Project No. 56018

Project Description

to support application Section 404 Individual Permit

2017 Dam Deconstruction and Sediment Relocation - Lower Eklutna River Dam Removal Project

Eklutna Inc. and
The Conservation Fund

Eklutna, Alaska

November 15, 2016

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1.0 Introduction

Eklutna Inc. (applicant), in partnership with The Conservation Fund, is proposing to deconstruct the lower Eklutna River dam, near the Native Village of Eklutna, Alaska. The Eklutna River flows from the Eklutna Glacier in the Chugach Mountains into Cook Inlet's Knik Arm. The Eklutna River mouth is approximately 25 miles northeast of Anchorage. The lower Eklutna River dam, 70-feet (ft) high and 100-ft wide, is located in a steep-walled canyon approximately 7 miles downstream of Eklutna Lake[1] (**Sheet 1**). The concrete dam, initially constructed in 1929, was abandoned in the 1950s and has been functionally obsolete since[2].

The purpose of the lower Eklutna River dam project is to remove the functionally obsolete lower Eklutna River dam, which will restore some natural stream functions currently inhibited by the dam's presence. Since dam maintenance was discontinued in the 1950s, an estimated 230,000 cubic yards (cy) of sediment, mainly sand and gravel, has accumulated behind the dam. Review of available LIDAR data suggests that the sediment plug extends an estimated 5,500 ft upstream of the dam (HDR 2016). The presence of the lower Eklutna River dam and the loss of about 90 percent of the natural flow due to the upper Eklutna River dam have led to poor sediment transport throughout the system, resulting in excessive siltation and gravel-starved stream channels downstream of the lower dam (USACE 2011).

Demolition of the dam and associated activities planned for 2017 will unavoidably impact jurisdictional wetlands and other waters of the United States (WOUS). Deconstructing the dam will require excavating portions of the sediment plug to access the dam and discharging the excavated sediment into downstream WOUS. Discharging fill into WOUS, an activity subject to Section 404 of the Clean Water Act (CWA), requires prior authorization from the U.S. Army Corps of Engineers (USACE) as well as a Title 16 permit authorization from the Alaska Department of Fish and Game (ADF&G).

The USACE and ADF&G authorized completion of site preparation activities in 2016 under Nationwide Permit #33 (Temporary Construction, Access, and Dewatering) on August 9, 2016 (POA-2016-248) and Fish Habitat (FH) permit FH-16-IV-0264 on June 23, 2016. As part of the 2016 effort, Eklutna Inc. placed unauthorized fill in WOUS and grubbed wetlands outside of the authorized work area. The HDR project manager reported the unauthorized activities to the USACE by phone on October 14, 2016 and further described these activities in an email sent to USACE on October 20, 2016. Impacts to WOUS from unauthorized activities are described in this document.

Eklutna Inc. is seeking authorization from USACE for the 2017 dam removal and associated activities under an Individual Permit (IP), as well as authorization for unpermitted activities conducted in 2016. Eklutna Inc. is also requesting authorization from the ADF&G to conduct the

[1]Elevation at top of dam is 262 ft, spill elevation is 253 ft; dam foundation built at 192 ft. The concrete arch structure is 61 ft high and 98 ft long at the crest; eight ft thick at base, five ft thick at crown; a sluice gate at base allowed release of gravel and debris downstream; previous studies estimate 300,000 cy of sediment were removed annually from behind dam (Hollinger 2002).
[2] The lower Eklutna River dam was constructed in 1929 as part of Alaska's first hydroelectric project, providing energy to Anchorage. However, the lower dam was abandoned in the 1950s when a new hydroelectric facility was constructed at Eklutna Lake; maintenance at the lower dam ceased at that time.

2017 activities described herein. **Section 3** summarizes the proposed project and construction methods, focusing on project components requiring in-water work or that have the potential to impact WOUS and fish habitat. Impacts to WOUS and fish habitat are discussed in **Section 4**. Permit application drawings and recent analyses that support the findings summarized herein relative to wetlands and sediment transport are attached as appendices. **Section 5** identifies the applicant's proposed avoidance and minimization measures. **Section 6** identifies environmental permits and authorizations necessary for the lower Eklutna River dam removal project. **Section 7** describes other alternatives considered, but deemed impracticable, by the applicant.

2.0 Project Location

The project is located in Township 16 North, Range 1 East, Sections 29 and 30, Seward Meridian. Approximate coordinates for the lower Eklutna River dam are latitude 61.451554 North and longitude 149.333500 (NAD 83). The lower Eklutna River dam and surrounding property are owned by Eklutna, Inc. While the dam site cannot be accessed by road, temporary access improvements were completed in 2016. A temporary gravel road extending southeast from Eklutna Lake Road to the top of a bluff was constructed (near the Near the Anchorage Water and Wastewater Utility [AWWU] treatment plant), and an aluminum stair system was installed in the ravine to provide workers temporary but safe access between the upper work area and the dam. Eklutna Inc. also constructed a temporary access route for vehicles on the north side of the river that extends approximately 1,000 ft upstream of the dam. The downstream side of the dam (**Figure 1**) is currently accessed by parking at the Thunderbird Falls trailhead, crossing the Eklutna River and walking up the canyon.

Figure 1. Photograph looking upstream at lower Eklutna River dam, May 2009 (USACE 2009).

3.0 Project Summary

Section 3.1 describes site preparation activities conducted in 2016 and **Section 3.2** describes activities proposed for 2017. Permit application figures are included as **Appendix A**.

3.1. Unauthorized Site Preparation Activities completed in 2016

Under POA-2016-248, Eklutna Inc. received authorization from the USACE to conduct site preparation activities in 2016 (**Sheet 2**). Authorized activity included grubbing in 0.44 acre of wetland and placing fill in 0.003 acre of waters for a temporary culvert. As indicated above, Eklutna Inc. conducted additional activities in 2016 without the prior authorization necessary from the USACE under Section 404 of the CWA. These activities (**Figure 2, Sheet 3**) include:

- Placing an estimated 1,650 cy of fill across about 0.51 acre of WOUS within authorized work area
- Grubbing an estimated 0.16 acre of wetlands outside of the authorized work area
- Placing an estimated 750 cy of fill across 0.23 acre of WOUS outside of authorized work area

Eklutna Inc. requests authorization for these reported activities through the IP process.

Figure 2. Looking upstream into canyon from lower staging area; fill placed in 2016 for the construction of an access route and helicopter landing pad/work area adjacent to the Eklutna River visible. Photo credit: Joe Miller, HDR, October 18, 2016.

3.2. Activities Proposed for 2017

The contractor will use low-pressure, tracked equipment including an excavator (135 or similar), skid steer, and potentially a bulldozer (D-6 or similar) to meet the project's intended purpose.

3.2.1. Temporary Stream diversions (2017)

Prior to and during sediment and dam removal, the contractor will need to temporarily divert flow from the Eklutna River and the tributary stream. For both stream diversions, the contractor plans to use an inflatable bladder type diversion dam (**Figure 3**) angled across the channel to direct flow into an adjacent diversion pond, where a diversion pipe fitted with a slip gate will convey water downstream. The diversion pipes will extend to the face of the dam, as shown on the attached permit application figures and described below. A plan view is provided as **Sheet 4**.

Figure 3. Photograph of a similar, water-inflated diversion dam courtesy of Hydrological Solutions, Inc.

The temporary diversion dam and pond on the Eklutna River will be located approximately **1,100 ft** upstream of the lower Eklutna River dam. Flow from the Eklutna River, estimated as 15 to 20 cubic ft/second (cfs), will be diverted through a pipe diameter sized to convey the 10-year storm event. Eklutna Inc. anticipates using either a 4- or 5-ft diameter pipe, or multiple smaller diameter pipes, to convey flow. Flexible piping will be used at either end of the diversion pipes for ease of movement. The Eklutna River bypass pipe will be approximately **1,100-ft** in length. Eklutna Inc. proposes to excavate a trench, approximately 3-ft deep and up to 6-ft wide, to house the bypass pipe; the lower 100 ft of pipe will be hung on the canyon wall[3]. As the sediment is relocated and sections of the dam are removed, the lower 100 ft of the Eklutna River bypass pipe will be lowered to ensure the downstream slope is maintained.

[3] Eklutna Inc. initially planned to hang the diversion pipe along the south side of the canyon wall in 2016; however, it was determined a ditch would instead be excavated and only the lower 100 ft of pipe would be hung along the canyon wall.

The contractor will excavate a temporary diversion pond (up to 5 ft deep, 30 ft wide by 50 ft long) directly adjacent to the Eklutna River and line it with a neoprene sheet. Eklutna Inc. anticipates that the diversion pond will be located on the north side of the bank where excavation occurred in 2016; however, the location may be adjusted depending on conditions. In 2017, the excavated material will be temporarily stockpiled at a higher elevation along the streambank to avoid the potential for the material to inadvertently be washed downstream. The pipe inlet will sit about 2.5 ft above the existing streambed at the diversion pond. As flow is directed into the diversion pond, the pond's water level will rise and the pipe will begin to convey water. The bypass pipe will be situated approximately 2 ft above the river's surface water elevation to maintain the downstream slope necessary for the gravity fed system. A slip gate fitted over the pipe intake will effectively allow the contractor to control when the pipe conveys flow. Once the lined diversion pond is in place, the contractor will install the temporary diversion dam at an angle across the stream channel. The anticipated dimensions of the Eklutna River diversion dam will be about 6 ft wide, 4 ft tall, and 200 ft across.

A similar approach will be used to divert flow from the tributary stream around the lower staging area. In spring 2017, a diversion pond (3 ft deep, 20 ft in diameter) will be excavated adjacent to the stream. The contractor will excavate a ditch for the placement of an 18-inch diameter (with a 12-inch liner) gravity fed pipe to convey flow from the tributary stream. Excavated material will temporarily be stockpiled nearby, in the dry. The tributary stream bypass pipe will be placed in an excavated ditch that extends upstream of the lower staging area (and staircase) and the bypass pipe will extend downstream to the face of the lower Eklutna River dam. The inlet of the bypass pipe will be fitted with a slip gate. Once the tributary stream bypass pipe is installed and the retention pond has been lined, an inflatable bladder-type diversion dam will temporarily be placed in the channel, upstream of the lower staging area, to divert flow into the pond. The tributary stream's anticipated temporary diversion dam will be approximately 2 ft by 4.5 ft and up to 25 ft long.

Once sediment removal from upstream of the dam has begun, the outlets of both streams' bypass pipes will be directed toward the sediment cast downstream of the dam. To create additional pressure at the outfall, the Eklutna River bypass pipe will be connected to smaller diameter pipe. While the returned water will help to transport the sediment cast over the dam, the applicant anticipates the need to mechanically transport some sediment farther downstream using a bull dozer. Therefore, Eklutna Inc. also proposes to construct a temporary access route downstream of the dam, as described below.

3.2.2. Construct Bulldozer Route Downstream of Dam (2017)

Approximately 300 feet downstream of the dam, the channel makes a relatively sharp bend to the south through its steep-walled canyon (**Figure 4**). Eklutna Inc. anticipates that once sediment is cast downstream of the dam, some of it will need to be mechanically transported farther downstream to avoid sediment accumulation in the canyon's constriction points. Prior to sediment relocation and dam removal, the applicant proposes to construct a safe access route for the bulldozer by regrading existing substrate along the streambank. The route would extend about 700 ft downstream of the dam, to another constriction point visible on imagery (**Sheet 4**).

