detections of radio-tagged fish that were released at the Middle River fishwheels.

4.7. Objective 7: Collect tissue samples to support the Fish Genetics Study

AEA implemented the methods with respect to Objective 7 as described in the Study Plan with no variances.

5. RESULTS

5.1. Objective 1: Capture, radio-tag, and track adults of five species of Pacific Salmon in the Middle and Upper Susitna River in proportion to their abundance. Capture and tag Chinook, coho, and pink salmon in the Lower Susitna and Yentna rivers.

5.1.1. Fish Capture

From May 22 to August 26, 2014, a total of 2,048 large Chinook salmon were captured in the Lower River, of which 1,880 were captured in fishwheels and 168 were captured in gillnets. From May 22 to June 25, a total of 2,990 large Chinook salmon were captured in the Yentna River (at the tag deployment site), of which 2,594 were captured in fishwheels and 396 were captured in gillnets.

A total of 877 adult Chinook salmon (672 large, 205 small), including recaptures, were captured at the Middle River fishwheels in 2014 (Table 5.1-1). The largest proportion of Chinook salmon were captured at Site 3 (48 percent), followed by Site 1 (41 percent) and Site 2 (11 percent). All fishwheels combined, peak catch of large Chinook salmon occurred on July 1 (58 fish), whereas catches of small Chinook salmon peaked on June 21 and July 6 (17 fish). CPUE for large Chinook salmon was highest at Site 1 (1.6 fish/hour on June 30), followed by Site 3 (1.1 fish/hour on July 1) and then Site 2 (0.5 fish/hour on July 5). Large Chinook salmon captured in the Middle River averaged 72 cm METF (28.2 in) and small Chinook salmon averaged 36 cm METF (14.2 in.). Cumulative length-frequency distributions for Chinook salmon captured in the Middle River fishwheels, by capture site, are shown in Figure 5.1-1.

One small Chinook salmon (35 cm METF) was captured on June 24 while set gillnetting along river left approximately 1 mile downstream of Site 2 (lat/long: 62.58747, -150.03842).

5.1.2. Radio-tagging

In the Lower River, 651 large Chinook salmon (527 caught in fishwheels, 124 caught in gillnets) were radio-tagged in 2014. In the Yentna River, 294 large Chinook salmon were radio-tagged (190 caught in fishwheels, 104 caught in gillnets).

A total of 623 Chinook salmon (590 large, 33 small) were radio-tagged at the Middle River fishwheels in 2014 (Table 5.1-2). The daily number of radio tags applied peaked at 51 for large Chinook salmon (July 1) and three for small Chinook salmon (June 30 and July 1, 2, and 5; Table 5.1-2). Radio tags were deployed in proportion to catch for large Chinook salmon since all healthy fish captured were tagged. In contrast, only 16 percent (33 of 205) of small Chinook salmon captured received a radio tag due to difficulties inserting the tags into smaller-sized fish. Cumulative length-frequency distributions for Chinook salmon captured and radio-tagged at the Middle River fishwheels, by size category, are shown in Figure 5.1-2.

5.1.3. Numbers and Size of Marked and Unmarked Fish at Selected Locations

5.1.3.1. Indian River Weir

The underwater video system at the Indian River weir was operated 24 hours a day, and collected 89 hours of video footage from 1:30 P.M. on June 22 to 6:29 A.M. on June 26, 2014. Due to poor visibility, 5.2 hours of video imagery collected on June 26 was not reviewed. Persistent rain on June 25 and June 26 contributed to high-water conditions in the Susitna (Figure 4.1-2) and Indian rivers. At approximately 6:29 A.M. on June 26, due to high flows and debris loading, the anchoring system failed and the majority of the weir components were flushed approximately one mile down river. A portion of the weir components were retrieved from July 4–8, and the remainder were retrieved on August 15 when water levels were considerably lower.

In total, three rainbow trout and two round whitefish, but no salmon, were observed on the video footage.

5.2. Objective 2: Determine the migration behavior and spawning locations of radio-tagged fish in the Lower, Middle, and Upper Susitna River

5.2.1. Stock Classifications and Spawning Locations – Lower River

Of the 656 large Chinook salmon tagged in the Lower River, 581 (89 percent) were classified by destination. Of these, 574 (99 percent) went to tributaries (mainly the Yentna, Deshka, Talkeetna, or Chulitna rivers), and 7 (1 percent) went to destinations in the mainstem Susitna River (Table 5.2-1; Figures 5.2-1 and 5.2-2). The remaining 75 Chinook salmon exhibited movements that prevented conclusive assignment to the mainstem or tributaries (see "Other Classifications" in Table 5.2-1).

5.2.2. Stock Classifications and Spawning Locations – Yentna River

Chinook salmon radio-tagged in the Yentna River were expected to stay within this major tributary, and significant movement to other Susitna River tributaries was not expected (relative to Chinook salmon tagged in the Lower River). Two hundred nineteen of the 295 Chinook salmon released in the Yentna River (74 percent) were classified with a Yentna destination, and 8 (3 percent) were classified in other Susitna River tributaries (Little Willow and Willow creeks, or Deshka or Chulitna rivers; Table 5.2-1). The remaining 68 salmon exhibited movements that prevented conclusive assignment to a specific destination.

5.2.3. Stock Classifications and Spawning Locations – Middle and Upper River

Of the 590 large Chinook salmon radio-tagged in the Middle River, 473 (80 percent) were classified by spawning destination (Table 5.2-1). Of those classified by spawning destination, 437 (92 percent) went to tributaries (mainly Portage Creek or Indian River) and 36 (8 percent) went to destinations in the mainstem Susitna River below Devils Canyon (Table 5.2-1; Figures 5.2-1 and 5.2-3). Destinations of the remaining 117 large Chinook salmon could not be

classified, due to movements that prevented conclusive assignment to the mainstem or tributaries (Table 5.2-1).

In addition to the large Chinook described above, 33 small Chinook salmon were radio-tagged and released in the Middle River. In all, 25 (76 percent) were classified by destination (Table 5.2-1). Of these, 21 (84 percent) went to tributaries (mainly Indian River or Portage Creek) and 4 (16 percent) went to destinations in the mainstem Susitna River (Table 5.2-1; Figure 5.2-1). Destinations of the remaining 8 small Chinook salmon could not be classified (Table 5.2-1).

Chinook salmon were tracked to 18 potential mainstem spawning sites in the Middle River between PRM 111.03 and PRM 155.9 (Figure 5.2-3).

5.3. Objective 3: Characterize adult salmon migration behavior and timing within and above Devils Canyon

5.3.1. Species, Number, and Destination

Of the 590 radio-tagged large Chinook salmon released at the Middle River fishwheels, 491 were detected above Gateway Station (PRM 130.1) after tagging. Of these 491 fish, 11 (2.2 percent) were tracked above Impediment 1, 8 (1.6 percent) above Impediment 2, and 2 (0.4 percent) above Impediment 3. Two of the Chinook salmon radio-tagged and released at the Lower River fishwheels were tracked above Impediment 1, one of which subsequently passed Impediment 2 (Table 5.3-1). Of the 33 radio-tagged small Chinook salmon released at the Middle River fishwheels, 25 were detected above Gateway Station after tagging. Of these 25 fish, none passed Impediment 1.

The likely spawning areas for each of the total 13 Chinook salmon tracked above Impediment 1 are provided in Table 5.3-2. Three (43 percent) of the seven Chinook salmon that passed Impediment 2 (but not Impediment 3), dropped back to destinations downstream of Impediment 2. One (25 percent) of the four Chinook salmon that passed Impediment 1 (but not Impediment 2) likely spawned in an area downstream of Impediment 1. One of the two Chinook salmon that passed Impediment 3 died below Impediment 3 and the other moved into Kosina Creek (Figures 5.3-1 and 5.3-2). Overall, 31 percent of the Chinook salmon that passed at least one of the three impediments dropped back to destinations downstream of the last impediment they passed – two of these went to Portage Creek, one in Cheechako Creek, and one in the mainstem near the mouth of Cheechako Creek.

Two Chinook salmon passed Impediment 3, each showing markedly different behaviors (Figures 5.3-1 and 5.3-2). One Chinook salmon just barely passed Impediment 3, subsequently returned downstream of it, and eventually died in the mainstem downstream of Impediment 1 (Figure 5.3-1). The other Chinook salmon travelled directly into Kosina Creek, spent 6 days therein, then took 5 days to swim to and return from Oshetna River (40 km [25 mi] each way), before returning to Kosina Creek (Figure 5.3-2). This latter fish stayed in Kosina Creek for another 6 days, and then drifted out, settling just downstream of the mouth of Fog Creek.

5.3.2. Migration Timing for Fish Passing Above Devils Canyon

The first successful fish passage past Impediment 1 occurred on June 30 when flow at the Tsusena Creek gage was 19,400 cubic feet per second (cfs; 26,000 cfs at the Gold Creek gage; Figure 5.3-3). Other fish passed on July 1 and on July 6, during flows of 23,200 cfs or greater at the Tsusena Creek gage (27,900 cfs or greater at the Gold Creek gage). No other fish passed until the period from July 18–August 1, when Tsusena Creek gage flows ranged between 15,500 and 23,400 cfs (18,800–27,100 cfs at the Gold Creek gage). There was a period with no fish passage from July 7 to 17, in which flows ranged from 19,900 to 35,300 cfs at the Tsusena Creek gage (24,200–36,500 at the Gold Creek gage; Table 5.3-3; Figure 5.3-3). Both Chinook salmon that passed Impediment 3 had passed Impediment 1 on the same day (July 20; Table 5.3-3).

Fish showed noticeable milling or holding behavior below Impediment 1 and Impediment 3. Fish that moved past Impediment 1 held below it for an average of 3.9 days, similar in duration to individuals that did not pass (average 4.5 days; Table 5.3-3). Four fish that passed Impediment 1 did not attempt to pass Impediment 2, rather they moved into Cheechako Creek, back-tracked to Portage Creek, or dropped downstream and died. All of the fish that approached Impediment 2 passed it quickly (≤ 1 day; Table 5.3-3). Three fish that passed Impediment 2 did not attempt to pass Impediment 3, rather, they explored the area around Chinook Creek, and eventually dropped back downstream. For the six fish that approached Impediment 3, the hold times were shorter and approach dates were later for the fish that passed, compared to those that did not pass. The two fish that passed Impediment 3 held below it for an average of 6.8 days, whereas those that did not pass, held for an average of 11.3 days before moving downstream. The two fish that passed approached on or after July 30, where approach dates of the non-passing fish ranged from July 2 to 28. Discharge when the two fish passed Impediment 3 ranged from 15,500 cfs (July 30) to 16,200 cfs (August 4) at the Tsusena Creek gage (19,200–19,400 cfs at the Gold Creek gage).

5.3.3. Relative Abundance of Salmon Passing Above Devils Canyon

Chinook salmon was the only species with radio-tagged fish detected upstream of Devils Canyon. Of the 491 Chinook salmon tagged at the Middle River fishwheels and detected moving above Gateway Station, two passed Impediment 3 (0.4 percent), and only one (0.2 percent) successfully migrated beyond Devils Canyon (Table 5.3-1). No Chinook salmon radio-tagged in the Lower River were detected upstream of Devils Canyon. Given the positions of the fixed-station receivers and the extensive mobile survey effort, it is unlikely that any radio-tagged fish passed upstream of Devils Canyon undetected.

5.3.4. Size of Chinook Salmon Tracked In and Above Devils Canyon

Of the 38 radio-tagged large Chinook salmon that entered Devils Canyon (6 tagged in Lower River, 32 tagged in Middle River), the mean body length of fish that approached but did not pass Impediment 1 (79.7 cm [31.4 in]) was not significantly different from that of fish that passed Impediment 1 (77.3 cm [30.4 in]; Table 5.3-1; $t_{36} = 0.28$, $P = 0.60$). The mean length of fish that approached, but did not pass, Impediment 3 (79.0 cm [31.1 in], n = 4) was identical to that of fish that passed Impediment 3 (n = 2; Table 5.3-1). These observations are suggestive that length was not a factor in successful passage through Devils Canyon for Chinook salmon.

