Pelican Hydroelectric Plant
Historic Water Conveyance System
Pelican, Chichigof Island, Alaska

HISTORIC AMERICAN ENGINEERING RECORD (HAER)
LEVEL II: WRITTEN HISTORICAL REPORT

Name: Pelican Hydroelectric Plant Historic Water Conveyance System

Location: Pelican, Alaska
USGS Sitka D-7 Topographic Quadrangle Map; Township 45 South, Range 56 East, Section 20, Copper River Meridian
UTM Coordinates at Dam: E 428084 N 6424689 (NAD83, Zone 8)
UTM Coordinates at Penstock: E 427810 N 6424605 (NAD83, Zone 8)

Present Owner: Pelican Utility District

Present Use: Water supply for hydroelectric plant and city potable water

Significance: The Pelican Hydroelectric system is significant at the local level for its association with the settlement and development of Pelican, Alaska from 1938 to current. The hydroelectric system was a key component in the operation of the Pelican Cold Storage facility. It provided necessary electrical power to run the plant. The system continues to supply both electrical power and potable water for the town. The water conveyance system (intake, flume, surge tank, and penstock) is significant as an example of a wood-box flume and penstock pipe dating to the late 1930s. Wood flumes of this era still in operation are rare, and the Pelican flume represents a unique opportunity to witness a fully-functioning historic water conveyance system.[1]

Historian(s): Burr Neely, M.A., R.P.A., Project Historian, Northern Land Use Research, Inc. (Summer 2009)

Project Information: The Pelican Utility District (PUD) proposes to remove the existing historic water conveyance system and replace it with modern pipe for better efficiency and lower maintenance costs. A license renewal from The Federal Energy Regulatory Commission (FERC) is required to continue operation of the hydroelectric plant. Consultation between FERC and the Alaska State Historic Preservation Office determined that the water conveyance system is a significant historic property, and a Memorandum of Agreement was executed (Summer 2009) to mitigate the adverse effects to the property that will result from its removal and demolition. The MOA calls for completing a modified Historic American Engineering Record (HAER) documentation package prior to project commencement.

[1] This report represents part of the historic documentation package prepared as mitigation of adverse effects associated with the eventual demolition of the flume. It is being replaced by a modern pipe. Part of the historic flume box collapsed in August 2009, only one month after the field documentation of the hydroelectric system was completed. As of April 2010, the flume was cobbled together to continue service until the new system is on-line later this year.

Part I. Historical Information

A. Physical History

1. **Construction:** The flume was constructed between 1938 and 1941 by the Pelican Cold Storage Company. The route was cleared of vegetation up to the impoundment location and construction started with the dam. No records of construction costs, labor, material costs, suppliers, or other pertinent information was found. Much of the timber for the trestles was locally harvested spruce and cedar. There was a sawmill in Pelican, which may have supplied locally milled dimensional lumber for construction, but it is likely material was also barged in from Seattle and Juneau.

2. **Architect/Engineer:** The Pelican Cold Storage Company constructed the hydroelectric system including the dam, flume, surge box, penstock, and original power plant. The specific project and engineer are not known. However, early diagrams and drawings of the head box and penstock were prepared by H.W. Beecher, Consulting Engineers (1941) and flume drawings were prepared by R.R. Poppleton Inc. Portland and Seattle (1938).

   A direct association with Henry Ward Beecher, civil engineer for the Brooklyn Bridge (among other things) is unlikely, as he died in 1887. But a contemporary roster of engineers in the Seattle area lists an H.W. Beecher, mechanical engineer and grandson of Henry Ward Beecher (Leonard 1922). It is probable that the grandson or his firm was the consulting engineer for the head box and penstock configuration at Pelican. By 1948, H.W. Beecher joined P.R. Sandwell of Vancouver to form Beecher and Sandwell, a consulting engineering firm focused on heat and power generation (Anon. 1948).

   R.R. Poppleton, Inc. was likely an electrical engineering outfit with offices in Portland, Oregon and Seattle, Washington. Though the specific corporate history is unknown, one reference noted that R.R. Poppleton and Company was awarded a contract to construct an electrical substation and transmission line from Shelton to McCleary, Washington in 1929 (Anon. 1929) which suggests power generation and transmission was the firm's primary focus.

3. **Building Contractor/Supplier:** Much of the wood used for the construction of the water conveyance system was native cedar. Additional supplies and materials were purchased and transported from Seattle by the Pelican Cold Storage Company. The specific supplier is not known at this time.

4. **Original Plans:** Drawings of the head box and penstock were prepared by H.W. Beecher, Consulting Engineers (1941). Flume cross-section diagram completed by R.R. Poppleton Inc. Portland and Seattle (1938).