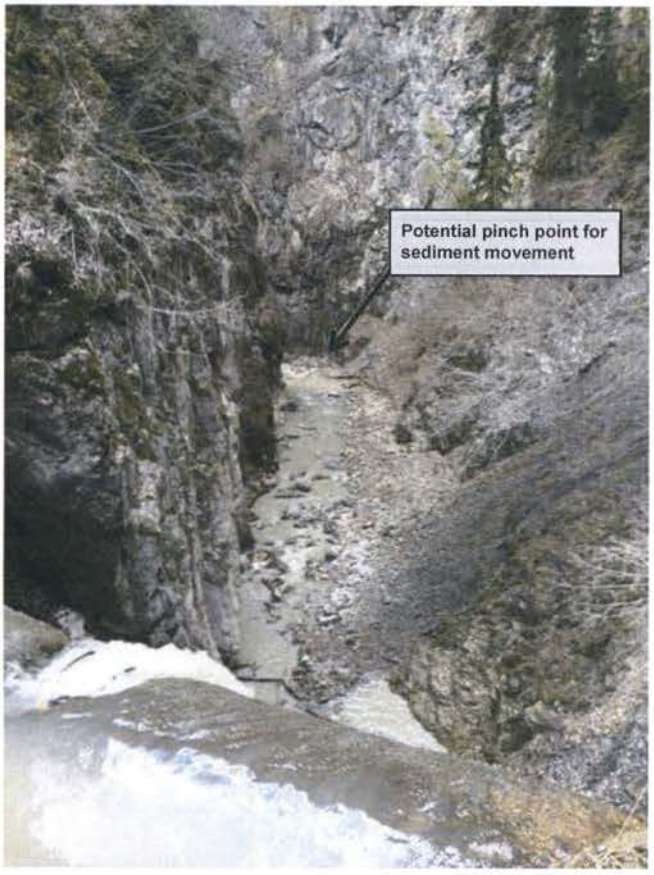


Figure 4. Photograph looking downstream from the lower Eklutna River dam face. Photo credit: Sam Barber 2016.

Constructing an access route downstream of the dam will require clearing and grubbing vegetation and placing fill into WOUS. Once a safe travel path has been created, the bulldozer will transport some of the sediment downstream of the bend and distribute it along the streambanks (**Sheet 4; Figure 1**). Eklutna Inc. does not anticipate the need to place mid-channel fill to cross the Eklutna River or divert the stream below the dam while operating equipment downstream of the dam.

3.2.3. Temporary Excavation Dewatering Sumps (2017)

The contractor will excavate and operate four temporary dewatering sumps in the Eklutna River upstream of the dam within the bypass reach prior to and during sediment removal. Each sump will be excavated to approximately 18 ft below ground surface. Sumps will consist of rigid, perforated HDPE pipe wrapped in geotextile fabric and be surrounded by clean, imported rock to prevent displacement of fines and clogging of the pump. A standard submersible sump pump (2-inch intake) will be used to dewater excavations; water will be returned to the river downstream of the dam face. The sumps will be located roughly 50 ft, 150 ft, 250 ft, and 350 ft upstream of the dam face; these locations may vary as sediment relocation progresses. Each pump will operate an estimated 16 to 18 hours per day while the Eklutna River is on bypass.

3.2.4. Sediment Relocation and Dam Deconstruction (2017)

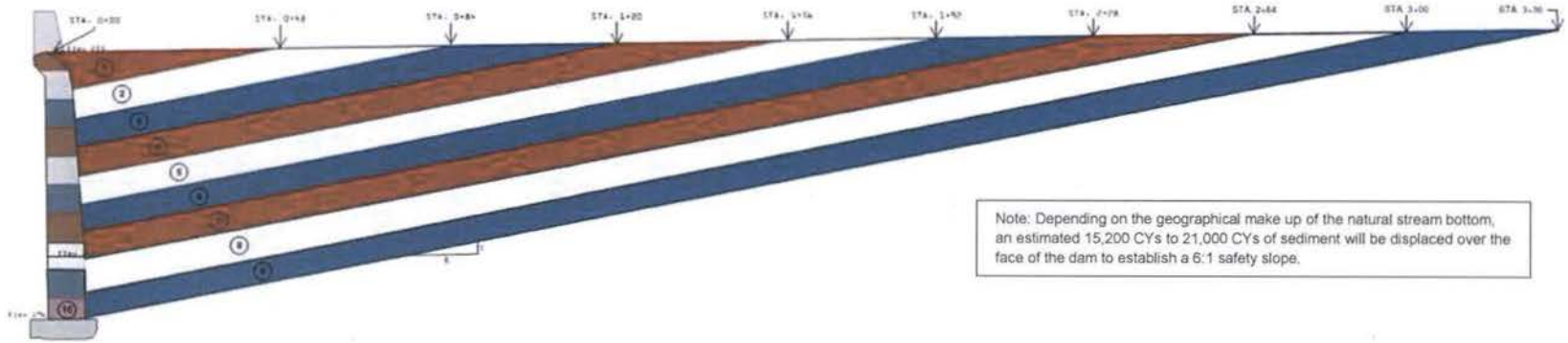
Sediment removal and dam deconstruction will begin once the Eklutna River and tributary stream are diverted and the temporary sumps are in place. Sediment relocation is anticipated to begin in mid-June 2017. Sediment from behind the dam must be relocated in order to access the dam so that it can be safely removed. To maintain safe working conditions, the sediment relocation and dam deconstruction will be an incremental process (**Figure 5; Sheet 5**).

The anticipated excavation limits for sediment relocation will extend approximately 360 feet upstream of the dam and to the edges of the canyon walls. The safety slope standard for workers will be 6h:1v within the sediment plug excavation area (east, up-valley). Excavated sediment will be periodically cast downstream over the dam so that the dam can be demolished in approximate 4 to 8-ft increments. In this way, workers will essentially alternate between sediment excavation and relocation operations and concrete demolition activities, as needed. Depending on the geographical make up of the natural stream bottom, the contractor estimates that between **15,000 and 21,000 cy** of sediment will be moved from the upstream side of the dam and relocated over its face to establish the 6h:1v safety slope.

During sediment excavation and relocation, a conveyor system will be used to transport the sediment downstream of the dam. The conveyor system will extend approximately 25 to 30 feet beyond the face of the dam so that sediment does not accumulate directly beneath it but falls farther downstream. A grizzly-type sediment sorter set on the conveyor system will be used to separate out sediment deemed too large to be transported by Eklutna River flows. The larger sediments will be stockpiled upstream of the dam. Once enough sediment has been excavated (depth 8 to 10 ft) from behind the dam and relocated, dam deconstruction will resume. The contractor anticipates sediment excavation and relocation will occur once every 10 days.

Demolition of the concrete dam will likely be accomplished using a combination of methods, including a hydraulic hammer or other such means, and if necessary, by drilling holes into the concrete and injecting an inert foam which expands and breaks the concrete. The Dam Deconstruction Plan, which will describe the methods and means of dam deconstruction, is forthcoming and will be submitted as **Appendix B** when available.

During demolition activities, concrete with rebar, concrete larger than 18-inches in diameter, and other metal debris (324 cy, estimated) will be removed from the canyon with a crane. The remaining concrete debris (1250 cy, estimated) will be mechanically transported upstream and temporarily stockpiled within the work limits (**Sheet 5**). Concrete rubble (18-inches in diameter and smaller) will ultimately be used to help armor the slope during site restoration (**Sheet 6**).



Note: Depending on the geographical make up of the natural stream bottom, an estimated 15,200 CYs to 21,000 CYs of sediment will be displaced over the face of the dam to establish a 6:1 safety slope.

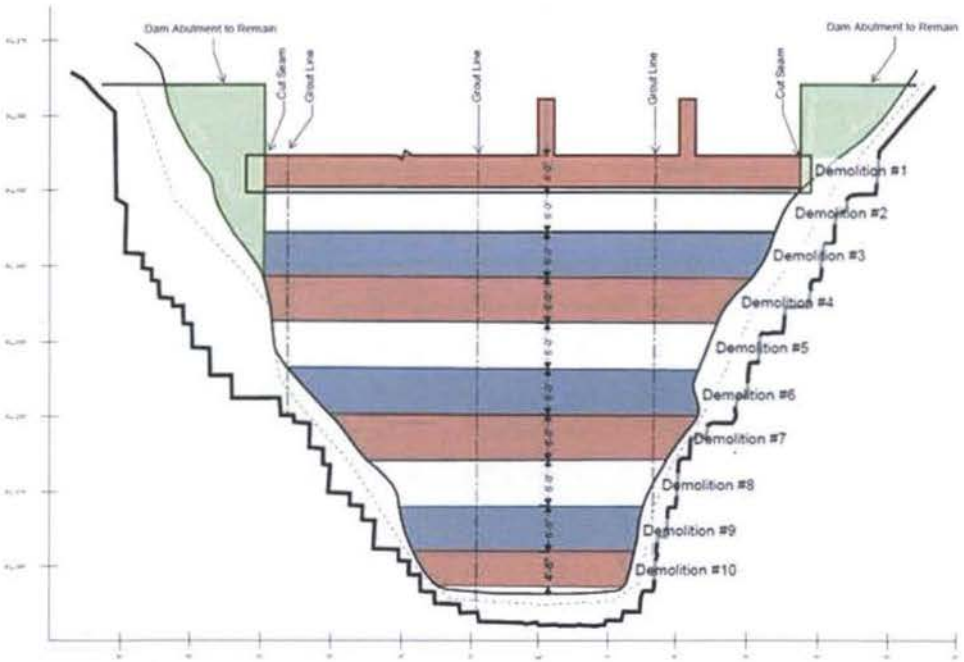


Figure 5. Incremental process: removing sediment from behind the lower Eklutna River dam as it is demolished.

3.2.5. Sediment Transport Monitoring (2017 and beyond)

During sediment relocation and dam deconstruction activities, the Eklutna River will be visually inspected for sediment deposition and scour at location(s) downstream of the dam in the vicinity of the Alaska Department of Transportation and Public Facility (DOT&PF) and/or Alaska Railroad Corporation (ARRC) crossing sites. A monitoring plan, which is currently under development, will include an emergency action plan in the event that sediment deposition related to dam removal threatens either bridge crossing. Post construction sediment monitoring at the established cross-section(s) will be continued in subsequent years after the 2017 dam removal. The post construction monitoring plan is forthcoming.

3.2.6. Demobilization and Site Restoration (2017)

3.2.6.1. LOWER WORK AREA

The contractor will remove metal and other debris from the canyon bottom and regrade the remaining sediment into a stable condition. The temporary diversion structures, bypass pipes, and culverts will be removed, and the two diversion ponds backfilled.

The limits of the excavated sediment plug will extend approximately 360 feet upstream of the dam and near the edges of the canyon walls. Concrete rubble (18-inches in diameter and smaller) will be used to help armor the slope (**Sheet 6, Sheet 7**). The excavated sediment plug will be re-contoured up valley at a 6h:1v slope, as described above, to the downstream edge of the remaining (upstream) sediment plug. No other stabilization or sediment control measures are planned. Additional information regarding the potential fate of the remaining sediment is provided in the attached Sediment Transport Study (**Appendix C**).

The anticipated post-project elevations will range from about 200 feet at its downstream end (former dam site) to about 260 feet approximately at the upstream extent of the excavated sediment plug (about 360 feet upstream). Post dam deconstruction profile and cross-sectional views are attached (**Sheet 7, Sheet 8**).

3.2.6.2. UPPER WORK AREA

The crane pad area and upper work area will be regraded to match surrounding topography and hydroseeded. The road approach will be removed and the aluminum stairway access will be removed from the gully. The entrance into the old penstock will also be blocked to minimize the potential for trespassing and related safety concerns.