5.3.5. Aerial Spawner Surveys

Chinook salmon were the only salmon species observed from Cheechako Creek upstream to the Oshetna River. Adult Chinook salmon were observed in Middle River tributaries between Impediments 1 and 2 (Cheechako Creek [0–17 fish]), between Impediments 2 and 3 (Chinook Creek [0–5 fish]), and above Impediment 3 (Devil [0–10 fish] and Fog [0–3 fish] creeks). No adult salmon were observed during spawning surveys in the mainstem Susitna River or in any Upper River tributaries (e.g., Deadman, Watana, and Kosina creeks, and the Oshetna River; Table 5.3-4).

5.3.6. Using Sonar to Enumerate Salmon at the Proposed Dam Site

The FERC SPD (Feb 2013) requested a feasibility assessment in 2013 of putting in a weir or sonar station near dam site in 2014 to provide a count of fish. Results from 2013 field activities showed that it was likely feasible to count salmon-sized fish (50 cm TL or greater) and corroborate counts with radio-telemetry. In 2014, AEA used ARIS sonar to count the number of salmon-sized fish (50 cm TL or greater), as well as those measuring less than 50 cm TL, passing the proposed Watana Dam site from July 6 to August 22, and collected bathymetry and water-velocity profiles at the monitoring sites.

During sonar operations from July 6 to August 22, Susitna River flows at the Tsusena Creek gage ranged from 14,200 to 35,300 cfs (16,700–36,500 cfs at the Gold Creek gage). Discharge in the Upper Susitna River generally decreased during the sonar sampling period after a peak of 35,300 cfs at the Tsusena Creek gage on July 8 (36,500 cfs at the Gold Creek gage). Periodic increases in discharge occurred in mid to late July. Throughout August, discharge remained below 19,000 cfs at the Tsusena Creek gage (below 22,000 cfs at the Gold Creek gage). With the exception of the period from July 30 through August 7 when the left bank station was demobilized due to permit compliance, both stations operated continuously throughout the sample period.

After initial setup of the sonar systems, the left bank station insonified an estimated 41.5 percent of the wetted channel width and the right bank station insonified an estimated 16.1 percent of the wetted channel width. With respect to overall scope, the systems covered 57.6 percent of the wetted channel widths, leaving 42.4 percent of the thalweg section of the river uncovered with sonar. Cross-sectional coverage of the water column throughout the sampling ranges of the left and right bank sonar systems is forthcoming.

A total of 24 net upstream-migrating (26 upstream, 2 downstream) Chinook salmon (50 cm TL or greater) were counted at the sonar stations in 2014 (Table 5.3-5). Twenty-two of the 24 fish (92 percent) were observed with the right bank sonar station. All fish detections were within 4 m from the sonar units with most occurring at 3 m (9.8 ft) in range.

In addition, 213 fish measuring 40–49 cm TL, and 1,044 fish measuring less than 40 cm TL, were counted at the sonar stations (direction of movement for these fish was not recorded). These fish were not identified. For fish which were less than 50 cm TL, while a percentage of these fish could potentially be small Chinook salmon (as based on measurements at the Middle River fishwheels (minimum 27 cm MEF; see Figure 5.1-1)), the potential species as based on

sampling from Study 9.5, and in order of likelihood in the observed size range, include Arctic grayling, burbot, round whitefish, and longnose sucker.

5.4. Objective 4: Use available technology to document salmon spawning locations in turbid water

From July 19 to July 25, 2014, 37 potential Chinook salmon spawning sites were visited and 15 were surveyed using DIDSON (Table 5.4-1). Confirmation visits were made at three of the 37 sites where Chinook salmon were previously observed milling or holding in areas considered to contain substrate suitable for redd construction. Several potential spawning sites could not be accessed via boat and others sites had physical characteristics not suitable for sonar sampling (e.g., low water or entrained air). The presence of chum salmon at some locations made confirmation of Chinook salmon difficult.

Chinook salmon were confirmed at nine sites, including the three confirmation sites. Behavior indicative of Chinook salmon spawning was observed at one mainstem location, approximately 8 m (26 ft) downstream of the confluence of Jack Long Creek and the mainstem. At this site, Chinook salmon were observed holding over and guarding a redd, located outside of the tributary's clear water zone of influence. In addition to the redd observed near Jack Long Creek, a second redd was identified downstream of the confluence of 4th of July Creek and the mainstem.

Due to bathymetry and size of substrate, many redd locations could not be visualized in the sonar imagery. Similarly, redd digging behavior could not be captured, despite collecting several hours of imagery containing Chinook salmon in areas considered to provide suitable substrate. This often occurred, when a fish swam into a depression and could not be observed due large cobble or small boulders between the sonar and the target fish.

5.5. Objective 5: Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon

5.5.1. Run Timing

In 2014, Chinook salmon (all size groups) were captured at the Middle River fishwheels from June 11 to August 24 (Figure 5.5-1). The earliest a Chinook salmon has been captured at the Middle River fishwheels is June 9 (1984), and the latest is August 20 (1981). The midpoint of catches in 2014 occurred on July 2, which was earlier than midpoints in 1981, 1983, 1984, and 2013 (range: June 24–30), but later than those in 1982, 1985, and 2012 (range: July 3–9). Dates of peak catch were similar over the recent 3-year period (July 2 in 2012 and 2013, and July 1 in 2014).

5.5.2. Relative Abundance

In recent years, total catch of Chinook salmon (all size categories) was highest in 2013 (952), followed by 2014 (877), and then 2012 (566; Table A-1). High catches in 2012 were due largely to the abundance of small Chinook salmon (336), as more large Chinook salmon were captured

in 2014 (672) than in 2013 (616). The majority (61–83 percent) of large Chinook salmon were captured at Site 1 in 2012 and 2013, compared to only 41 percent in 2014. Operating a third fishwheel at Site 3 throughout the entire Chinook salmon run in 2014 improved overall catches as 48 percent of large Chinook salmon were caught at this site.

Over eight years of operation (1981-1985 and 2012-2014), the highest catches of adult Chinook salmon at the Middle River fishwheels occurred in 1984 (1,589) and lowest in 1981 (284). Catches in 2012, 2013, and 2014, ranked 7th, 4th, and 5th, respectively.

5.5.3. Spawning and Holding Salmon Locations

Potential spawning sites of Chinook salmon in the mainstem river were identified using radio telemetry (Sections 5.2.1 to 5.2.3), and confirmed with sonar (DIDSON) in the Middle River.

In 2014, radio-tagged Chinook salmon were tracked to four potential spawning sites in the Lower River, and 17 sites in the Middle River. The only confirmed spawning site for Chinook salmon was at the mouth of Jack Long Creek in the Middle River (Table 5.4-1). Similarly, tributary deltas were the only mainstem habitats confirmed for Chinook salmon spawning during the 1980s surveys (Barrett et al. 1985; Thompson et al. 1986).

5.6. Objective 6: Generate counts of adult Chinook salmon spawning in the Susitna River and its tributaries

From July 7 to August 19, 11 aerial spawner surveys were conducted in the Indian River (approximately every 3rd day; Table 6.4-1). Data collected for this task could support alternative methods to assess mark rates.

6. LITERATURE CITED

AEA. 2012. Revised Study Plan: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2012. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska. http://www.susitna-watanahydro.org/study-plan.

AEA. 2013. Adult Salmon Distribution and Habitat Utilization Study. Susitna-Watana Hydroelectric Project, FERC Project No. 14241. February 2013. Anchorage, Alaska. http://www.susitna-watanahydro.org/wp-content/uploads/2013/03/Attachment-A-AS.pdf

AEA. 2014. Initial Study Report, Salmon Escapement Study, Study Plan Section 9.7, Part A. Susitna-Watana Hydroelectric Project, FERC Project No. 14241. June 2014. Anchorage, Alaska. http://www.susitna-watanahydro.org/wp-content/uploads/2014/05/09.07_ESCAPE_ISR_PartA.pdf

Ames, J., and D. E. Phinney. 1977. 1977 Puget Sound summer-fall chinook methodology: escapement goals, run size forecasts, and in-season run size updates. Wash. Dep. Fish. Tech. Rep. No. 29: 71 p.

English, K.K., R.C. Bocking, and J.R. Irvine. 1992. A robust procedure for estimating salmon escapement based on the area-under-the-curve method. Can. J. Fish. Aqu. Sci. 49: 1982.

Faulkner, A. V. and S. L. Maxwell. 2009. An aiming protocol for fish-counting sonars using river bottom profiles from a Dual-frequency Identification Sonar (DIDSON). Alaska Department of Fish and Game, Fishery Manuscript No. 09-03, Anchorage, AK.

Federal Energy Regulatory Commission (FERC), Office of Energy Projects. 2013. Study Plan Determination for the Susitna-Watana Hydroelectric Project. Federal Energy Regulatory Commission, Washington, D.C. Issuance: 20130201-3041.

Maxwell, S. L. and A. V. Smith. 2007. Generating river bottom profiles with a Dual- frequency Identification Sonar (DIDSON). North American Journal of Fisheries Management 27:1294-1309.

7. TABLES

Table 5.1-1. Number of Chinook salmon captured at three fishwheel sites in the Middle River, by size category and year.

Species (Size)	Site	2012	2013	2014	All Years
Chinook Salmon	Site 1	256	514	273	1,043
(Large)	Site 2	166	89	79	334
	Site 3		13	320	333
	All Sites	422	616	672	1,710
Chinook Salmon	Site 1	83	262	85	430
(Small)	Site 2	61	64	18	143
	Site 3		10	102	112
	All Sites	144	336	205	685
Total		566	952	877	2,395

Notes:

Totals include all tagged fish recaptured at the fishwheels.

Large: 50 cm METF or greater; Small: less than 50 cm METF.

Site 3 was not used in 2012; and it was not used in 2013 until July 17.

Table 5.1-2. Number of Chinook salmon radio-tagged at three fishwheel sites in the Middle River, by size category and year.

Species (Size)	Site	2012	2013	2014	All Years
Chinook Salmon	Site 1	214	449	247	910
(Large)	Site 2	138	81	75	294
	Site 3	-	6	268	274
	All Sites	352	536	590	1,478
Chinook Salmon	Site 1	0	55	18	73
(Small)	Site 2	0	12	2	14
	Site 3	-	0	13	13
	All Sites	0	67	33	100
Total		352	603	623	1,578

Notes:

Large: MEF 50 cm or greater; Small: MEF less than 50 cm.

Site 3 was not used in 2012; and it was not used in 2013 until July 17.

Table 5.2-1. Classifications for radio-tagged Chinook salmon in 2014, by size category and release site.

	Chinook Salmon (≥ 50 cm)			Chinook Salmon (<50 cm)
Classification	Lower River	Middle River	Yentna	Middle River
Tributary Destinations (total)	574	437	227	21
Yentna	113	0	219	0
Deshka	136	0	4	0
Willow	30	0	2	0
Little Willow	22	0	1	0
Kashwitna	16	1		0
Goose	3	1		0
Sheep	6	0		0
Montana	16	5		0
Sunshine	1	0		0
Birch	2	1		0
Talkeetna	89	25		1
Chulitna	109	15	1	0
Whiskers	1	1		1
Lane	0	3		2
4th of July	0	8		0
Gold	0	6		0
Indian	17	182		9
Jack Long	0	3		0
Portage	12	183		8
Cheechako	1	2		0
Kosina	0	1		0
Mainstem Destinations (total)	7	36	0	4
Mainstem Proper	3	8		0
Downstream of Lane	*3*	*1*		*0*
no prior spawn location	*3*	*1*		*0*
Upstream of Lane	*0*	*7*		*0*
no prior spawn location	*0*	*6*		*0*
was in Portage Creek	*0*	*1*		*0*
Tributary Mouths	2	21		*3*
Talkeetna Mouth	*1*	*0*		*0*
Lane Mouth	*0*	*1*		*0*
no prior spawn location	*0*	*0*		*0*
was up Talkeetna River	*0*	*1*		*0*
5th of July Mouth	*0*	*3*		0
4th of July Mouth	*0*	*2*		*0*
no prior spawn location	*0*	*0*		*0*
was up Indian River	*0*	*1*		*0*
was up 4th of July Creek	*0*	*1*		*0*
Indian Mouth	*0*	*10*		*3*
no prior spawn location	*0*	*8*		*1*
was up Indian River	*0*	*2*		*2*

Table 5.2-1. Continued.