5. **Alterations and Additions:** The water conveyance system has undergone continual maintenance and sections have been rebuilt or modified as necessary to maintain an operating flume. Annual maintenance additions to the flume

typically include: (1) placement of 4-inch channel steel on each sidewall connected with tie rods under and over the flume box to provide additional lateral support, (2) replacement of deck planks as needed due to rot and deterioration, (3) adding or adjusting iron tie rods, turnbuckles, and eye bolts drilled into the uphill side of the flume and cliff face to prevent leaning and downhill collapse of the flume box, and (4) adding plywood lining to the inside of the box to prevent leaks and stabilize sidewalls.

In the early 1970s, the majority of the wood flume box between the tunnel and the surge box (roughly 375 linear feet of the 700-foot-long flume) was reconstructed due to deterioration and instability. Narrower (1 x 6") sidewall planks with double tongue-and-groove edges replaced the original and wider (1 x 8") single tongue-and-groove sidewall planks. The original 4 x 6" wood-beam braces spanning the top of the flume box were replaced with 4 x 4" beams. A handrail constructed of 2 x 4" boards was also added at this time. The original trestles supporting the flume and penstock were maintained.

A blow-out in the mid 1980s in the first trestle section of the flume required repair, and the resulting sag in the flume box was corrected by adding another 2 x 6" inch plank to the top of each sidewall to compensate for the dip in elevation along this approximately 100' long section.

A major dam upgrade project between 1995 and 2003 resulted in the addition of a steel I-beam framework to the downhill face of the original log crib dam and steel superstructure surrounding the flume intake gate. This included the placement of seven I-beam angle braces attached to the downhill face of the dam (imbedded in bedrock and bolted/welded to addition horizontal steel beams across the front of the log cribbing), and a welded I-beam frame to support the platform over the flume intake (particularly to reinforce the wood posts holding the operating gate) and wing wall over the intake area. The cedar plank-lined spillway was widened to accommodate seasonal water fluctuations and both bridge abutments and wing-walls were replaced and reinforced. Many of the planks on the spillway deck were replaced, though the original planks on the dam face remain in place.

Historical photographs indicate the original intake gate was constructed of wood and a metal gate is currently present, though the date of this alteration is not known.

Some components in the design prints vary from current conditions. For example, the original diagrams indicate bracing on each side and the top of the penstock pipe, though no such bracing is currently present and the wood stave pipe is supported by a cross-timber with a U-shape cut to hold the pipe in place. Another illustration shows the base of the box flume as being supported by 2 x 12" stringers on end with wood-cross sisters and sidewall angle braces that extend from sill logs to the top of the flume box. The existing flume box rests on 6 x 6" stringer timbers (spanning longitudinally between the trestles) with 4 x 6" sills that extend beyond the width of the flume to provide base anchors for the lateral angle bracing. The current angled bracing extends roughly one-third up the flume wall height and does not extend to the top as suggested by the drawing. Whether the variances between the design plans and currently observed construction method represent alterations is unclear; the flume may have originally been constructed differently from the plans.

B. Historic Context:

1. **Hydropower Overview:** The hydropower potential of Southeast Alaska has been discussed in detail since the beginning of the twentieth century. As early as 1908, there were over 30 developed waterpower sites, with a total capacity of 15,319 horsepower, operating in the Southeast (Whitehead 1983). At this time, the U.S. Department of the Interior conducted a water-power reconnaissance to assess the potential for further development of hydropower facilities in the Southeast (Hoyt 1915). By 1924, the federal government had hopes that the Southeast would be "another Norway," believing that the hydropower potential coupled with abundant timber would make the region a leading force in the paper pulp industry (Dort 1924). The plant at Pelican was one of a number of such hydroelectric facilities constructed in Alaska in the first part of the 20th century to provide power for communities and small-scale local industries (e.g., Whitehead 1983).

2. **Pelican Historic Context:** Key environmental factors, such as proximity to the fishing grounds, deep water for steamboat access, and potential for hydropower, all converged in the place that was to become Pelican (DeArmond 1996b). The town was founded in 1938 by Kalle "Charlie" Raatikainen, popularly known as "Pelican Charlie." Raatikainen was a fisherman in the trolling fleet in Southeast Alaska (Persson 1947). The town takes its name from Raatikainen's boat, Pelican.

   Raatikainen earned his living as a fish buyer for the trolling fleet, and as the salmon catch increased, the cold storage facilities in Sitka and Juneau could not provide the necessary capacity. Raatikainen was often forced to run as far south as Ketchikan with his fish—a 360 mile journey. Tired of this long commute, Raatikainen began to plan for a town closer to the fishing grounds where a cold storage plant could be built (Persson 1947). He found an ideal place at the site of Pelican, in Lisianski Inlet on Chicagof Island and in 1938, along with partner Henry Roden, incorporated the Pelican Cold Storage Company (DeArmond 1996b). They had plans drawn up for a wharf, fish house, and cold storage building and construction began that same year at the close of the fishing season. Word got out and the place began to be known as Pelican City (DeArmond 1996b).