3.3. Anticipated Schedule (2017)

The anticipated 2017 schedule, subject to changes and adjustments, is summarized as follows:

- April 15-May 3: Mobilize equipment and prepare site
- May 3-May 10: Remove miscellaneous metal debris from work areas
- May 4-May 17: Construct temporary diversion pond, install temporary bypass pipe and install diversion dam to temporarily divert flow in tributary stream and dewater work area
- May 10-June 8: Construct temporary diversion pond and install diversion dam to temporarily divert flow in the Eklutna River and dewater work area
- June 8-June 9: Install temporary sumps in Eklutna River upstream of dam

- June 9-June 20: Mobilize bulldozer and construct access route downstream of dam for subsequent sediment transport
- June 21-August 31: Start excavating sediment and casting it downstream of dam
- June 26-Sept 6: Start deconstructing the lower Eklutna River dam
- Sept 7-Sept 20: Place concrete debris along banks of the Eklutna River
- Sept 21-Oct 11: Remove the temporary diversion dam from the Eklutna River, diversion pond and liner, and bypass pipe; backfill diversion pond
- Oct 12-Oct 20: Remove the temporary diversion dam, pond and liner, bypass pipe and culvert from the tributary stream, backfill diversion pond
- Oct 23-Oct 31: Remove stairs and access to canyon
- Nov 6-Nov 9: Replace overburden and hydroseed upper staging area, remove construction fencing and road approach

4.0 Environmental Considerations

4.1. Jurisdictional Waters of the United States

A wetland scientist completed an office-based jurisdictional determination report (JDR) and functional assessment (FA) to identify locations in the vicinity of the lower Eklutna River dam that are subject to Section 404 of the Clean Water Act (33 Code of Federal Regulations [CFR] Part 323) and Section 10 of the Rivers and Harbors Act of 1899 (33 CFR 322). The study was also intended to provide an assessment of the ecological and hydrological functions. Wetlands and other WOUS within the mapping study area were coded using the National Wetland Inventory (NWI) classification and assigned ecological functions and relative ecological values (REVs) using the Anchorage Debit-Credit methodology (ADCM).

The 59.2-acre mapping study area extended approximately 0.8 miles upstream of the dam and 0.2 miles downstream of the dam. Wetland scientists mapped approximately 1.8 acres of wetlands and 3.0 acres of the Eklutna River and associated gravel bars. The Eklutna River and the small stream (upstream of the dam) were classified as NWI code R3UBH, which are permanently flooded riverine waterbody within an upper perennial stream. Approximately 0.5 acres of unvegetated gravel bars and banks of the Eklutna River (within the study area) were classified as NWI code R3USC. R3USC are adjacent to perennial streams and seasonally flooded with enough frequency to inhibit development of vegetation.

Scrub-shrub wetlands adjacent to the Eklutna River, classified as NWI code PSS1C, was the only wetland type mapped within the study area. PSS1C are seasonally flooded scrub-shrub wetlands dominated by broad-leaved deciduous vegetation. The remaining 54.5 acres in the mapping study area were classified as uplands.

The Eklutna River and associated gravel bars (WOUS) downstream of the dam were assigned the highest REV, which is REV1. Downstream of the lower dam, the Eklutna River supports Pacific salmon and other salmonid species. Upstream of the dam, the Eklutna River and its associated gravel bars and the small perennial stream within the study area was classified as REV2. All 1.8 acres of mapped wetlands within the study area were classified as REV2. The

project-specific *Eklutna Dam Removal Office-Based Jurisdictional Determination Report and Functional Assessment* report is attached as **Appendix D**.

4.2. Fish and Essential Fish Habitat

The Eklutna River is catalogued by the ADF&G as an anadromous stream (#247-50-10175) that supports chum, coho, pink, Chinook, and sockeye salmon from its mouth to about one half mile upstream of the Thunderbird Creek (Johnson and Litchfield 2016). Thunderbird Creek (#247-50-10175-2025), the Eklutna River's primary tributary stream, supports spawning and rearing Chinook salmon. Thunderbird Creek is a clear-water stream that joins the Eklutna River about a mile downstream from the lower Eklutna River dam. Thunderbird Creek's anadromous reach extends about one third of a mile upstream from its mouth to the base of a waterfall.

Historically, the Eklutna River system supported larger runs of these Pacific salmon species and was an important subsistence harvest area for local natives. However, both the lower and upper Eklutna River dams block fish passage and have led to habitat degradation and a decline in fish distribution and abundance throughout the Eklutna River system. The Upper Eklutna River dam diverts all flows from Eklutna Lake, severely restricting instream flows downstream in the Eklutna River. Resulting low flows have led to a loss of overwinter habitat, poor sediment transport functions, and excessive siltation of stream channels, gravel-starved streams, reduced water quality, and insufficient spawning depths for Chinook salmon (USACE 2011). Due to the diversion of water at the Eklutna Lake outlet, Thunderbird Creek is currently the main source of water in the river (USACE 2011). The Eklutna River is normally quite turbid until its confluence with Thunderbird Creek. Habitat conditions in the Eklutna River system are described in the Habitat Assessment of the Lower Eklutna River (Prince of Wales Tribal Enterprises Consortium 2007) and the *Eklutna River Aquatic Ecosystem Restoration Technical Report* (USACE 2011). USACE 2011 also discusses ecosystem restoration recommendations.

4.3. Impacts to Wetlands and other Waters of the U.S.

The Eklutna River, wetlands, and other WOUS mapped within the study area are subject to Section 404 of the CWA. Project components that involve discharging fill into WOUS and grubbing in wetlands therefore require authorization from the USACE.

The applicant is seeking authorization for activities that were not authorized under POA-2016-248 but conducted in 2016 (**Table 1**):

- Place an estimated 2,400 cy of fill material across 0.74 acre of WOUS to construct an access road and temporary helicopter pad/work area in the canyon
- Grubbing an estimated 0.16 acre of wetlands outside of the authorized work area

Table 1. Estimated Impacts to Wetlands and other Waters of the U.S. from Unauthorized 2016 Site Preparation Activities

NWI Code	Wetland/Waters Type	Relative Ecological Value	Activity	Impact (Acres)
PSS1C	Seasonally flooded broad leaved deciduous scrub-shrub wetlands	REV 2	Grubbing	0.16
			Place fill for temporary access/work areas	0.56
R3UBH	Permanently flooded upper perennial unconsolidated bottom stream	REV 2		0.07
R3USC	Seasonally flooded upper perennial unconsolidated shore - unvegetated gravel bar	REV 2		0.11

In 2017, the applicant proposes to:

- Place temporary diversion structures in the Eklutna River and tributary stream
  - Tributary diversion: 8.3 cy across 0.001 acre (R3UBH-REV2)
  - Eklutna diversion: 177.8 cy across 0.018 acre (R3UBH-REV2)
- Regrade existing sediment downstream of dam to create a temporary bulldozer route for sediment transport across an estimated 0.18 acres of WOUS, including an estimated:
  - 0.12 acre of R3USC-REV1
  - 0.04 acre of R3UBH-REV1
  - 0.017 acre of PSS1C-REV1
- Relocate an estimated 21,000 cy of sediment from upstream of lower Eklutna River dam (sediment plug) by placing it downstream in the Eklutna River (R3UBH & R3USC-REV1)

Relocating the excavated sediment plug downstream, deconstructing the dam, and regrading the post-project canyon floor will result in a loss of wetlands along the Eklutna River. By removing the lower Eklutna River dam, an existing barrier to fish and wildlife passage, several miles of WOUS upstream of the lower Eklutna River dam location may potentially become REV1 WOUS, as opposed to REV2 WOUS, as fish passage is restored.

The project is anticipated to cause an increase in turbidity downstream of the dam during and after dam demolition. An increase in turbidity in anadromous fish habitat during and after dam deconstruction has the potential to affect spawning success and egg survival and alter fish habitat. A sediment transport study conducted for this project discusses potential scenarios for the fate of the remaining sediment based on modeled and observed sediment transport trends in lower Eklutna River. The sediment transport study completed for this project is attached as **Appendix C.**

The sediment transport study anticipates that the finer sediment relocated downstream of the dam will generally be transported through the Eklutna River system and deposited into Knik Arm within approximately two years. Deposition of coarse sands and gravels is predicted from the Thunderbird Creek confluence to the Old Glenn Highway Bridge. During and after dam removal, the Eklutna River will be monitored for sediment deposition and scour near the DOT&PF and/or ARRC crossing sites to ensure sediment does not threaten existing infrastructure. The monitoring plan, which is currently under development, will include an emergency action plan if either bridge crossing appears at risk. The monitoring plan is forthcoming.

While the project is likely to result in adverse short-term impacts to aquatic resources, the project is anticipated to have an overall net increase in aquatic resource function because it would help to restore sediment transport and natural stream system functions over the long term. Improved sediment transport has the potential to improve the quality of spawning gravels in the Eklutna River. While full restoration of the Eklutna River's ecosystem would require removal of both dams (USACE 2011), deconstructing the lower Eklutna River dam is a step toward restoring ecological functions within the system. Removing the dam will help to restore some of the intrinsic river functions that have been adversely affected by its presence, chief among them are the traditional and cultural practices of the residents of the Native Village of Eklutna; corresponding impacts to terrestrial wildlife, fish habitat, and fish passage; and improvements to natural stream functions associated with the transport of sediment and organic debris.

The ADF&G typically sets in-water work timing windows to avoid the peak of salmon outmigration and spawning to minimize impacts to anadromous fish. For this area, in-water work is typically authorized to occur from May 15 to July 15 in anadromous waters. However, the applicant is requesting authorization to conduct in-water work below OHW in the Eklutna River throughout the 2017 open water season.

5.0 Avoidance and Minimization Measures

Regulations and guidelines associated with Section 404 of the CWA call for project proponents to take measures that avoid or reduce adverse impacts to WOUS and other resources. The project has been designed with the following avoidance and minimization measures:

- The project was designed to incorporate the incremental sediment relocation and deconstruction methodology to minimize downstream impacts to fish habitat and WOUS while maintaining safe working conditions.
- The limits of the work areas will be clearly identified in the field (e.g., staking, flagging) prior to ground disturbing activities to ensure avoidance of impacts to wetlands, WOUS and other resources beyond the defined boundary.
- Heavy equipment shall remain inside the identified disturbance limits.
- Low-pressure, tracked equipment including an excavator (135 or similar), skid steer, and potentially a bulldozer (D-6 or similar) will be used.
- Fueling will occur within the designated staging areas with containment in place (i.e., containment boom at the toe of the pad, duck ponds for generators, and 5 gallon safety cans). During the 2017 bulldozer-assisted sediment relocation that may be necessary downstream of the dam, only minimal refueling will be necessary; refueling will occur as needed using 5 gallon safety cans.
- The contractor will continue to remove metal debris and concrete with rebar from the bottom of the canyon, minimizing the amount of debris that will be stockpiled along the banks of the Eklutna River.
- Temporary storage, staging, materials lay down, and other work areas will be sited in uplands or previously disturbed areas to the extent practicable.

- Disturbed areas within the work limits will be re-contoured to match surrounding contours after sediment relocation/dam deconstruction is complete. The lower work area will be allowed to re-vegetate naturally; hydroseed will be applied to portions of the upper work area.
- The United States Fish and Wildlife Service recommends that vegetation clearing, grubbing, and other site preparation activities be avoided from May 1 through July 15 to minimize potential impacts to nesting birds (USFWS 2009), as migratory birds are protected by the Migratory Bird Treat Act. However, the project proposes to clear vegetation, as necessary, during the May 1 through July 15 timeframe. Therefore, a qualified biologist will conduct a nest survey within 3 days of clearing activity. If active nests[4] or evidence of nesting birds are observed, activities will be delayed and coordination with USFWS will occur prior to clearing.
- Eklutna Inc. will prepare a SWPPP and maintain compliance with that plan. The plan will clearly describe BMPs required during construction to prevent erosion and runoff from entering aquatic habitats.
- During and after dam removal, the Eklutna River will be monitored for sediment deposition and scour near the DOT&PF and/or ARRC crossing sites to ensure sediment does not threaten existing infrastructure. The monitoring plan, which is currently under development, will include an emergency action plan if either bridge crossing appears at risk. The monitoring plan is forthcoming.