Classification	Chinook Salmon (≥ 50 cm)						Chinook Salmon (<50 cm)	
	Lower River		Middle River		Yentna		Middle River	
Gold Mouth	*0*		*1*				*0*	
Portage Mouth	*0*		*4*					*0*
no prior spawn location		*0*		*2*				*0*
was up Portage Creek		*0*		*2*			*0*	
Cheechako Mouth	*1*		*0*					*0*
no prior spawn location		*0*		*0*				*0*
was up Cheechako Creek		*1*		*0*			*0*	
Side Channels & Sloughs	2		7					*1*
Slough 8A	*0*		*0*					*0*
Slough 9	*0*		*0*				*0*	
Slough 11	*0*		*0*				*0*	
Slough 21	*0*		*0*					*0*
Other areas	*2*		*7*					*1*
no prior spawn location		*2*		*6*			*1*	
was up Indian River		*0*		*1*			0	
Other Classifications (total)	75		117		68		8	
Other Mainstem	31		59		4		3	
Max Zone downstream of Lane		*30*		*0*		*4*		*0*
Max Zone upstream of Lane		*1*		*59*		*0*		*3*
Downstream Only	16		40		46		4	
Near Release Site	13		17		9		1	
No or Single Detections	15		1		9		0	
Total Tags Released	656		590		295		33	

Notes:

Fish that were detected on several occasions within a limited area were classified with a 'Mainstem Destination' (either in side-channel/slough locations, in a tributary mouth, or in the mainstem proper). Some of the fish that showed the 'Mainstem Destination' detection pattern did so after entering a spawning tributary (those that had at least one live detection in the mainstem location and that spent less than 6 days in the tributary location are noted in the table – otherwise the mainstem detection was ignored and the fish was assigned to the tributary location). Tags that were recovered or returned were included in this table either under the 'Other Mainstem' classification (if the recovery date was outside of the range of probable spawning dates) or within the row that was associated with the recovery location (if recoveries were from within a tributary, or were in a possible mainstem spawning location).

Table 5.3-1. Details of the radio-tagged Chinook salmon that approached or passed the Middle River impediments, 2014.

Chinook Salmon (≥ 50 cm) that Passed Impediment 3

Tag Number	Species	Capture/ Release Site	Capture Date	METF Length (cm)	Sex	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Comments
537	CN	Curry, Site Three	4 Jul	80	Male	20 Jul	20 Jul	4 Aug	just above I3, then mort DS
787	CN	Curry, Site Two	11 Jul	78	Undetermined	20 Jul	20 Jul	30 Jul	Kosina (8/2-8/7), Oshetna (8/9), then Kosina (8/12-18), drfited to below Fog Ck.

Chinook Salmon (≥ 50 cm) that Passed Impediment 2 but not Impediment 3

Tag Number	Species	Capture/ Release Site	Capture Date	METF Length (cm)	Sex	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Comments
17	CN	Curry, Site One	14 Jun	70	Undetermined	30 Jun	30 Jun	-	Below I3, then Cheechako (7/10) then Portage (7/14-8/6) then mort DS
139	CN	Curry, Site One	21 Jun	61	Undetermined	24 Jul	28 Jul	-	Cheechako (7/25-26) then mort near Chinook Creek
222	CN	Curry, Site Two	24 Jun	75	Undetermined	6 Jul	18 Jul	-	Below I3, then mort DS
516	CN	Curry, Site One	4 Jul	87	Undetermined	1 Aug	1 Aug	-	Cheechako to Chinook mouths, then Cheechako (8/9) then out, mort at mouth
882	CN	Curry, Site Three	16 Jul	51	Undetermined	25 Jul	1 Aug	-	Chinook mouth then Cheechako (8/3-9) then mort DS
903	CN	Curry, Site Three	17 Jul	78	Undetermined	23 Jul	24 Jul	-	Below I3, mort between Chinook and I3
5531	CN	Lower River, gill net	12 Jun	93	Undetermined	18 Jul	18 Jul	-	Below I3, then in Cheechako (8/12) and at mouth (8/15 onwards)

Chinook Salmon (≥ 50 cm) that Passed Impediment 1 but not Impediment 2

Tag Number	Species	Capture/ Release Site	Capture Date	METF Length (cm)	Sex	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Comments
221	CN	Curry, Site One	24 Jun	92	Undetermined	20 Jul	-	-	Portage (7/10), just Above I1, then Below I1, drifted as mort DS
828	CN	Curry, Site Three	13 Jul	55	Undetermined	18 Jul	-	-	Cheechako Stn, then Portage
868	CN	Curry, Site Three	15 Jul	94	Male	23 Jul	-	-	Cheechako (7/31-8/1 and 8/6-8/12), mouth (to 8/18) then drifted DS to below Portage
5702	CN	Lower River, gill net	23 May	91	Undetermined	1 Jul	-	-	0.75 mi above Cheechako Stn, then in Cheechako

Table 5.3-1. Continued.

Chinook Salmon (≥ 50 cm) that Approached Impediment 1 but did not Pass

Tag Number	Species	Capture/ Release Site	Capture Date	METF Length (cm)	Sex	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Comments
23	CN	Curry, Site Two	14 Jun	63	Undetermined	-	-	-	Below I1, Portage (7/25-8/4), then mort DS
33	CN	Curry, Site Two	15 Jun	63	Undetermined	-	-	-	Below I1, then Talkeetna
40	CN	Curry, Site Two	16 Jun	68	Undetermined	-	-	-	Below I1, then Portage
91	CN	Curry, Site Three	19 Jun	92	Undetermined	-	-	-	Below I1, then Portage
103	CN	Curry, Site One	20 Jun	81	Undetermined	-	-	-	mort Below I1
108	CN	Curry, Site Two	20 Jun	99	Undetermined	-	-	-	Below I1, Portage (7/22-23) then DS
111	CN	Curry, Site Three	20 Jun	97	Undetermined	-	-	-	Portage (7/4-7/5), Below I1, Portage (7/19-onwards)
166	CN	Curry, Site One	22 Jun	63	Undetermined	-	-	-	Below I1, Portage (7/14), Portage mouth (7/22-8/4), mort DS
198	CN	Curry, Site One	23 Jun	78	Undetermined	-	-	-	Below I1, then Talkeetna
237	CN	Curry, Site One	25 Jun	93	Male	-	-	-	Below I1, Indian (7/22-8/6) then DS
239	CN	Curry, Site One	25 Jun	87	Female	-	-	-	Below I1, then Portage
244	CN	Curry, Site Two	25 Jun	84	Undetermined	-	-	-	Below I1, then Portage (mid-Aug onward, incl mort 8/20)
264	CN	Curry, Site One	28 Jun	78	Undetermined	-	-	-	Below I1, then Gold Creek
300	CN	Curry, Site One	29 Jun	66	Undetermined	-	-	-	Portage mouth , Below I1, then up Portage
359	CN	Curry, Site Three	30 Jun	59	Undetermined	-	-	-	Below I1, then mort DS
562	CN	Curry, Site One	5 Jul	79	Undetermined	-	-	-	Below I1, then Portage
611	CN	Curry, Site Three	5 Jul	91	Undetermined	-	-	-	Below I1, then Portage
621	CN	Curry, Site One	6 Jul	87	Undetermined	-	-	-	Below I1, then Portage
668	CN	Curry, Site Three	6 Jul	80	Undetermined	-	-	-	Below I1, then Portage
716	CN	Curry, Site One	8 Jul	95	Undetermined	-	-	-	Below I1, then mort DS
818	CN	Curry, Site Two	13 Jul	64	Undetermined	-	-	-	Below I1, then Indian (7/26-8/5) then mort DS of mouth
5242	CN	Lower River, East Bank	4 Jun	75.5	Undetermined	-	-	-	Chulitna, Below I1, then Chulitna
5255	CN	Lower River, East Bank	7 Jun	83	Undetermined	-	-	-	Deshka, Below I1, then Portage
5384	CN	Lower River, West Bank	17 Jun	73.5	Undetermined	-	-	-	Below I1, then mort DS
5408	CN	Lower River, gill net	31 May	93	Undetermined	-	-	-	Below I1, then Portage

Table 5.3-1. Continued.

Chinook Salmon (< 50 cm) that Approached Impediment 1 but did not Pass

Tag Number	Species	Capture/ Release Site	Capture Date	METF Length (cm)	Sex	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Comments
574	CNj	Curry, Site One	5 Jul	41	Undetermined	-	-	-	Below I1, Portage (7/25-8/4), then Indian (8/9), then back to Portage (8/15-onwards)

Notes:

Fish characteristics include 'tag numbers' (unique numbers assigned to each individual radio-tagged fish), species (CN = Chinook salmon ≥ 50 cm; CNj = Chinook salmon < 50 cm; and SO = sockeye salmon), capture and release site, capture date, METF (mid-eye to fork length, in cm) and sex. Tracking details include the date of first detections above each impediment, and a comment about the general movments of the fish. Top panel: Chinook salmon (≥ 50 cm) that passed Impediment 3. Second panel: Chinook salmon (≥ 50 cm) that passed Impediment 2, but not Impediment 3. Third panel: Chinook salmon (≥ 50 cm) that passed Impediment 1, but not Impediment 2. Fouth panel: Chinook salmon (≥ 50 cm) that approached within 1 km of Impediment 1, but did not pass. Fifth panel: Chinook salmon (< 50 cm) that approached within 1 km of Impediment 1, but did not pass.

Table 5.3-2. Destinations of radio-tagged Chinook salmon that passed each Middle River impediment, 2014.

	Chinook Salmon (≥ 50 cm)			
	Passed I1 but not I2	Passed I2 but not I3	Passed I3	Total
Classification				
Tributary Destinations				
Portage Creek	1	1		2
Cheechako Creek	2	1		3
Kosina Creek			1	1
Mainstem Destinations				
Mouth of Cheechako		1		1
Unknown Destination	1	4	1	6
Total	4	7	2	13
Downstream from Impediment				
Number	1	3	0	4
Percent	25%	43%	0%	31%

Notes:

An "I" refers to "impediment."

Table 5.3-3. Details of impediment-passage events for radio-tagged Chinook salmon, 2014.