   In 1939, establishment of a post office lent an aura of permanence to Pelican. As former resident and post master turned historian Bob DeArmond (1996d) noted: "Attitudes among the people living there began to change. Pelican was now a town, not just a place that might be there today and gone tomorrow." After the post office was established, a school opened (for eight pupils), and a sawmill was built and put in to operation, providing rough lumber for the construction of more homes in town (DeArmond 1996d).

Construction of the dam began in 1938 under the direction of Gust Savela (alternately spelled Gus Savila) (Carson and Carson 2008; DeArmond 1996c). Savela was an engineer from Finland who had become a fish buyer in Alaska. Under his direction, local fishermen, paid in company stock, worked through the winter, often with crude, handmade tools, to construct the dam (Persson 1946). Savela and "his crew of Scandinavians" worked on the dam and a local named Jack Koby, who had been mining at the "Lucky Strike" prospect three miles up the Lisianski Inlet from Pelican, was hired to do the blasting (Carson 2009). Material was salvaged for the construction of the plant: the water main to carry water to the cold storage site from the stream that also was to furnish power was made from a string of wood stave pipe that had served the old Columbia salmon cannery on Tenakee Inlet (DeArmond 1996d). The U.S. Federal Power Commission (1947:112) reported that Application No. 1521 for a preliminary permit was filed with the Commission November 10, 1938 by the Pelican Cold Storage Company for the above site. It was issued July 22, 1939. Application for a license was filed July 19, 1941, and was issued July 31, 1942 to the same company. The plant equipment consists of a 20-inch 720 R.P.M., 700-horsepower turbine wheel direct connected to a 625kva, 500 KW, 300-volt generator. The energy is transmitted 2,790 feet to a cold storage plant of the Pelican Cold Storage Company located in Pelican City, and is also used for utility services in connection with the living quarters of the workers engaged by the company.

In addition to the salvaged material, it is possible that lumber freighted up from Seattle was used in construction of the dam and powerhouse. In 1938, the Tongass arrived in Pelican with lumber and other supplies for erection of the cold storage plant and other town facilities (DeArmond 1996c). The freight was unloaded onto the beach, at which point it became clear that the Pelican Cold Storage Company did not have the money to pay for it. After some negotiations, the Tongass skipper agreed to leave the supplies in Pelican and Raatikanen agreed to travel to Seattle to talk with the manager of the company or its owner, Norman Clapp (DeArmond 1996c).

The hydro plant was operational by 1941 (DeArmond 1996d). The completion of the plant was a fortunate development for the cold storage project as it provided 24 hours of electric light and relieved dependence on a faulty gasoline-powered generator (DeArmond 1996d).

Raatikainen and Roden found a financial backer for their enterprise in 1941 when Norton Clapp (whose business had provided initial lumber and supplies to Pelican back in 1938), a prominent businessman in the timber industry, agreed to participate in the cold storage venture (DeArmond 1996d). In 1942, Pelican Cold Storage officially opened and began buying, processing, and freezing fish—the first load of salmon was frozen in August of that year (Carson 2009).

In 1952, the (US Federal Power Commission) license was transferred from the Pelican Cold Storage Company to the Pelican Utility Company. On January 12, 1983, the hydroelectric station burned down (USKH 1983). A new station was built adjacent to the old facility's foundations (USKH 1983). The hydroelectric facility, still operated and maintained by the Pelican Utility District, continues to be an important power resource for the community of Pelican, in conjunction with a bulk fuel (diesel) facility.

Part II. Structural/Design Information

A. **General Description:** The Pelican Hydroelectric System is comprised of five interrelated components that collectively provide a pressurized water supply to operate electrical turbines in the power plant. The five components include: 1) a dam or water intake structure, 2) a flume, 3) a surge box or head box, 4) a penstock, and 5) a power plant. The original power plant was destroyed by a fire in 1982 and a new facility was built adjacent to the old facility's foundations. The remaining four components uphill from the power plant all retain aspects of the original water conveyance system and are the focus of the structural documentation. Descriptions of each component are provided starting at the intake and following the flow of water to the power plant. The interaction of the components in a complete system and the current condition are reviewed separately following the structural description.

B. **Dam/Water Intake:** The prime deciding factor in constructing a hydroelectric plant at Pelican (as apposed to some other creek in the area) was the close proximity of the hanging valley on Pelican Creek to the coast. A significant drop in elevation at the precipice of any hanging valley is the prime spot to construct a dam and water impoundment. In many watersheds in Southeast Alaska, the hanging valley ledge is far away from the coast which would require constructing a longer flume to convey water and maintain the necessary elevation and generate a drop sufficient enough to operate the power turbines. The dam location at Pelican is less than one-quarter mile from the coast, has sufficient elevation to create needed water pressure, and therefore would require a much shorter flume.