6.0 Permits and Authorizations

The lower Eklutna River dam removal project requires a number of environmental permits and authorizations prior to conducting certain components of the proposed work, including but not limited to those identified in **Table 2**. To date, the applicant has received authorization from the ADF&G (FH Permit FH-16-IV-0264) and the USACE (NWP #33) to complete the 2016 site preparation activities and the Alaska Department of Natural Resources (ADNR) (Temporary Water Use Authorization A2016-58). Since the 2016 activities were issued under a NWP, a separate Section 401 water quality certification was not required (Rypkema 2016). The Municipality of Anchorage Public Works Department determined that acquisition of a flood hazard permit would not be necessary for this project (Urbanus 2016). APDES General permit # AKR10FL33 expires 10/30/2017

Eklutna Inc. is currently requesting authorization from the USACE to conduct the 2017 activities associated with sediment relocation and dam deconstruction under the IP application process. The applicant also seeks authorization from the ADF&G (Fish Habitat Permit) and ADNR (Dam Removal Permit) to conduct respective components of the 2017 activities. Compliance with Section 401 of the CWA will also be necessary. Based on correspondence with the Alaska Department of Environmental Conservation, the Section 401 water quality certification process will be concurrent with the IP permit process.

[4] Nests are considered active if an incubating bird is in the nest, eggs are present in the nest, or an adult is very close to the nest.

Table 2. Environmental Permits and Authorizations – Lower Eklutna River Dam Removal Project

Agency / Organization	Permit / Authorization	Activity
Alaska Department of Fish & Game (Habitat Division)	Fish Habitat Permit (Title 16)	In-water work below OHW outside of ADF&G's in-water work window: • operating equipment below OHW in fish habitat downstream of dam • potential downstream impacts to fish habitat from operating equipment above dam
Alaska Department of Natural Resources	Temporary Water Use Authorization	Temporary bypass of Eklutna River and tributary, temporary dewatering sumps
	Dam Removal Permit	Deconstructing and removing dam
U.S. Army Corps of Engineers	Nationwide Permit *(#33 Temporary Construction, Access, and Dewatering)*	Discharging fill into WOUS (2016): • culvert and fill in tributary stream Mechanical grubbing in WOUS (2016): • grubbing in wetlands and below Eklutna River OHW
	Individual Permit	Discharging fill into WOUS (2017): • sediment in Eklutna River • temporary stream diversions
U.S. Department of Environmental Conservation	Section 401 Water Quality Certification (concurrent with NWP and IP process)	Temporary impacts to water quality during construction
	APDES General permit (# AKR10FL33 expires 10/30/2017)	Stormwater discharges for construction

Notes: Acquisition of a flood hazard permit was deemed unnecessary for this project (Urbanis 2016). A separate short-term water quality variance will not be required for this project since the applicant is pursuing authorization under a NWP and an IP (Rypkema 2016).

7.0 Alternatives Analysis

The applicant has prepared this section to demonstrate compliance with Section 404(b)(1) Guidelines of the CWA. The first step in the 404(b)(1) evaluation process is the identification of practicable alternatives. The Guidelines define a practicable alternative as an alternative that is "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purpose."

The applicant considered several alternatives to safely remove the lower dam on the Eklutna River during the project development phase. The dam, located in a relatively narrow canyon confined by steep walls, is not accessible by road. Given the site's topographical constraints and the large volume of sediment that has accumulated upstream of the dam, safe management of that accumulated sediment is the primary challenge of the project. In summary, the accumulated sediment (estimated 230,000 cy) could either be removed from the canyon (Alternative 1) or remain in the canyon (Alternative 2) in order to deconstruct the dam. The applicant considered several options for each of the two alternatives:

- Alternative 1 – Transport Sediment out of the Canyon
    - Option 1A: Improve an existing access route located upstream
    - Option 1B: Construct a new road to canyon

- Option 1C: Install bucket conveyor system
- Alternative 2 – Leave Sediment in the Canyon
  - Option 2A: Stockpile excavated sediment in canyon
  - Option 2B: Cast excavated sediment downstream of dam
  - Option 2C: Deconstruct dam using explosives

The applicant also considered different approaches for dam deconstruction. As part of this process, the applicant determined that the dam could either be demolished in horizontal sections as sediment is removed and the dam face is exposed, or by the use of explosives without the need to excavate sediment to access the dam face.

The three options under Alternative 1 and two options under Alternative 2 would share the same general approach for dam deconstruction but differ primarily in how the accumulated sediment that must be relocated to gain access to the dam face would be managed while maintaining safe working conditions in the canyon. Elements common to these five options and that would require activity in WOUS include:

1. Temporarily diverting the Eklutna River and a tributary stream
2. Excavating a portion of the accumulated sediment plug and dewatering the excavation
3. Relocating excavated sediment and deconstructing the dam in incremental horizontal sections
4. Placing fill in wetlands and waters

The option under Alternative 2 that explores the use of explosives to demolish the dam (Option 2C) would not require activities 1 through 3 listed above. However, Option 2C would require the placement of fill in wetlands and waters of the U.S.

The alternatives and associated options considered by the applicant for practicability during project development are described in more detail below.

7.1. Alternative 1 – Transport Sediment out of Canyon

The three options considered under Alternative 1 would involve excavating sediment as the dam is demolished in horizontal sections and removing an estimated 230,000 cy of accumulated sediment from the canyon. Since there is no road access to the dam site, the applicant considered three primary options to haul the sediment out of the canyon. The applicant considered improving an old AWWU access road that extends into the canyon upstream of the project site. Another consideration was to construct a new road and haul sediment out of the canyon using trucks. The applicant also considered setting up a bucket conveyor system in the ravine to transport sediment out of the canyon. A brief description of each approach is provided in the subsections below.

7.1.1. Option 1A: Re-establish AWWU Access Road to Haul Sediment out with Trucks

The applicant considered improving an old, overgrown AWWU access route that extends from Eklutna Lake Road to the canyon at a point about 1.4 miles upstream of the lower Eklutna River dam. Road access into the canyon would allow the applicant to transport equipment and haul

excavated sediment out of the canyon using trucks. A temporary road established in 2016 extends into the canyon about 1,000 feet upstream of the dam. Since no road route exists within the canyon between this point and the AWWU road upstream, a new access route (about 1.4 miles long) along the banks of the Eklutna River would be necessary to support the trucks and other equipment and minimize surface disturbance. Fill placement would be necessary to minimize potential impacts to WOUS from repeated travel. The extent to which fill placement would extend into WOUS to allow safe vehicular traffic within this segment was not studied.

Additionally, there is a pinch point about halfway between the dam and the AWWU access road where the canyon is about 12 feet wide and the Eklutna River about four feet deep. To use this route, heavy equipment would potentially be needed to widen the canyon walls and a large diameter temporary culvert would be installed to convey stream flow underneath the access road. Travel within this stream corridor would be technologically and logistically possible.

An estimated 230,000 cy of sediment would be removed from the canyon. The material excavated prior to and during dam deconstruction would be temporarily side-cast and loaded onto dump trucks. Each truck could carry an estimated 10-14 cy of material. Therefore, an estimated 16,000 to 23,000 trips along the 1.4-mile access road in the canyon would be required to reach the AWWU access road and haul sediment out of the canyon.

Eklutna Inc. estimates this alternative would cost approximately $650,000 to construct a new road and about $1.4 million to upgrade the existing AWWU access road. Eklutna Inc. estimates that hauling the sediment out of the canyon under this alternative would cost an additional $4.96 million. Eklutna Inc. estimates this alternative would cost around **$8.2 million total** and add an additional 3 seasons to the schedule.

The technology is available to build a road in the canyon and re-establish and improve an existing road, which would allow the contractor to haul sediment out of the canyon. This option would increase the logistics and project duration; managing the logistics associated with road construction and hauling sediment is possible. However, the extra costs associated with this option make it prohibitive for the applicant. Eklutna, Inc. does not consider this option practical or feasible due to excessive cost as well as additional impacts within a larger project footprint in the Eklutna River canyon.

7.1.2. Option 1B: Construct Temporary Road to Haul Sediment out with Trucks

The applicant looked into the feasibility of constructing a road to access the canyon within the vicinity of the dam site. Road access to the canyon would allow trucks to haul the excavated sediment out of the canyon for delivery to a disposal site located near the village of Eklutna. Engineers scouted potential road locations from the top of the canyon along Eklutna Road. The team descended the canyon along potential routes to evaluate the feasibility of construction. The route deemed most feasible, from an engineering and safety standpoint, would be sited about 0.2 miles from the 2016 upper work area off Eklutna Lake Road and access the bottom of the canyon. To support the weight of loaded dump trucks, the temporary road in the canyon (established in 2016) would need to be extended about 0.1 mile farther upstream, requiring additional fill placement into WOUS.

An estimated 230,000 cy of sediment would be removed from the canyon. The material excavated prior to and during dam deconstruction would be temporarily side-cast and loaded onto dump trucks. Each truck could carry an estimated 10-14 cy of material. Therefore, an estimated 16,000 to 23,000 trips would be required along the access road in the canyon to haul the sediment out of the canyon.

Construction of an access road in this steep terrain is possible when considering existing technologies. Construction of such a road could be accomplished by winching construction equipment down into the canyon. Eklutna, Inc. estimates that under this alternative, the project would cost about **$9.1 million total**. While possible to achieve, the extra cost to construct a road and haul the sediment out of the canyon was not considered reasonable. The applicant deemed this alternative infeasible due primarily to how such challenging logistics would influence the cost of building a road to the dam site.

7.1.3. Option 1C: Install Bucket Conveyor to Haul Sediment out of Canyon

The applicant explored the possibility of setting up a bucket conveyor system in the ravine, located just northeast of dam, to move sediment out of the canyon. Upon excavation, sediment would be temporarily side-cast, transported to the lower staging area by earth-moving equipment, and placed into the bucket conveyor system, which would move the sediment to the upper staging area at the top of the canyon. From there, the conveyor would load that sediment into dump trucks in a designated loading area. Trucks would then haul the sediment to a disposal site located near the village of Eklutna.

Eklutna, Inc. estimates the overall project cost would be about **$7.8 million total** under this option. The cost of installing the bucket conveyor and hauling the sediment out of the canyon was estimated to be about $3.9 million. While the installation and operation of a bucket conveyor system is logistically and technologically available, the additional cost of the bucket conveyor system make this alternative unfeasible for the applicant to achieve the project's purpose.

7.2. Alternative 2 – Leave Sediment in the Canyon

The applicant evaluated three options that would involve leaving the accumulated sediment in the canyon, as opposed to hauling the sediment out of the canyon. Two of those options, Options 2A and 2B, would involve excavating a portion of the sediment plug to access the dam and relocating that sediment downstream of the dam, regrading the excavated area to post-construction contours, and leaving the remainder of the sediment plug in place. The third approach, Option 2C, would also leave the accumulate sediment in place but would use explosives to deconstruct the dam. A brief description of each option is provided in the subsections below.