Chinook Salmon (≥ 50 cm) that Passed Impediment 3

Tag Number	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Hold Time Below I1 (d)	Hold Time Below I2 (d)	Hold Time Below I3 (d)	Flow at I-1 Passage (cfs)	Flow at I-2 Passage (cfs)	Flow at I-3 Passage (cfs)
537	20 Jul	20 Jul	4 Aug	4.5	0.5	8.0	21,100	21,100	16,200
787	20 Jul	20 Jul	30 Jul	2.5	0.5	5.5	21,100	21,100	15,500
Average	20 Jul	20 Jul	2 Aug	3.5	0.5	6.8	21,100	21,100	15,850

Chinook Salmon (≥ 50 cm) That Passed Impediment 2 but not Impediment 3

17	30 Jun	30 Jun	-	1.0	0.5	4.5	19,400	19,400	-
139	24 Jul	28 Jul	-	7.0	1.0	d.n.a.	17,800	16,500	-
222	6 Jul	18 Jul	-	1.0	0.5	17.0	23,700	18,700	-
516	1 Aug	1 Aug	-	10.5	0.5	d.n.a.	15,700	15,700	-
882	25 Jul	1 Aug	-	4.5	0.5	d.n.a.	17,600	15,700	-
903	23 Jul	24 Jul	-	0.5	0.5	10.5	17,800	17,800	-
5531	18 Jul	18 Jul	-	2.5	0.5	13.0	18,700	18,700	-
Average	18 Jul	22 Jul		3.9	0.6	11.3	18,671	17,500	

Chinook Salmon (≥ 50 cm) That Passed Impediment 1 but not Impediment 2

221	20 Jul	-	-	4.5	d.n.a.	-	21,100	-	-
828	18 Jul	-	-	2.5	d.n.a.	-	18,700	-	-
868	23 Jul	-	-	6.5	d.n.a.	-	17,800	-	-
5702	1 Jul	-	-	3.0	d.n.a.	-	23,200	-	-
Average	16 Jul			4.1	-		20,200		

Chinook Salmon (≥ 50 cm) That Approached Impediment 1 but didn't pass

Tag Number	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Hold Time Below I1 (d)	Hold Time Below I2 (d)	Hold Time Below I3 (d)	Flow at I-1 Passage (cfs)	Flow at I-2 Passage (cfs)	Flow at I-3 Passage (cfs)
23	-	-	-	3.0	-	-	-	-	-
33	-	-	-	4.5	-	-	-	-	-
40	-	-	-	1.5	-	-	-	-	-

Table 5.3-3. Continued.

Chinook Salmon (≥ 50 cm) That Approached Impediment 1 but didn't pass

Tag Number	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Hold Time Below I1 (d)	Hold Time Below I2 (d)	Hold Time Below I3 (d)	Flow at I-1 Passage (cfs)	Flow at I-2 Passage (cfs)	Flow at I-3 Passage (cfs)
91	-	-	-	4.5	-	-	-	-	-
103	-	-	-	25.5	-	-	-	-	-
108	-	-	-	5.0	-	-	-	-	-
111	-	-	-	5.0	-	-	-	-	-
166	-	-	-	1.5	-	-	-	-	-
198	-	-	-	1.5	-	-	-	-	-
237	-	-	-	4.0	-	-	-	-	-
239	-	-	-	1.5	-	-	-	-	-
244	-	-	-	13.5	-	-	-	-	-
264	-	-	-	7.5	-	-	-	-	-
300	-	-	-	2.5	-	-	-	-	-
359	-	-	-	1.5	-	-	-	-	-
562	-	-	-	1.5	-	-	-	-	-
611	-	-	-	2.5	-	-	-	-	-
621	-	-	-	12.0	-	-	-	-	-
668	-	-	-	0.5	-	-	-	-	-
716	-	-	-	0.5	-	-	-	-	-
818	-	-	-	1.0	-	-	-	-	-
5242	-	-	-	2.0	-	-	-	-	-
5255	-	-	-	3.0	-	-	-	-	-
5384	-	-	-	5.5	-	-	-	-	-
5408	-	-	-	1.5	-	-	-	-	-
Average				4.5					

Chinook Salmon (< 50 cm) That Approached Impediment 1 but didn't pass

Tag Number	First Detection Above I-1	First Detection Above I-2	First Detection Above I-3	Hold Time Below I1 (d)	Hold Time Below I2 (d)	Hold Time Below I3 (d)	Flow at I-1 Passage (cfs)	Flow at I-2 Passage (cfs)	Flow at I-3 Passage (cfs)
574	-	-	-	1.5	-	-	-	-	-
Average	-			1.5			-		

Table 5.3-4. Number of Chinook salmon counted during aerial spawner surveys, by location and survey period, 2014.

River Section	Waterbody	Confluence Project River Mile	Miles Surveyed	Survey Dates						
				Jul 14 - Jul 15	Jul 19 - Jul 20	Jul 25 - Jul 26	Jul 31 - Aug 1	Aug 6 - Aug 7	Aug 12 - Aug 13	Aug 18- Aug 19
Middle River -	Cheechako Creek	Susitna 155.9	2.4	11	16	8	13	7	0	0
Below Impediment 3	Chinook Creek	Susitna 160.4	8.7	0	5	5	2	2	0	0
Middle River -	Devil Creek	Susitna 164.8	2.5	0	0	0	2	10	5	2
Above Impediment 3	Fog Creek	Susitna 179.3	19.3	0	0	0	3	2	0	1
	Fog Creek Tributary L1	Fog Mile 5.1	7.6	0	0	0	0	0	0	0
	Unnamed PRM 184.0	Susitna 184.0	5.7	0	0	0	0	0	0	0
	Unnamed PRM 184.0 Tributary R1	Unnamed 0.8	8.2	0	0	0	0	0	0	0
	Tsusena Creek	Susitna 184.4	3.6	0	0	0	0	0	0	0
Upper River -	Deadman Creek	Susitna 188.4	0.3	0	0	0	0	0	0	0
Within Reservoir	Watana Creek	Susitna 196.9	21.3	0	0	0	0	0	0	0
	Watana Creek Tributary R5	Watana 8.6	8.6	0	0	0	0	0	0	0
	Kosina Creek	Susitna 209.2	18.8	0	0	0	0	0	0	0
	Gilbert Creek	Kosina 6.2	6	0	NS[2]	NS[2]	0	0	0	0
	Tsisi Creek	Kosina 7.3	6.4	0	NS[2]	0	0	0	0	NS[1]
	Tsisi Lake 1	Tsisi 7.2	2.8	NS[1]	NS[1]	0	0	0	0	0
	Tsisi Lake 2	Tsisi 10.6	5.2	NS[1]	NS[1]	0	0	0	0	0
	Jay Creek	Susitna 211.0	13.3	0	0	0	0	0	0	0
Upper River -	Goose Creek	Susitna 232.9	11.2	0	0	0	0	0	0	0
Above Reservoir	Oshetna River	Susitna 235.1	26.3	0	0	0	0	NS[2]	0	0
	Black River	Oshetna	6.2	0	0	0	0	NS[2]	0	

[1] No survey - surveys targeting sockeye salmon began July 25-26.

[2] No survey - high and/or turbid water prevented survey.

Table 5.3-5. Sample effort, CPUE, and net upstream count of fish measuring 50 cm or greater at two ARIS units located at PRM 187.1 in the Upper River, 2014. Mean daily discharge of the Susitna River at Tsusena Creek is also shown.

	River Left					River Right					
	Fish Count					Fish Count					
Date	Upstream	Down-stream	Net Upstream	Sample Effort (h)	CPUE (fish/h)	Upstream	Down-stream	Net Upstream	Sample Effort (h)	CPUE (fish/h)	Mean Discharge (cfs)
06-Jul	0	0	0	7.1	0.00						23,648
07-Jul	0	0	0	24.0	0.00	0	0	0	11.8	0.00	31,521
08-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	35,331
09-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	29,431
10-Jul	0	0	0	24.0	0.00	1	0	1	24.0	0.04	28,232
11-Jul	0	0	0	24.0	0.00	0	0	0	23.7	0.00	27,668
12-Jul	0	0	0	24.0	0.00	0	1	-1	24.0	-0.04	30,000
13-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	31,527
14-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	31,069
15-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	25,300
16-Jul	0	0	0	24.0	0.00	2	0	2	24.0	0.08	21,900
17-Jul	0	0	0	24.0	0.00	1	0	1	24.0	0.04	19,900
18-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	18,700
19-Jul	0	0	0	24.0	0.00	1	1	0	24.0	0.00	18,500
20-Jul	0	0	0	24.0	0.00	1	0	1	24.0	0.04	21,100
21-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	23,400
22-Jul	0	0	0	24.0	0.00	1	0	1	24.0	0.04	20,400
23-Jul	0	0	0	24.0	0.00	1	0	1	24.0	0.04	17,800
24-Jul	0	0	0	24.0	0.00	1	0	1	24.0	0.04	17,800
25-Jul	1	0	1	24.0	0.04	1	0	1	24.0	0.04	17,600
26-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	20,000
27-Jul	0	0	0	24.0	0.00	1	0	1	24.0	0.04	18,600
28-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	16,500
29-Jul	0	0	0	24.0	0.00	0	0	0	24.0	0.00	16,100
30-Jul	0	0	0	10.7	0.00	0	0	0	24.0	0.00	15,500

Table 5.3-5. Continued.

Date	River Left Fish Count Upstream	River Left Fish Count Down-stream	River Left Fish Count Net Upstream	River Left Sample Effort (h)	River Left CPUE (fish/h)	River Right Fish Count Upstream	River Right Fish Count Down-stream	River Right Fish Count Net Upstream	River Right Sample Effort (h)	River Right CPUE (fish/h)	Mean Discharge (cfs)
31-Jul	River left sonar not operational					2	0	2	24.0	0.08	15,600
01-Aug						3	0	3	24.0	0.13	15,700
02-Aug						2	0	2	24.0	0.08	15,900
03-Aug						1	0	1	24.0	0.04	16,200
04-Aug						0	0	0	24.0	0.00	16,200
05-Aug						1	0	1	24.0	0.04	16,600
06-Aug						1	0	1	24.0	0.04	17,300
07-Aug	0	0	0	10.3	0.00	0	0	0	23.9	0.00	16,200
08-Aug	0	0	0	24.0	0.00	1	0	1	24.0	0.04	15,600
09-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	15,700
10-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	14,800
11-Aug	0	0	0	23.7	0.00	0	0	0	24.0	0.00	14,200
12-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	14,700
13-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	14,800
14-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	14,500
15-Aug	0	0	0	24.0	0.00	1	0	1	24.0	0.04	14,700
16-Aug	1	0	1	24.0	0.04	0	0	0	24.0	0.00	16,400
17-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	17,300
18-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	18,000
19-Aug	0	0	0	23.8	0.00	0	0	0	24.0	0.00	17,700
20-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	16,200
21-Aug	0	0	0	24.0	0.00	0	0	0	24.0	0.00	15,400
22-Aug	0	0	0	10.1	0.00	1	0	1	12.0	0.08	14,700
Total	2	0	2	891.5		24	2	22	1067.2		

Table 5.4-1. Survey effort and observations using DIDSON to identify Chinook salmon spawning behavior in turbid water, 2014.

Site	Date	Sample Location	Latitiude	Longitude	DIDSON Used	Chinook Observed	Spawning Observed	Redds Observed	Comments
1	19-Jul	Gateway Slough	62.67643	-149.89302	Yes	No	-	-	
2	19-Jul	Mainstem gravel bar, d/s PRM 133	62.70674	-149.84082	No	No	-	-	
3	19-Jul	4th of July Slough (60 m u/s of outlet)	62.71587	-149.80301	Yes	No	-	-	
4	19-Jul	Mainstem side channel, PRM 135.5	62.72485	-149.75978	No	No	-	-	Inaccessable by boat
5	19-Jul	Mainstem slough, river right, near PRM 137	62.73609	-149.74144	No	No	-	-	No potential sampling sites
6	19-Jul	Slough 11	62.74281	-149.72163	No	No	-	-	Inaccessable by boat
7	20-Jul	Slough between PRM 121 and 122	62.58162	-150.04994	Yes	No	-	-	
8	20-Jul	Mainstem side channel, near PRM 117	62.53128	-150.10338	Yes	No	-	-	Entrained air and river velocity precluded usable sonar imagery
9	20-Jul	Mainstem d/s 4th of July Cr. mouth	62.71481	-149.80823	Yes	Yes	No	No	Individuals observed milling/holding
10	20-Jul	4th of July slough (30 m u/s of outlet)	62.69163	-149.85922	No	No	-	-	
11	20-Jul	4th of July Cr. Slough (100 m u/s outlet)	62.72582	-149.75722	No	No	-	-	Large cobble substrate
12	21-Jul	Portage Creek mouth, river right	62.83034	-149.38153	No	No	-	-	
13	21-Jul	Mainstem d/s Portage Cr. mouth, river right	62.83035	-149.38403	Yes	Yes	No	No	Individuals observed milling/holding
14	21-Jul	Mainstem d/s Portage Cr. mouth, river right	62.83116	-149.38715	No	No	-	-	
15	21-Jul	Mainstem u/s Jack Long Cr. mouth, river left	62.82270	-149.49220	No	No	-	-	Sand substrate
16	21-Jul	Mainstem u/s Jack Long Cr. mouth, river left	62.82143	-149.50706	No	No	-	-	Large cobble substrate
17	21-Jul	Mainstem d/s Jack Long Cr. mouth, river left	62.82245	-149.49872	Yes	Yes	Yes	Yes	Individual observed guarding and holding
18	21-Jul	Mainstem d/s Jack Long Cr. mouth, river left	62.82150	-149.50507	Yes	No	-	-	
19	21-Jul	Mainstem d/s Gold Cr. mouth, river left	62.76779	-149.69141	No	No	-	-	
20	21-Jul	Mainstem d/s Sherman Cr. mouth, river left	62.71310	-149.81103	No	No	-	-	
21	21-Jul	Mainstem d/s Skull Cr. mouth, river left	62.67699	-149.86920	No	No	-	-	
22	22-Jul	Side channel entrance u/s Indian R., river right	62.79191	-149.62464	No	No	-	-	Areas of upwelling
23	22-Jul	Side channel exit u/s Indian R., river right	62.78956	-149.63977	No	No	-	-	
24	22-Jul	Mainstem below side channel, river right	62.78861	-149.64438	No	No	-	-	Sand substrate
25	22-Jul	Mainstem at Beaver impoundment exit, river right	62.78752	-149.65044	No	No	-	-	

Table 5.4-1. Continued.

Site	Date	Sample Location	Latitiude	Longitude	DIDSON Used	Chinook Observed	Spawning Observed	Redds Observed	Comments
26	22-Jul	Mainstem d/s Indian R. delta (10 m), river right	62.78514	-149.65891	Yes	Yes	No	No	Individuals observed milling/holding
27	22-Jul	Mainstem d/s Indian R. delta, over flow channel, river right	62.78413	-149.66248	No	No	-	-	
28	22-Jul	Mainstem d/s Indian R. slough entrance	62.78296	-149.66805	Yes	Yes	No	No	Individuals observed milling/holding
29	22-Jul	Mainstem d/s Indian R., river right	62.78377	-149.65660	No	No	-	-	
30	22-Jul	Mainstem d/s Indian R. slough exit	62.77943	-149.68706	Yes	No	-	-	
31	23-Jul	Slough u/s Gold Cr., river left	62.77146	-149.68672	No	No	-	-	Sand and large cobble substrate
32	23-Jul	Mainstem d/s Gold Cr., river right	62.76829	-149.69449	No	No	-	-	
33	23-Jul	Mainstem d/s Gold Cr., river right	62.76650	-149.71121	Yes	Yes	No	No	Traveling u/s observed
34	23-Jul	Mainstem channel d/s Curry unnamed tributary delta, river right	62.59989	-150.03344	No	No	-	-	
35	25-Jul	Confirmation: d/s Portage Cr Mouth	62.83044	-149.38871	Yes	Yes	No	No	Individuals observed milling/holding
36	25-Jul	Confirmation: d/s Jack Long Cr Mouth	62.82243	-149.49821	Yes	Yes	No	No	Individual observed milling/holding
37	25-Jul	Confirmation: d/s 4th of July Cr Mouth	62.71475	-149.80908	Yes	Yes	No	Yes	Individual observed milling/holding

Table 6.4-1. Number of adult Chinook salmon counted during aerial spawner surveys in the Indian River, by date and river section, 2014.

Survey Date	River Section[a]	Observed Count	Comment	Survey Date	River Section[a]	Observed Count	Comment
07-Jul	1	36	Good conditions	01-Aug	1	47	Good conditions
	2	91	Most fish holding in pools		2	351	
	3	0	pool count estimated		3	146	
	Total	127			Total	544	
10-Jul	1	82	Fair conditions	03-Aug	1	59	Good conditions
	2	184	dark, light rain		2	323	
	3	29	Most fish holding in pools		3	96	
	Total	295	pool count estimated		Total	478	
14-Jul	1	123	Good conditions	06-Aug	1	34	Good conditions
	2	233	Some fish holding in pools		2	214	
	3	72	pool count estimated		3	58	
	Total	428			Total	306	
17-Jul	1	110	Good conditions	09-Aug	1	18	Good conditions
	2	389	Less fish in pools		2	127	
	3	101	Spawning activity		3	24	
	Total	600			Total	169	
19-Jul	1	61	Poor conditions	12-Aug	1	6	Good conditions
	2	330	Bad weather		2	55	
	3	56	dark and rainy		3	14	
	Total	447			Total	75	
22-Jul	1	160	Excellent conditions	15-Aug	1	5	Good conditions
	2	490	Fish evenly distributed		2	16	
	3	148	on spawning grounds		3	4	
	Total	798			Total	25	
26-Jul	1	70	Fair conditions	18-Aug	1	0	Good conditions
	2	327	Turbidity in lower reaches		2	2	
	3	108	following high water event		3	1	
	Total	505			Total	3	
29-Jul	1	67	Excellent conditions	19-Aug	1	0	Good conditions
	2	379	Fish redistributed		2	2	
	3	160	following high water event		3	1	
	Total	606			Total	3	

[a] Section 1 = clearwater plume to Bridge 1; Section 2 = Bridge 1 to Powerline; Section 3 = Powerline to Forks.

8. FIGURES

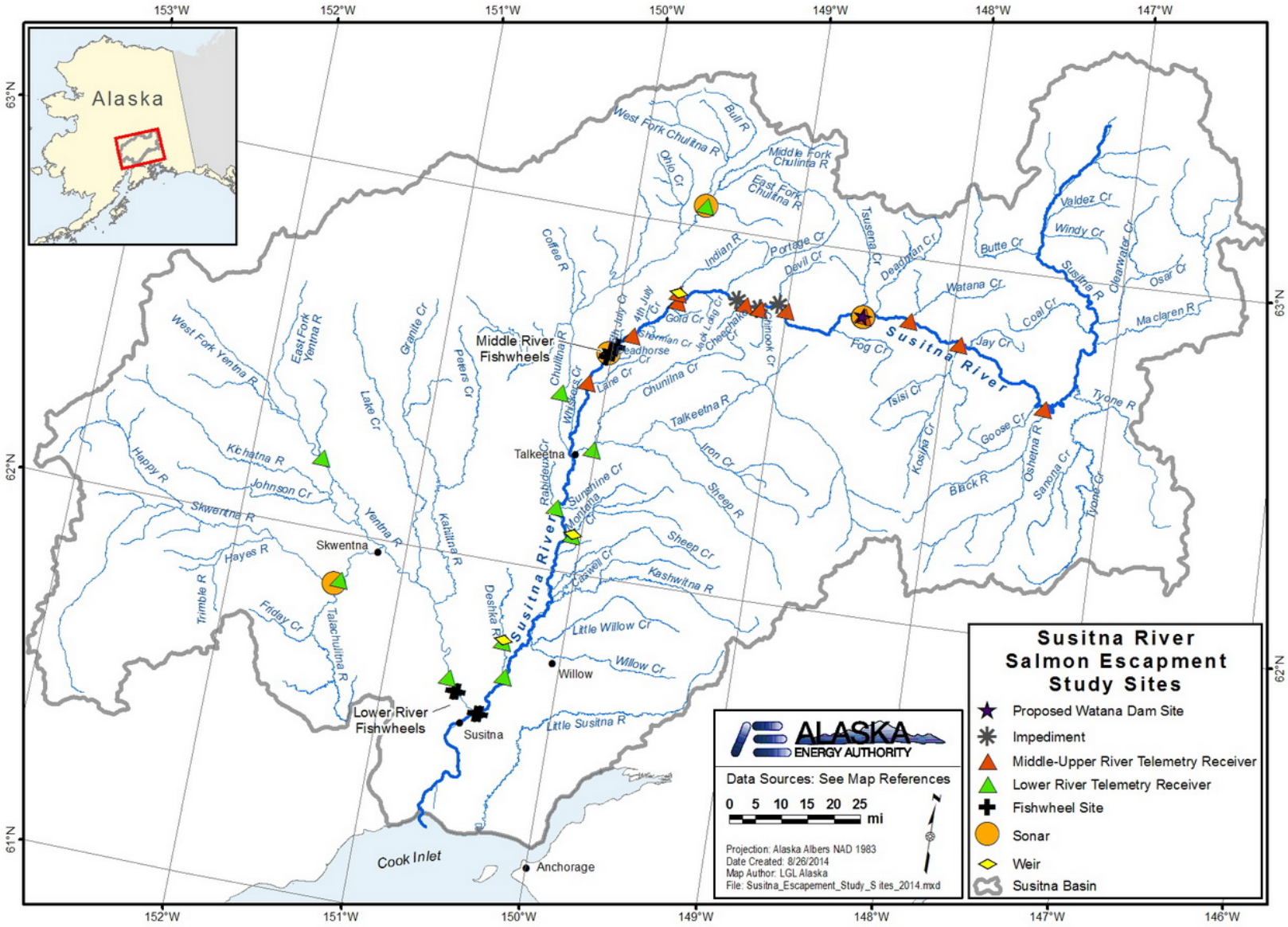

Figure 3-1. Susitna River watershed showing fish capture sites (fishwheels) and the locations of fixed-station telemetry receiver sites, 2014.

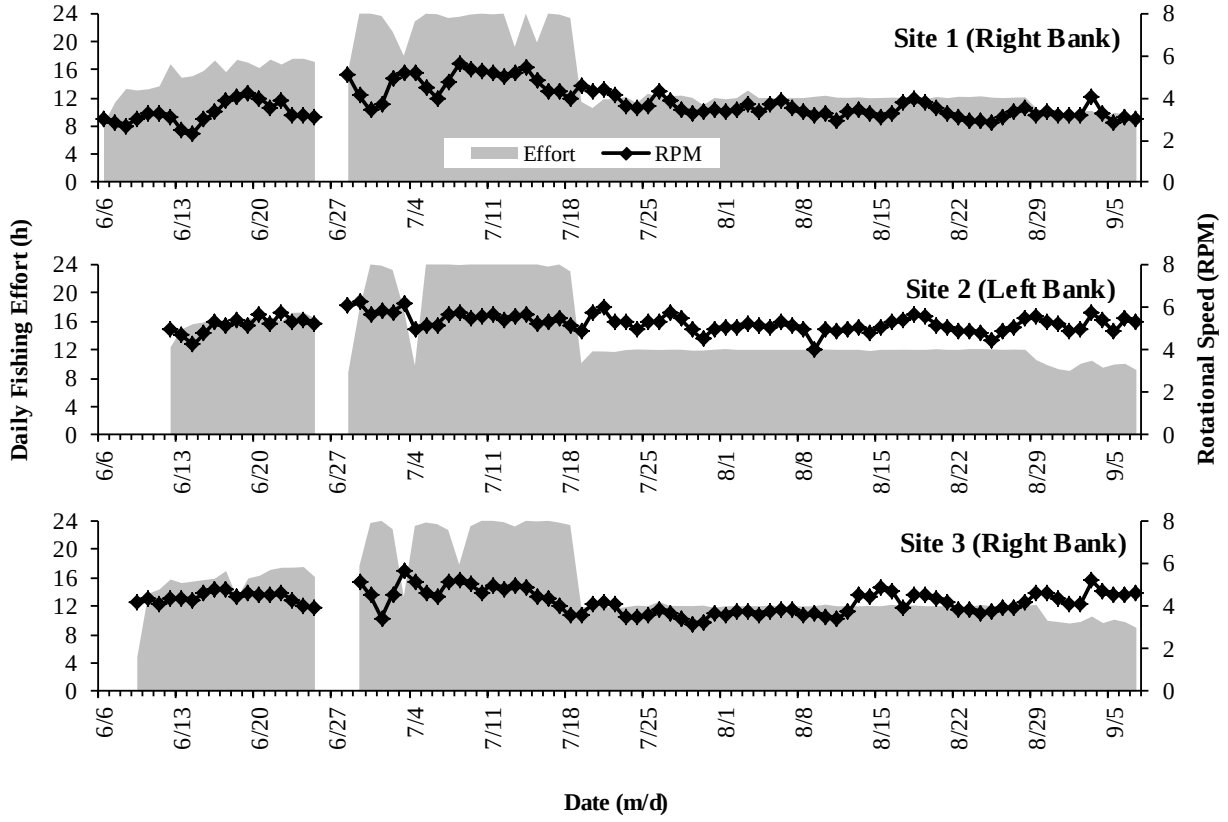

Figure 4.1-1. Daily fishing effort (hours) and rotational speed (RPM) at three fishwheel sites in the Middle River, 2014. Only data through August 11 was included.