7.2.1. Option 2A: Stockpile Sediment in Canyon

Under this approach, sediment excavated to gain access to the dam would be stockpiled approximately 450 feet upstream of the dam as the dam is demolished in horizontal sections. This approach would require placing the temporary diversion dam farther upstream on the Eklutna River in order to create enough space to maintain safe working conditions and to

transport and stockpile the excavated sediment. Eklutna, Inc. estimates this option would cost approximately **$6.8 million total.** While costs would not be considered prohibitive to the applicant, this approach was not selected due primarily to the safety concerns (logistics) inherent to working downstream of a high volume of stockpiled sediment within a canyon. Further, given the limited area within the canyon, sediment stockpiled upstream of the dam could potentially be washed back into the excavation during a flood event, which would create substantial delays and unnecessary financial risk.

7.2.2. Option 2B: Cast Sediment downstream of Dam

Under this approach, sediment excavated to gain access to the dam would be periodically cast over the face of the dam as the dam is demolished in horizontal sections. The applicant anticipates that relocated excavated sediment would be redistributed farther downstream through a combination of a water bypass system and use of a D6 bulldozer to move the sediment farther downstream of the dam. The bulldozer would also be utilized to breach potential debris dams that may form at pinch points within the project limits. This approach would also require placing a temporary diversion dam on the Eklutna River; however, it would not need to extend to the top of the sediment plug since the excavated sediment would be moved downstream of the dam (as opposed to farther upstream). Under this option, the diversion temporary dam would extend approximately 650 feet upstream of the Lower Eklutna River dam. Eklutna, Inc. estimates this option would cost approximately **$6.7 million total**.

In light of cost, logistics, and existing technology, the applicant identified this approach as practicable; it was deemed the safest and most cost-effective option. This alternative has since been carried forward for consideration as the Least Environmentally Damaging Practicable Alternative (LDEPA).

7.2.3. Option 2C – Deconstruct Dam using Explosives

The applicant considered the possibility of using explosives to deconstruct the dam, similar to methods used on other dam removal projects in the lower 48 states. The upstream face of the dam would still potentially need to be excavated in order to safely place the explosives.

The applicant considered full detonation as well as blasting an arch in the bottom of the dam. While it would be possible to deconstruct the dam using either method, the stability of the surrounding canyon wall is in question. There is also concern that the dam debris and sediment would create an earthen dam downstream of the explosion and block the channel given that nearly all of the Eklutna River's flow is diverted at the upper Eklutna River dam. The potential is also great for fractured or loose material in the canyon wall to contribute to the debris pile in an unknown quantity. Eklutna, Inc. estimated this alternative would cost approximately **$7 million total**. The applicant determined that this option poses too many risks to safety and given the complicated and logistics, this option was deemed not to be practicable.

8.0 References

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HDR. 2016b. *Office-based Jurisdictional Determination Report and Functional Assessment, Eklutna Dam Removal.* Prepared for The Conservation Fund, March 3, 2016.

IpaC. 2016. The United States Fish and Wildlife Service (USFWS) Ecological Conservation Online System (ECOS) on-line Information, Planning, and Conservation decision support system (IPaC) website was queried to determine if federally-listed threatened, endangered, proposed, candidate or other sensitive species under USFWS management occur near the dam site. https://ecos.fws.gov/ipac

Johnson, J and V. Litchfield. 2015. *Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes – Southcentral Region, Effective June 1, 2015.* Alaska Department of Fish and Game, Special Publication No. 15-07, Anchorage.

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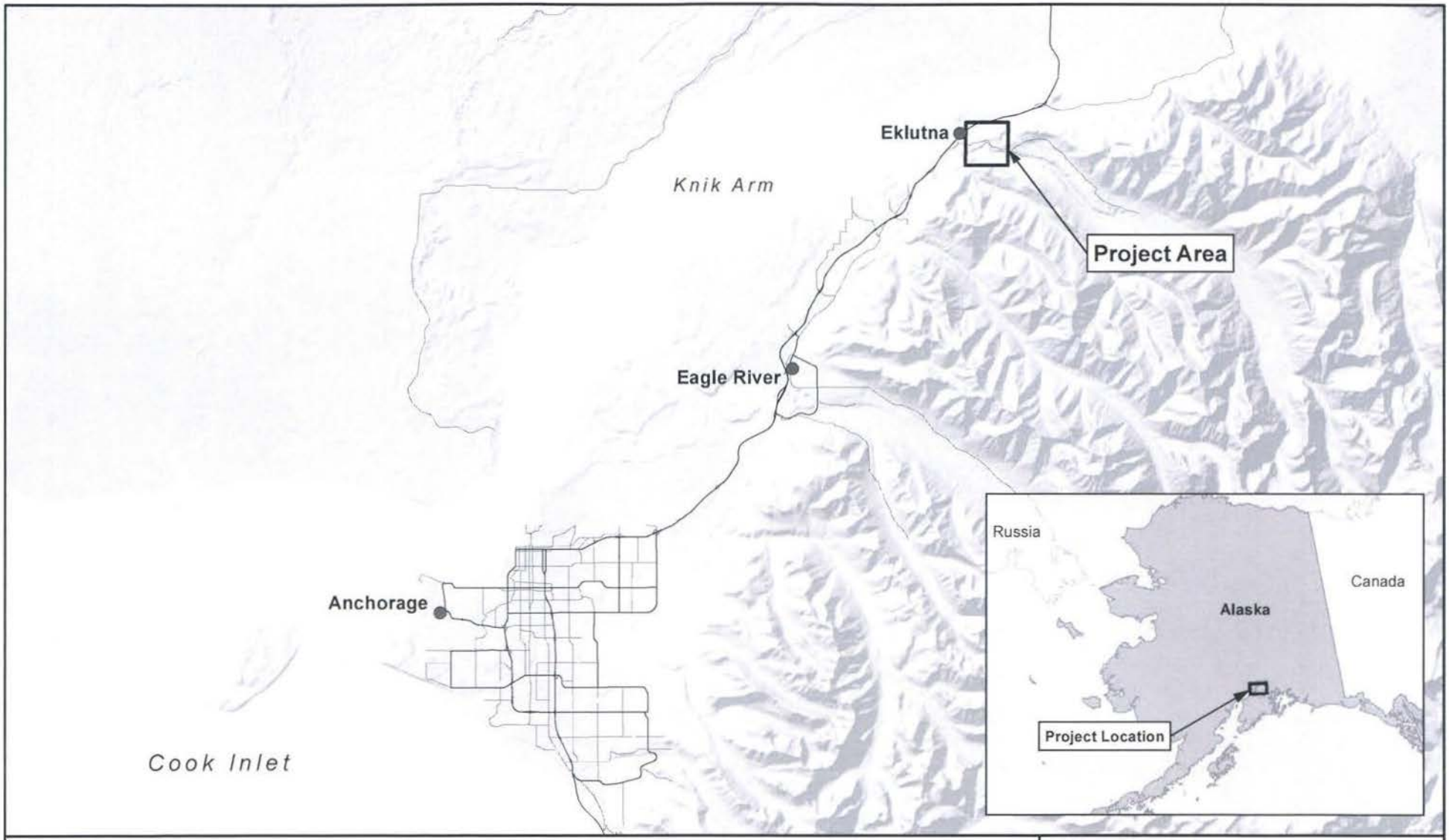
Rypkema, J. 2016. Telephone correspondence between Erin Cunningham (HDR) and Jim Rypkema (Alaska Department of Environmental Conservation) on April 29, 2016.

United States Fish and Wildlife Service (USFWS). 2009. *Land Clearing Timing Guidance for Alaska: Recommended Time Periods to Avoid Vegetation Clearing.* Prepared by the USFWS July 2009.

Urbanus, J. 2016. Email correspondence between Joe Miller (HDR) and Jeffrey Urbanus (Municipality of Anchorage Public Works Department) confirming that a flood hazard permit would not be necessary for this project and that the MOA should be courtesy copied on other permit applications. Email dated April 14, 2016.

9.0 Appendix A: Permit Application Drawings



Town
Project Area
Highway
Road

N

0 2.5 5 10 Miles

APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

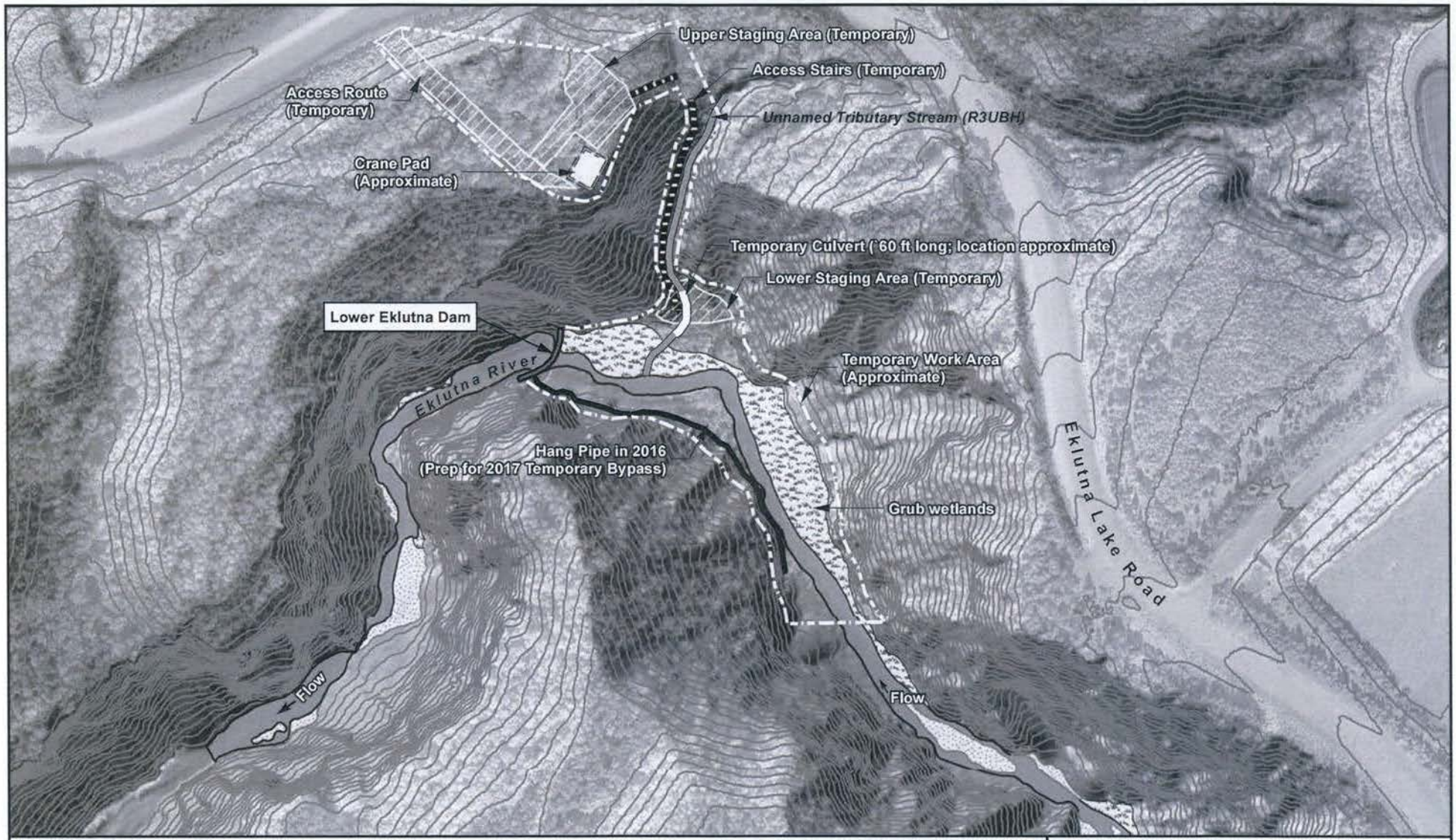
WATERWAY: Eklutna River

PROPOSED ACTION: Dam Removal

LOCATION: Sections 29, 30, Township 16N, Range 1E, Seward Meridian

SHEET 1 of 8 DATE: October 31, 2016

VICINITY MAP



Wetlands

NWI Code

- PSS1C
- R3UBH
- R3USC

- Lower Eklutna Dam
- River Flow Direction
- Contour (10ft)
- Crane Pad
- Temporary Stairs