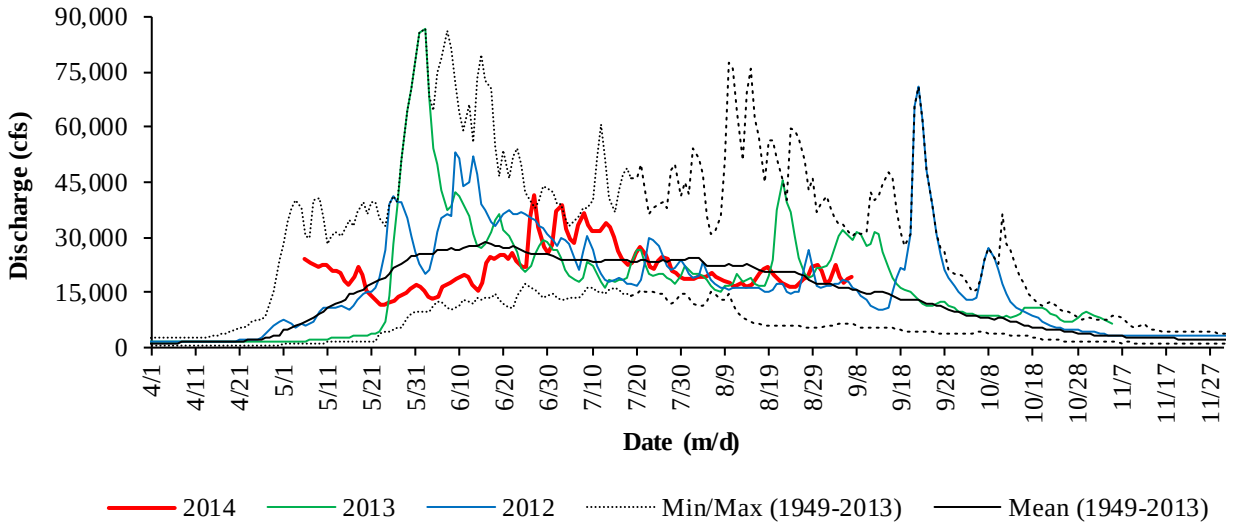

Figure 4.1-2. Daily discharge of the Susitna River at Gold Creek from April 1 to November 30, 2012-2014. Historical (1949-2013) minimum, maximum, and mean discharges are shown for reference. Source: USGS National Water Information System (http://waterdata.usgs.gov/nwis).

Figure 4.3-1. Ortho image showing the ensonified wetted width coverage of each ARIS unit near the Watana Dam Site, 2014. Ensonified coverage is scaled to match the width of the river. River flow is from right to left.

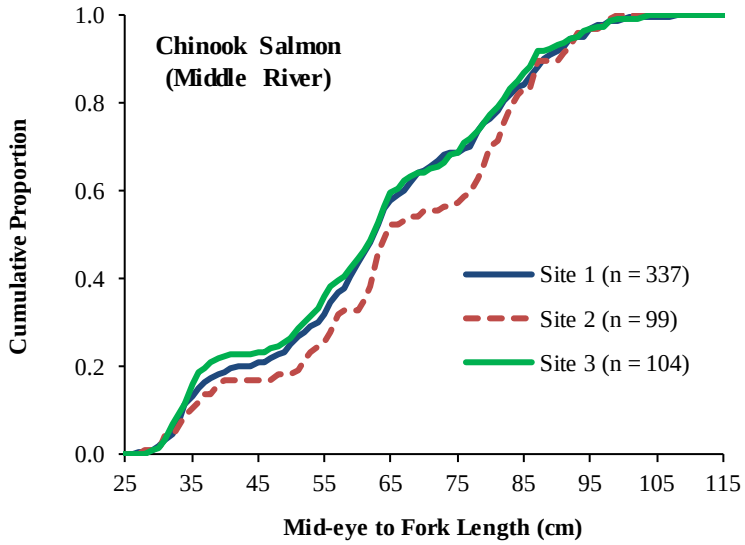

Figure 5.1-1. Cumulative length-frequency distributions for Chinook salmon captured at the Middle River fishwheels, by size category and capture site, 2014.

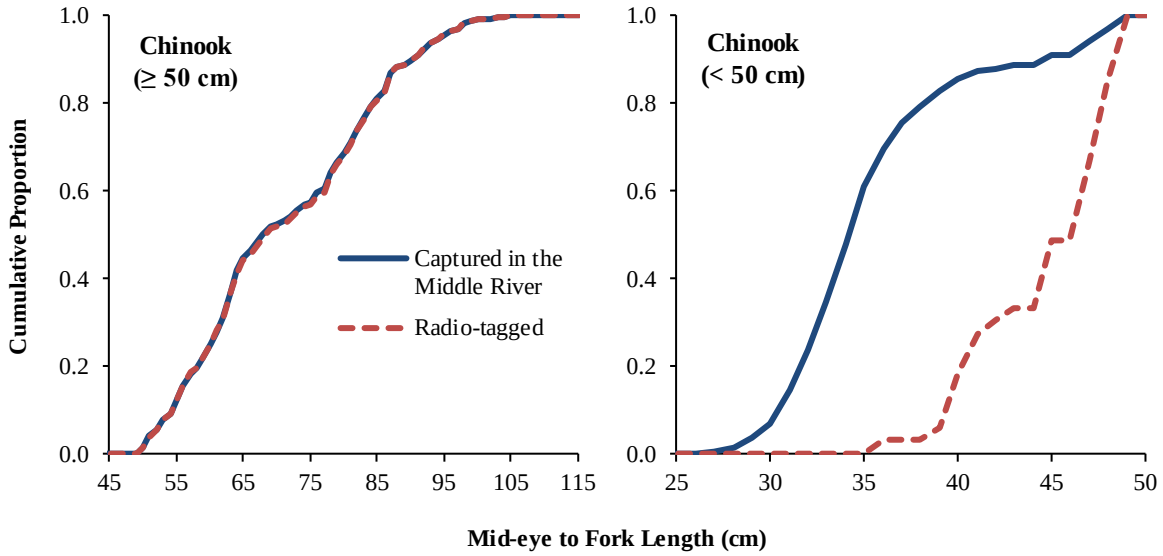

Figure 5.1-2. Cumulative length-frequency distributions for Chinook salmon captured and radio-tagged at the Middle River fishwheels, by size category, 2014.

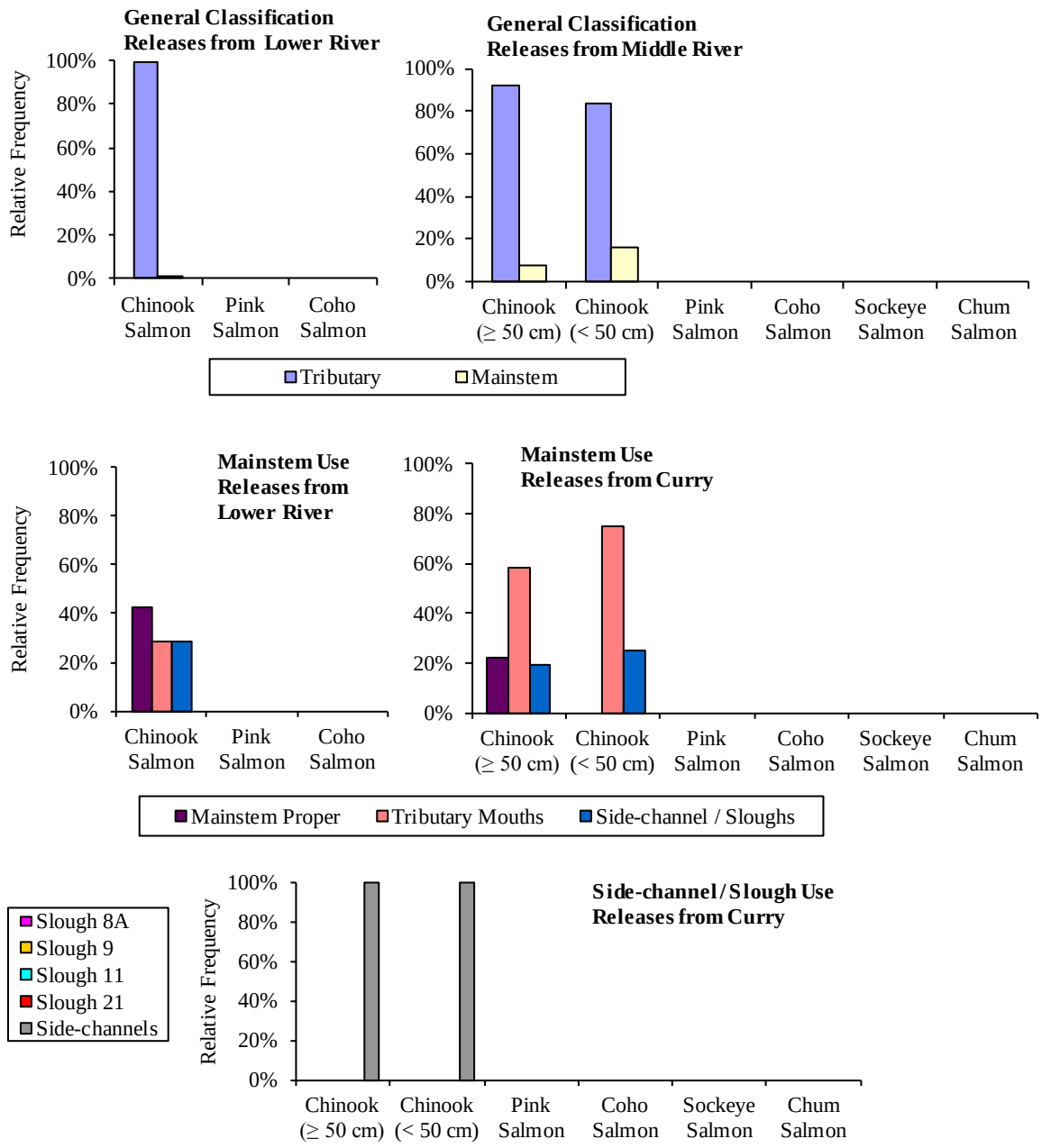

Figure 5.2-1. Classifications for radio-tagged Chinook salmon released in the Lower River (left panels) or Middle River (right panels), by size category, 2014. Top panels: Fish that were detected on several occasions within a limited area were classified with a 'Mainstem Destination' (either in side-channel/slough locations, in a tributary mouth, or in the mainstem proper). Some of the fish that showed the 'Mainstem Destination' detection pattern did so after entering a spawning tributary, and those that had at least one live detection in the mainstem location. See text and Table 5.2-1 for more detailed classifications. Middle Panels: Relative use of side-channel/slough locations, tributary mouths, and the mainstem proper, by fish that were classified with a 'Mainstem Destination.' Bottom Panel: Relative use of sloughs vs. side-channel habitats by fish classified with a 'Mainstem Destination.' 'tbd' = to be determined.