N

0 125 250 375 500 Feet

APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

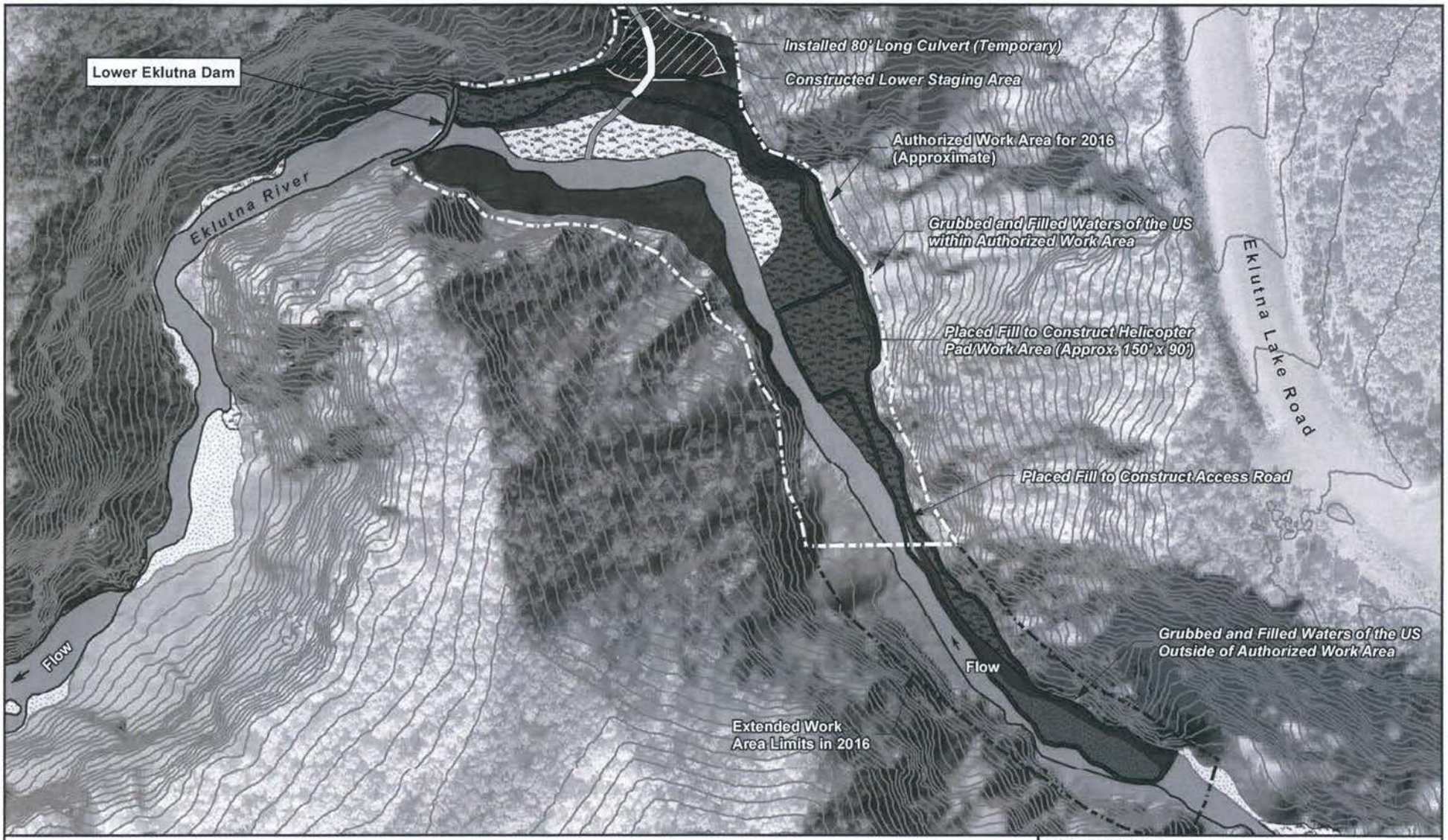
WATERWAY: Eklutna River

PROPOSED ACTION: 2016 Site Preparation for 2017 Dam Removal

LOCATION: Sections 29, 30, Township 16N, Range 1E, Seward Meridian

SHEET 2 of 8 DATE: November 02, 2016

Activities Authorized by POA-2016-248



APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

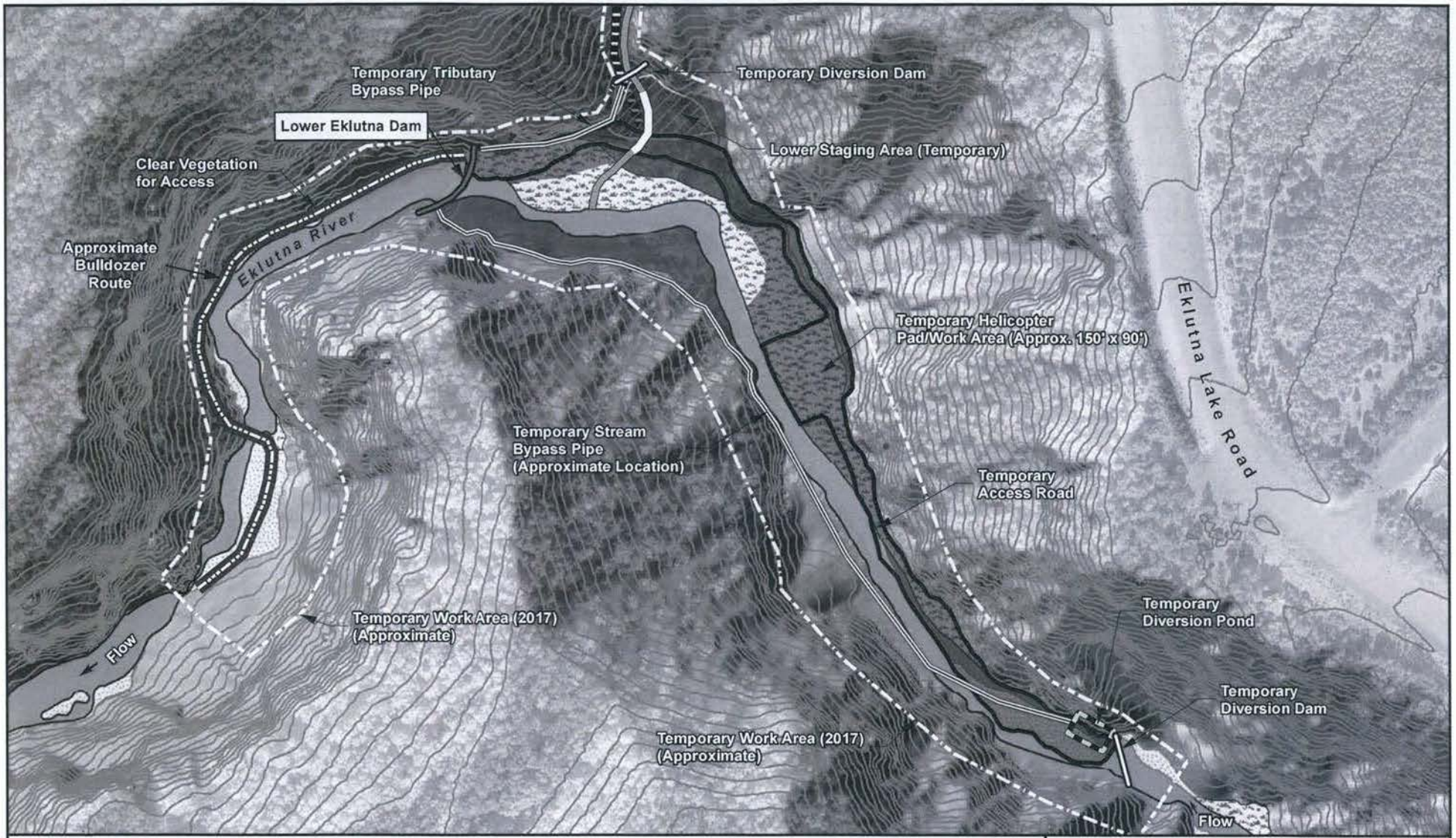
WATERWAY: Eklutna River

PROPOSED ACTION: 2016 Site Preparation for 2017 Dam Removal

LOCATION: S29, 30, T16N, R1E, Seward Meridian

SHEET 3 of 8 DATE: November 02, 2016

ACTIVITIES CONDUCTED IN THE CANYON IN 2016



Wetlands

NWI Code

- PSS1C
- R3UBH
- R3USC
- Unnamed Tributary

- Lower Eklutna Dam
- Temporary Diversion Dam
- Temporary Diversion Pipe
- Temporary Work Area
- Contour (10ft)