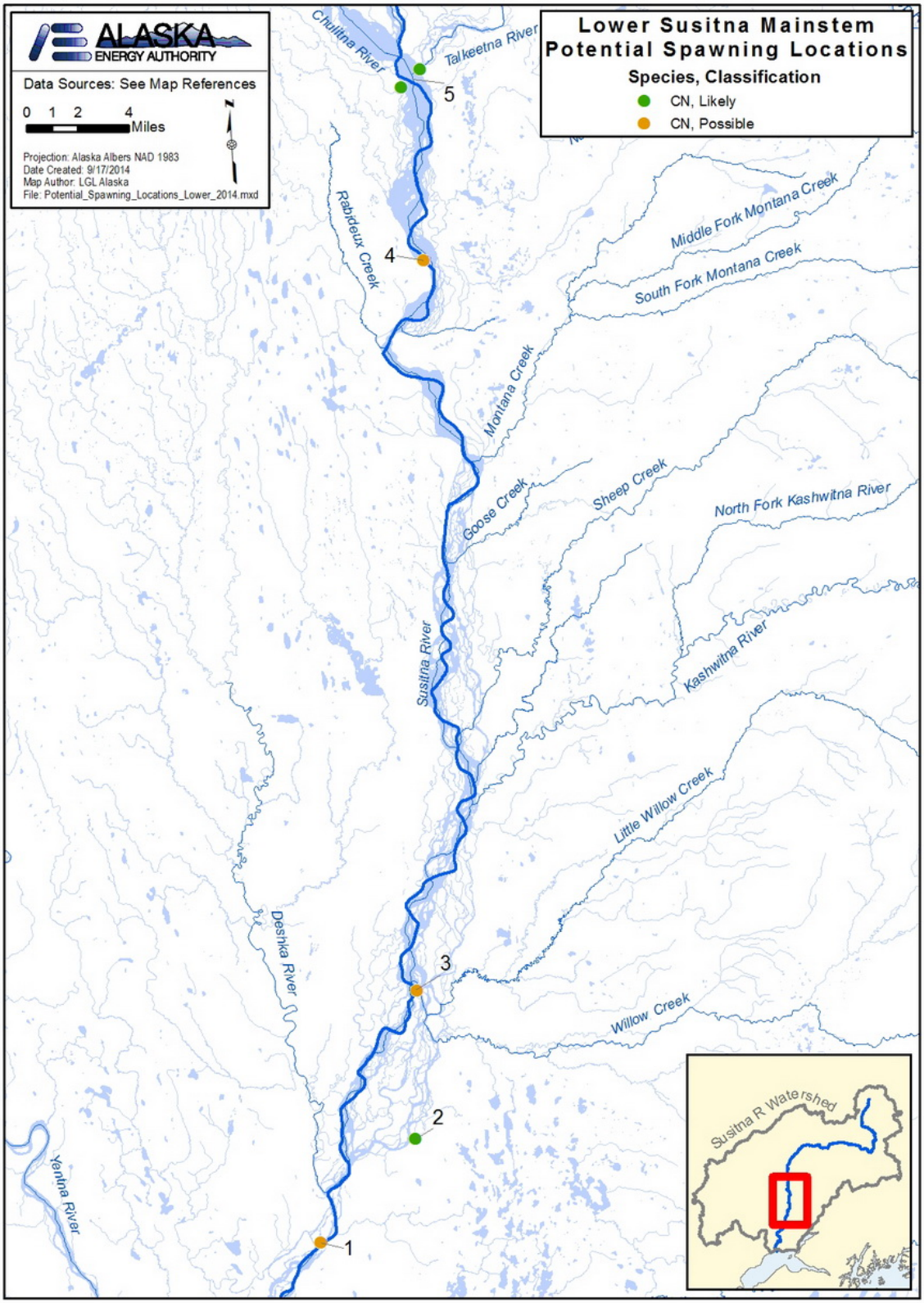

Figure 5.2-2. Potential mainstem spawning sites for radio-tagged Chinook salmon in the Lower River, 2014.

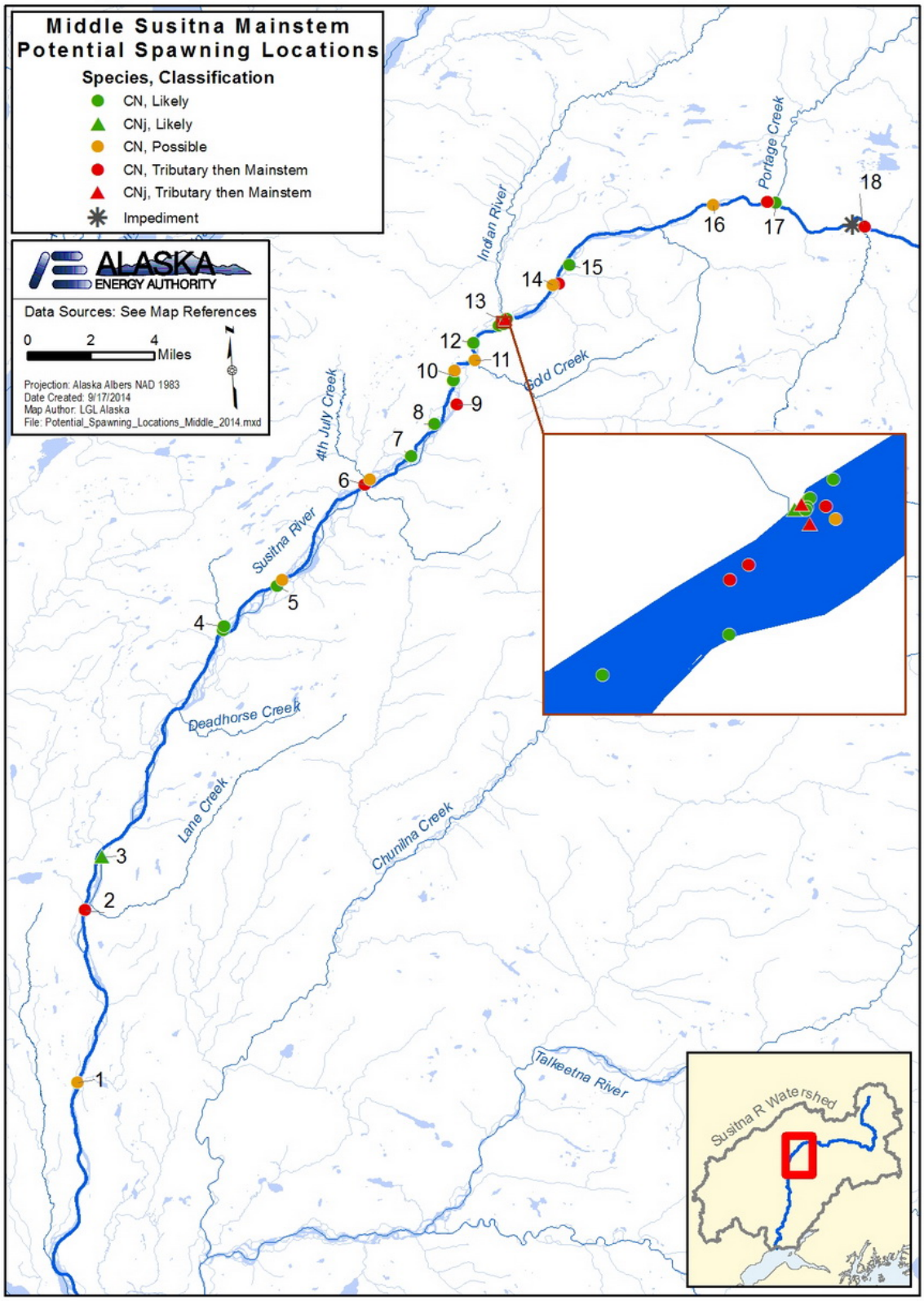

Figure 5.2-3. Potential mainstem spawning sites for radio-tagged Chinook salmon in the Middle River, 2014.

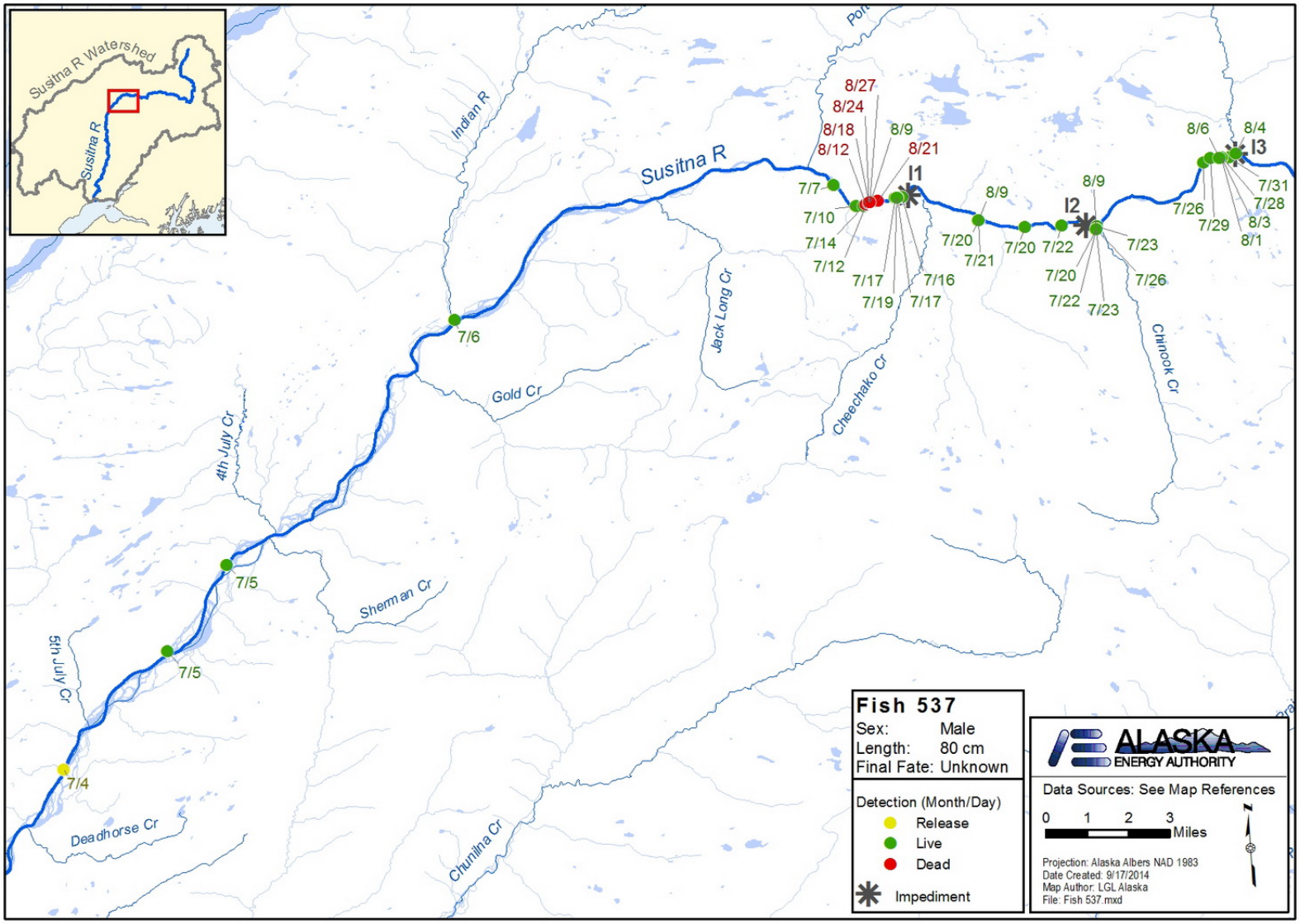

Figure 5.3-1. Tracking history of a radio-tagged Chinook salmon (tag #537) that was detected above Impediment 3, 2014.