- Approximate Bulldozer Route

N

0 100 200 300 400 Feet

APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

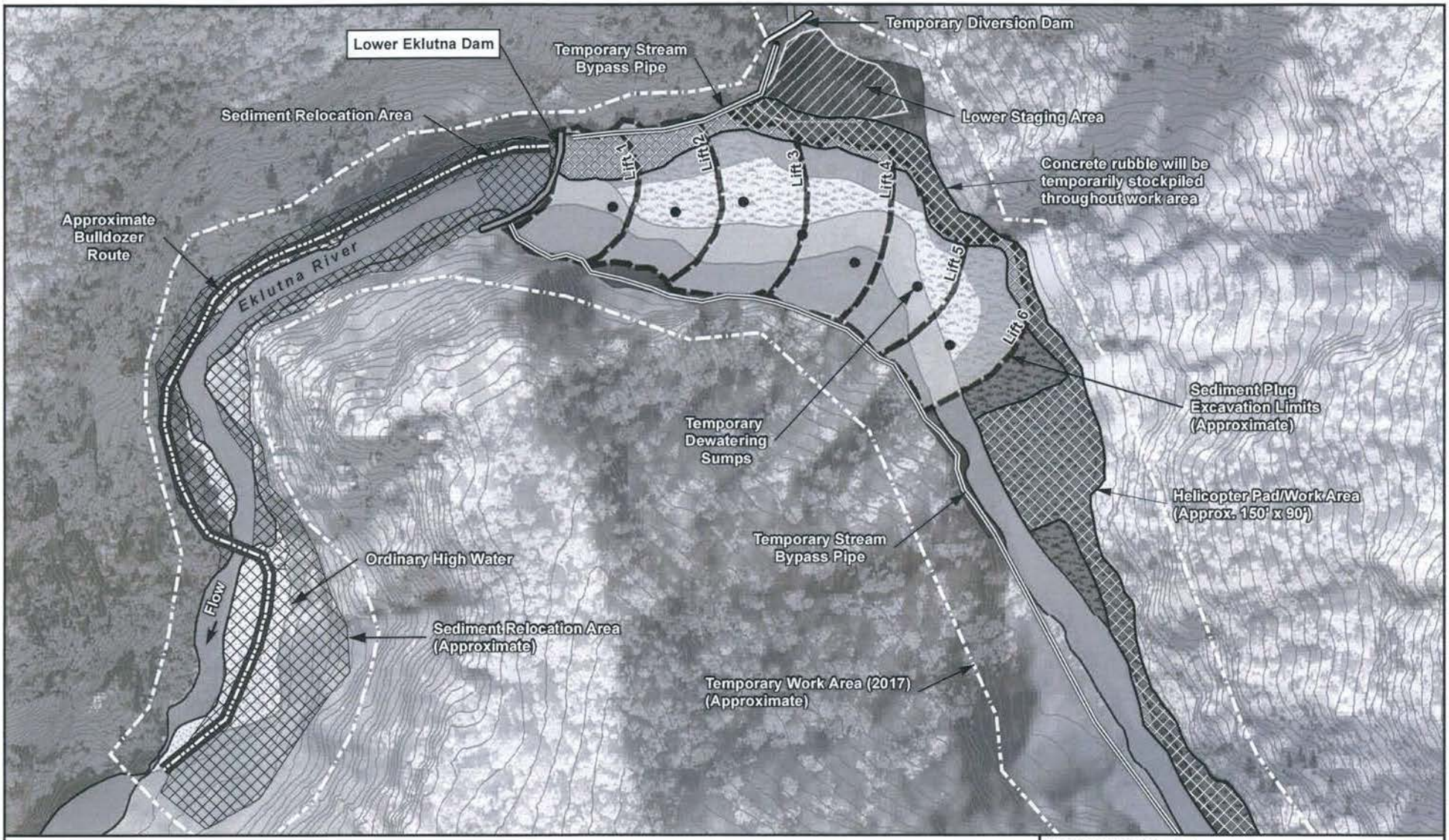
WATERWAY: Eklutna River

PROPOSED ACTION: Dam Removal

LOCATION: Sections 29, 30, Township 16N, Range 1E, Seward Meridian

SHEET 4 of 8 DATE: November 02, 2016

2017 SITE LAYOUT AND ACCESS IN CANYON



Wetlands

NWI Code

- PSS1C
- R3UBH
- R3USC

- Temporary Diversion Dam
- Lower Eklutna Dam
- Temporary Water Bypass Pipe
- Unnamed Tributary
- Temporary Dewatering Sumps
- Sediment Relocation Areas (Approximate)
- Sediment Plug Excavation & Lift Sequence
- 10 foot Contour

N

0 100 200 Feet

APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

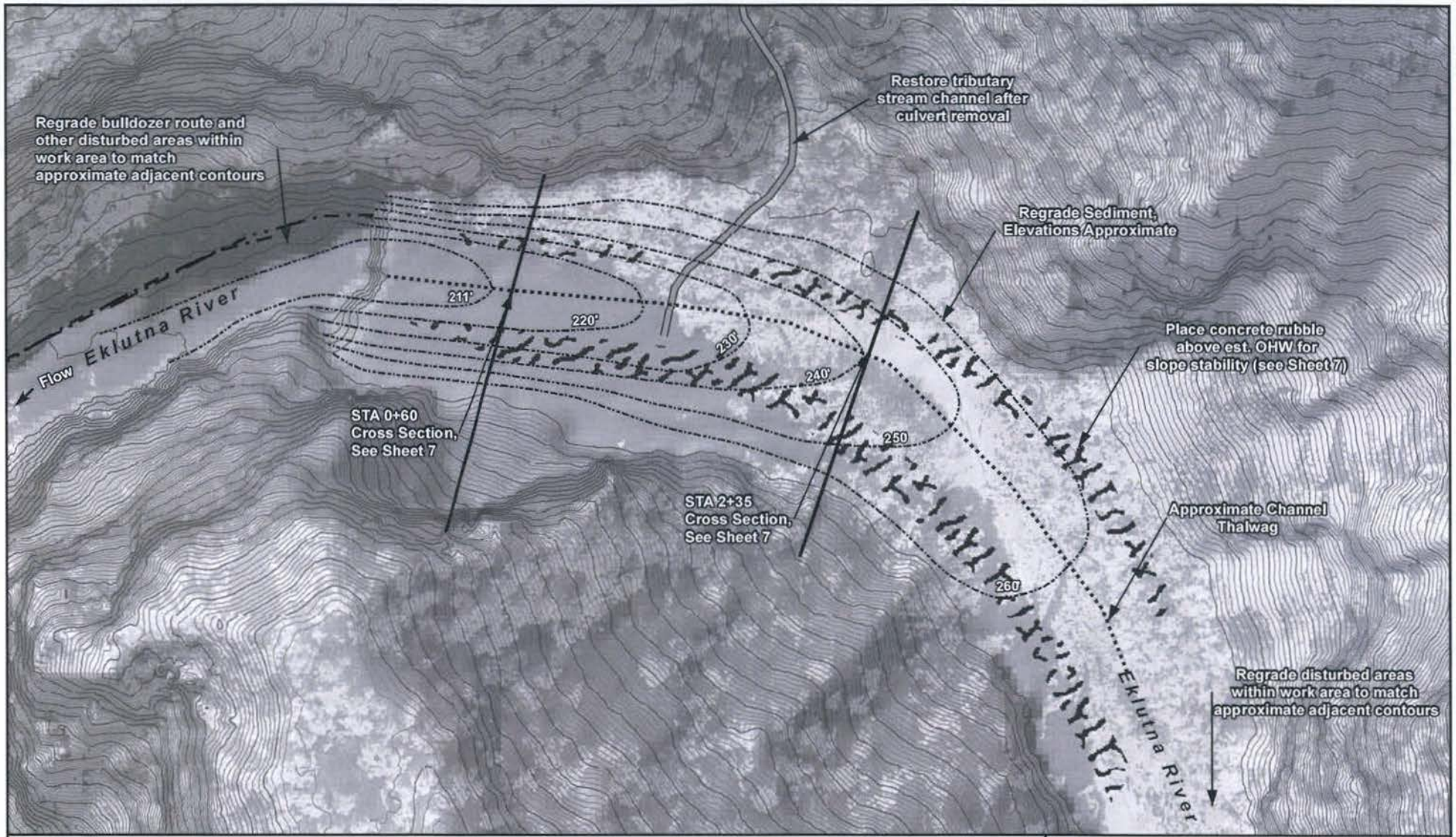
WATERWAY: Eklutna River

PROPOSED ACTION: Dam Removal

LOCATION: Sections 29, 30, Township 16N, Range 1E, Seward Meridian

SHEET 5 of 8 DATE: November 02, 2016

SEDIMENT RELOCATION AND DAM REMOVAL - PLAN



See Sheet 7 for Sediment Cross Sections

Concrete Rubble (Approximate)

Valley Centerline

Final Grade Contours (Approximate)

Existing Contours (2ft above 200ft)

N

0 60 120 Feet

APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

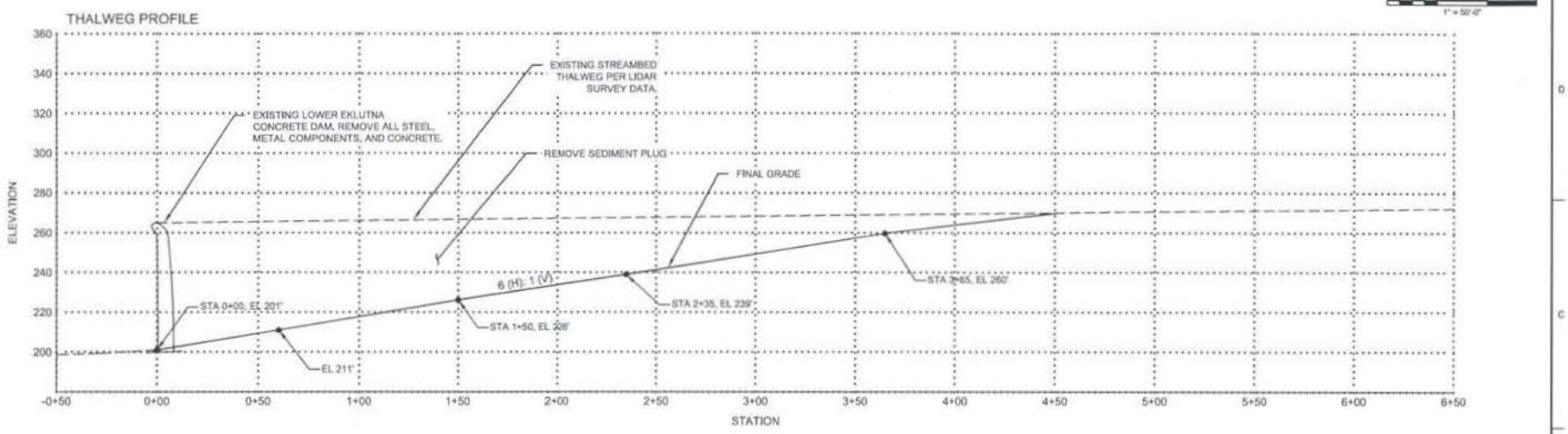
WATERWAY: Eklutna River

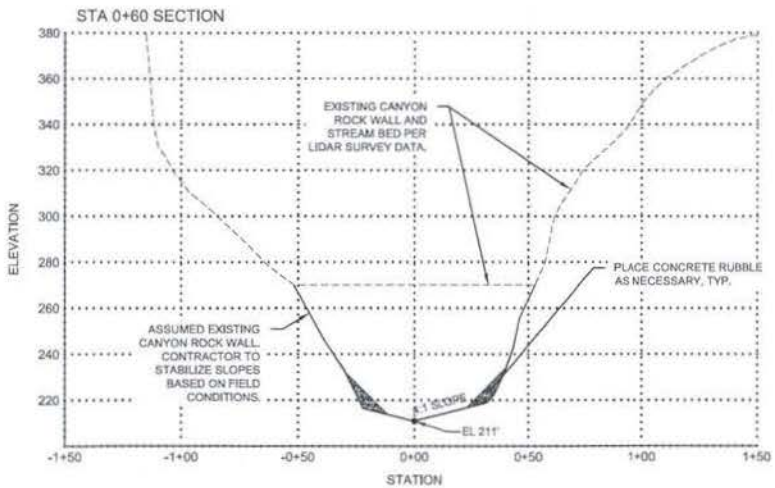
PROPOSED ACTION: Dam Removal

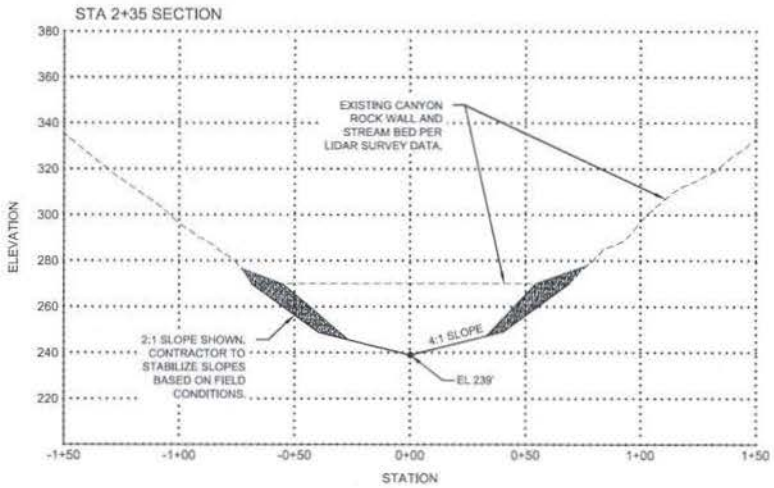
LOCATION: Sections 29, 30, Township 16N, Range 1E, Seward Meridian

SHEET 6 of 8 DATE: November 03, 2016

FINAL GRADING - PLAN VIEW







APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

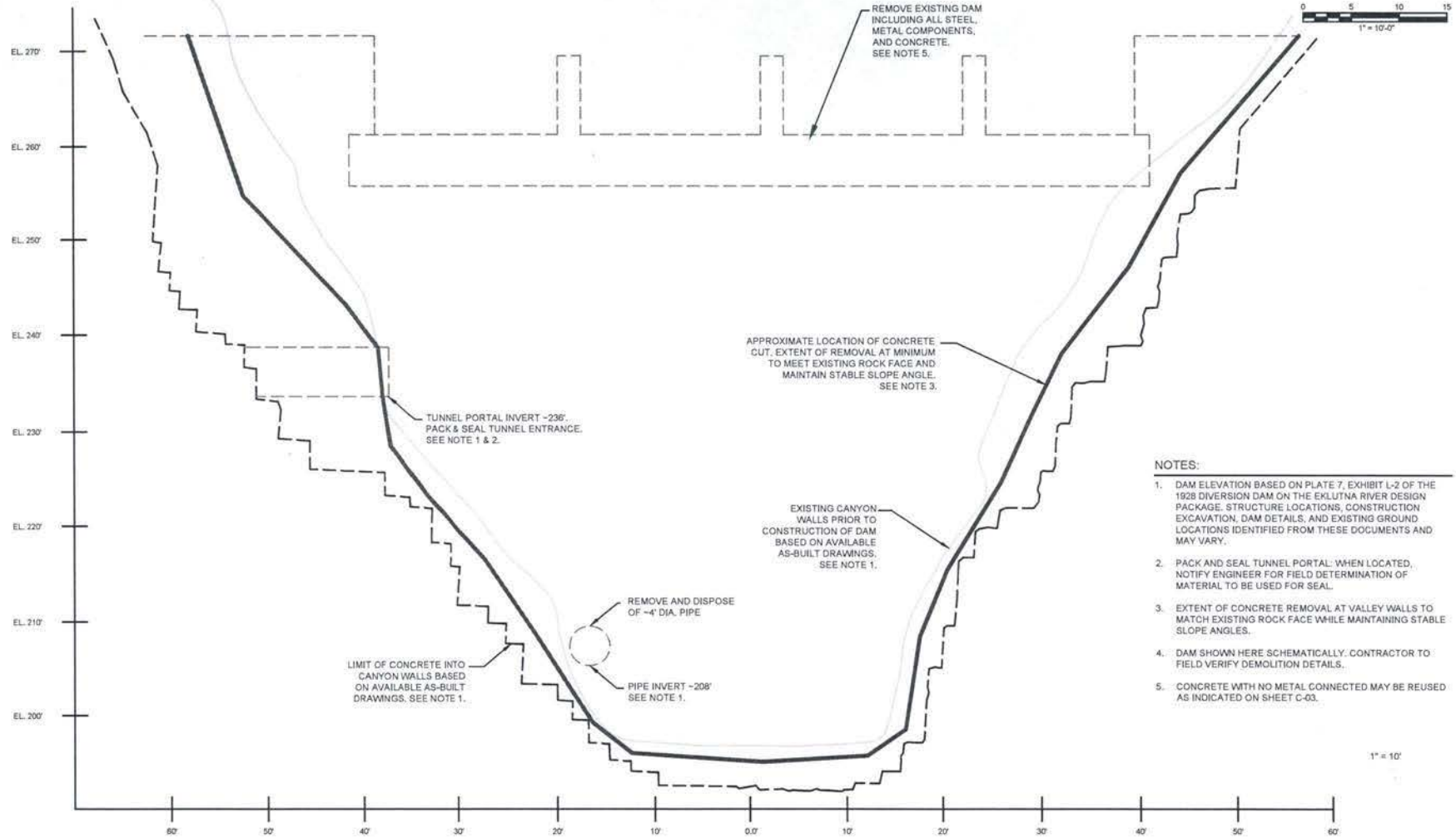
WATERWAY: Eklutna River

PROPOSED ACTION: Dam Removal

LOCATION: Sections 29, 30, Township 16N, Range 1E, Seward Meridian

SHEET 7 of 8 DATE: November 1, 2016

EKLUTNA DAM CROSS SECTIONS



APPLICANT: Eklunta Inc.

FILE NO: POA-xxxx-xxx-xx

WATERWAY: Eklutna River

PROPOSED ACTION: Dam Removal

LOCATION: Sections 29, 30, Township 16N, Range 1E, Seward Meridian

SHEET 8 of 8 DATE: October 31, 2016

EKLUTNA DAM ELEVATION

10.0 Appendix B: Dam Deconstruction Plan

HDR

Memo

Date: Tuesday, November 15, 2016

Project: Eklutna River Lower Dam Removal

To: Alaska Department of Natural Resources Dam Safety Division

From: Joe Miller, HDR, Inc.

Subject: Dam Removal Methodology

The Eklutna River lower dam is a concrete-arch dam approximately 70- feet tall and 100 feet wide at the crest. The dam will be demolished using mechanical methods, including hydraulic jackhammers, Brokk remote control demolition robots, expandable foam, or a combination of the three. This method requires removing sediment away from the upstream face of the dam in order to expose the concrete and provide access for the demolition equipment.

The sediment will be dewatered and graded to a 6:1 slope during removal to maintain worker safety. The dam will be demolished in 10 sections; as sediment is removed to expose the concrete, it will be cast over the downstream face of the dam using a conveyor belt. This sediment will then be mobilized away from the dam face using Eklutna River bypass water and a D6 bulldozer.

Exposed metal along the crest of the dam will be cut off and removed from the canyon. Concrete from the dam will be broken down into 12-inch diameter sections or smaller; larger pieces that contain embedded metal will be removed form the canyon. The concrete will be temporarily stockpiled upstream of the dam and repositioned along the canyon walls once demolition is complete.

The first demolition section includes the initial sediment layer removal of 8 feet followed by four feet of concrete from the crest in order to maintain a four-foot safety barrier. Demolition sections two through eight includes removing six feet of sediment followed by an additional six feet of concrete to maintain the four-foot safety barrier. Demolition nine will remove six feet of sediment followed by an additional 6 feet of concrete leaving a 4.5-foot wall as a safety barrier. The tenth and final demolition will remove the remaining four-plus feet to the base of the dam for complete demolition.

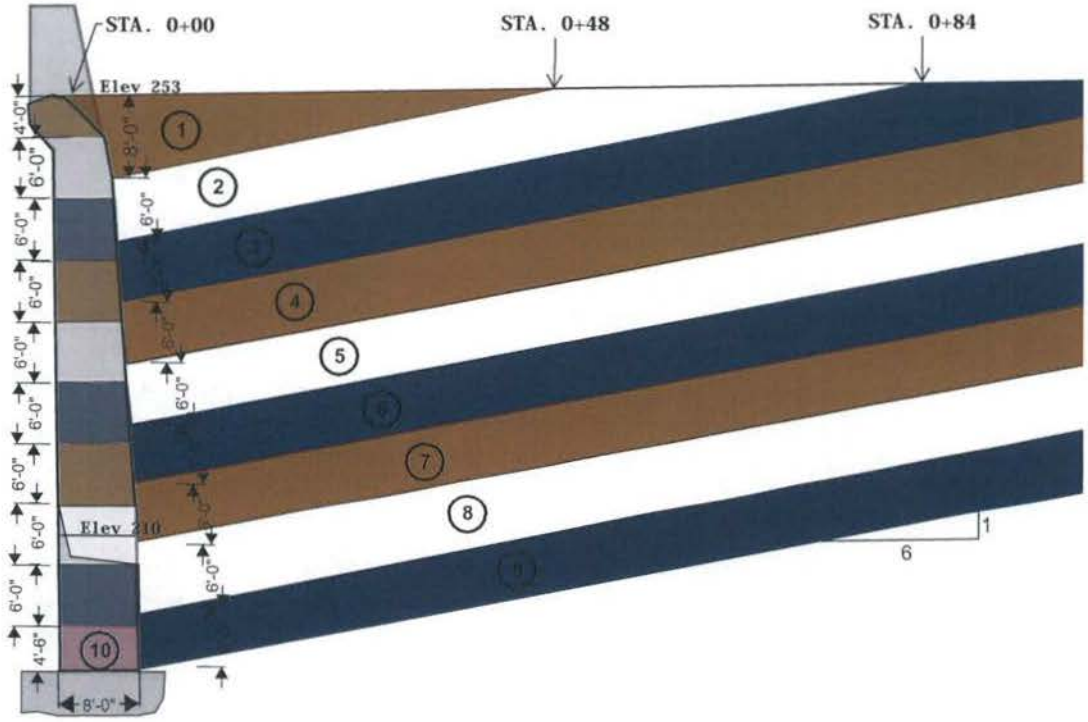
The diversion tunnel, which is located along the right abutment approximately ten feet below the crest, will be plugged for safety considerations. The abutments will likely remain in place on the canyon walls unless there is a risk of falling in to the canyon. This will be determined with a pull test during removal.

The demolition sections are shown in the illustrations below.

Eklutna Construction & Maintenance, LLC

Demolition Profile

Demo 1 = 8' Initial Layer Removal followed by 4' Concrete Elevation Demolition to m
Demo 2-8 = 6' Layer Removal followed by 6' above Concrete Elevation Demolition to
Demo 9 = 4' Layer Removal followed by 6' above Concrete Elevation Demolition to m
Demo 10 = 4'6" Concrete Elevation Demolition to Dam base to complete total demoli



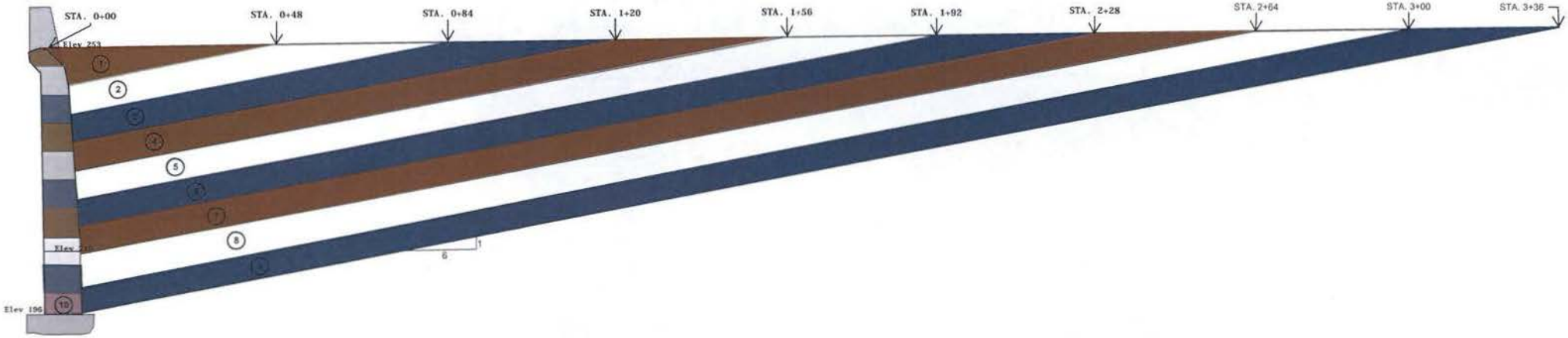
Demolition Sequencing Plan
Version 1.0
Rev. 11-7-2016

Eklutna Construction & Maintenance, LLC

Demolition Profile- Full Scale

Demo 1 = 8' Initial Layer Removal followed by 4' Concrete Elevation Demolition to maintain 4' safety barrier
Demo 2-8 = 6' Layer Removal followed by 6' above Concrete Elevation Demolition to maintain 4' safety barrier
Demo 9 = 4' Layer Removal followed by 6' above Concrete Elevation Demolition to maintain 4' safety barrier
Demo 10 = 4'2" Concrete Elevation Demolition to Dam base to complete total demolition

From Station 0+00 to Sta 3+36



Demolition Sequencing Plan
Version 1.0
Rev. 11-7-2016

Eklutna Construction & Maintenance, LLC

Dam Demolition Profile - Dam Demolition Sequence