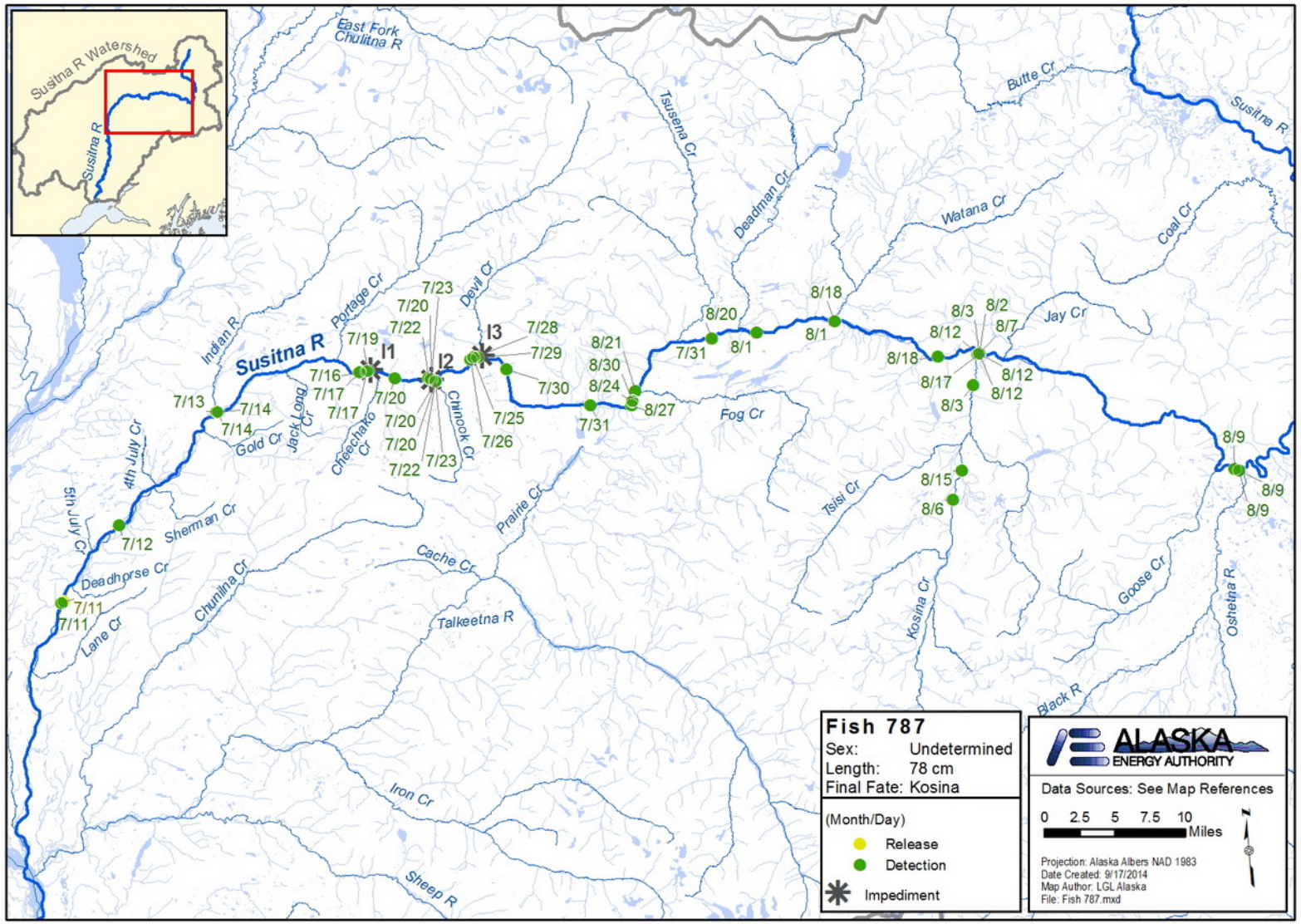

Figure 5.3-2. Tracking history of a radio-tagged Chinook salmon (tag #787) that was detected above Impediment 3, 2014.

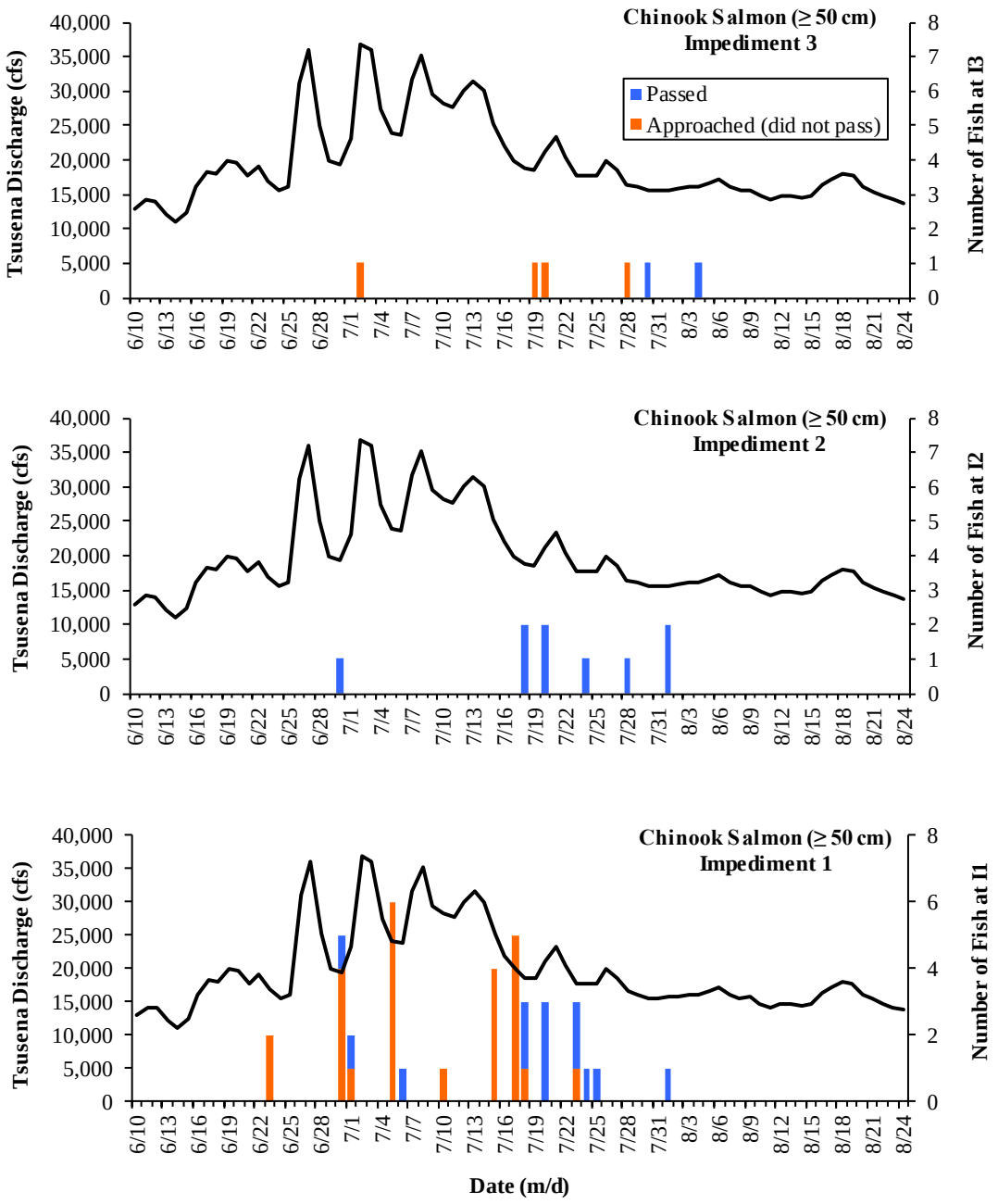

Figure 5.3-3. Daily numbers of large Chinook salmon that approached and passed each of the three Middle River impediments in 2014. Orange bars: fish that approached but did not pass. Blue bars: fish that approached and successfully passed. Figures show the date of first detection above the impediment (blue) or the date of first detection below the impediment (orange). Also shown is the average daily flow of the Susitna River as measured at the Tsusena Creek gage.

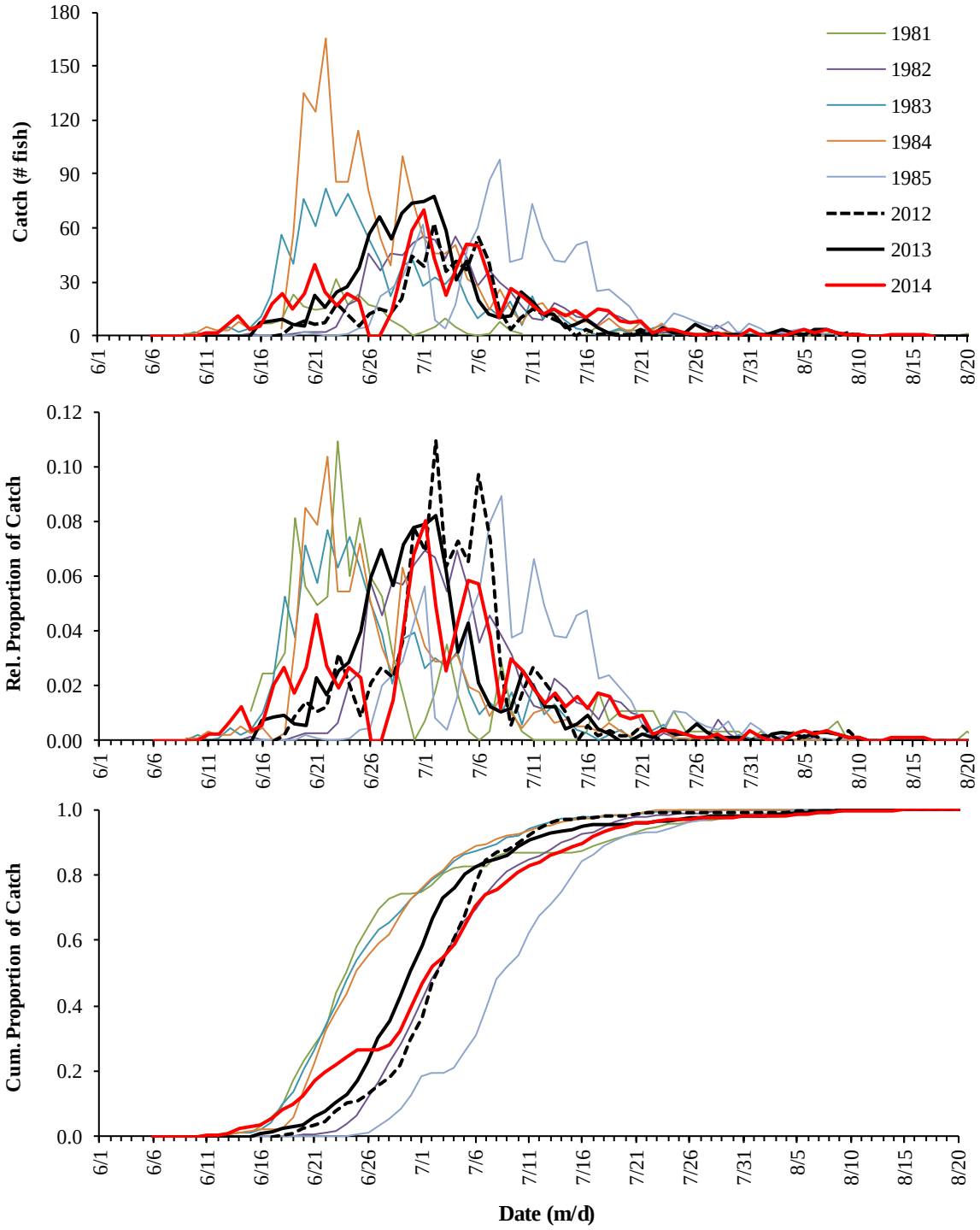

Figure 5.5-1. Comparison of Chinook salmon catches (top panel), relative proportion of catches (middle panel), and cumulative proportion of catches (bottom panel), at the Middle River fishwheels near Curry, 1981-2014. These data include Chinook salmon of all size categories, and catches at two (1981-2012) or three (2013-2014) fishwheels.