The dam itself is a typical wedge-shaped log crib dam with a vertical downhill wall and an angled upstream face. Roughly 12 to 16" diameter logs were built into a 35' long by 15' wide (base measurement) hollow crib that spanned the valley floor and was then backfilled with rock. The 12' tall crib is approximately 10' wide at the top and capped with butted, flat-lying 2 x 8" and 2 x 10" planks that act as the spillway deck. The deck was completely reconstructed and widened in 2002. The face of the dam is lined with doubled up 2 x 8" yellow cedar planks that overlap the upstream side of the deck and create an ogee curve effect as water crosses over the spillway. The entire crib structure is now braced by a series of steel I-beams on the vertical downhill wall. Seven beams were visible underneath the waterfall; though design drawings indicate as many as 10 beams were added during the retrofit and upgrade project (described above).

The overall length of the dam measures approximately 60' between abutments. The spillway is flanked by two wing walls. The L-shaped left wing wall (as observed facing downstream) was reconstructed during the dam upgrade project in the late 1990s. The

5’ tall (from water line) wall is constructed of 2 x 10” double tongue-and-groove planks placed vertically in an L-shape around a steel reinforced substructure (no steel is visible). The face of the wing wall perpendicular to the spillway is approximately 10’ wide and there is a shorter wall constructed of horizontal boards paralleling the spillway. The vertical face boards on the impoundment side of each wing extend into the water. This side of the dam was not accessible.

The right wing wall is consistent in construction design and materials to the left wing wall, but it is longer and includes two separate walls. The first wall is the same L-shaped design with a 5’ wide by 5’ tall short wall with horizontal 2 x 8” and 2 x 10” boards paralleling the spillway and an approximately 18’ long face wall with vertical 2 x 8” boards that extend into the water. The face boards on the impoundment side of the wing wall are doubled up to cover seams and prevent seepage. There is a 3’ wide deck at the base of the short wall overlooking the spillway and water intake opening which is accessed from a short wooden catwalk extending off the end of the flume. This section of the wall was also reconstructed during the dam upgrade and stabilization project and it is back-supported by various scrap timbers and steel I-beam braces. There is an additional 10’ long wing wall extension off of the end of the L-shaped wall which likely represents an original section of the wing wall that was not replaced during the upgrade. The extension wall is also constructed of vertical planks that extend into the water. All the wing walls are slightly angled to match the slope of the impoundment face. Wire nails, including 6” spikes, are used to fasten wing wall and spillway deck boards together.

The flume intake opening is at the toe of the impoundment face and tunnels underneath the right wing wall at a roughly 45 degree angle. The intake channel is excavated out of bedrock, and 2” pipe set at 1’ intervals covers the opening to prevent debris from passing into the flume box. The intake channel under the wing wall is approximately 10’ long from the face of the dam to the start of the flume box. Historic photographs taken during construction indicate the intake channel has a square, U-shaped profile lined with poured concrete. This feature was not visible during documentation as it is under the wing wall and full of rushing water, though a poured concrete cap over the intake channel was observed. Log cribbing parallel to and on the uphill side of the flume extends beyond the downstream edge of the intake channel and appears to be part of the abutment’s substructure.

There is an iron delivery head gate on the downstream side of the intake channel to regulate water flow into the flume box. The gate is accessed by a 4’ wide by 9’ long wood-plank catwalk constructed of 2 by 4” boards suspended over the flume supported by a 2” angle iron framework that is welded and bolted to the larger retrofitted I-beam structure on the back side of the wing wall. The iron head gate is a hand-powered screw operated mechanism with a 1’-8” diameter wheel that turns a ¾” screw affixed to the gate. The wheel is bolted to a 4 x 4” cross timber and operates a 4’-10” wide iron sheet metal gate. The gate slides on 2 ½” wide wood posts that are reinforced with steel rails, and metal plates bolted to the posts reduce friction when opening or closing the gate. No manufacturer marks or labels were observed on the delivery head gate, and it is very likely an expediently constructed mechanism using locally derived or salvaged materials.

A catwalk supported by two round logs spans the flume at the downstream side of the head gate deck. This catwalk allows for access from the spillway by bridging over the flume box leading up to the right abutment. The wood box flume component of the system starts immediately after the head gate.

C. Flume Overview: The Pelican Flume is a typical wood box flume. Overall, it measures nearly 700' long from the intake to the surge box above the power plant, though water passes through a roughly 90' long tunnel near the dam leaving just over 600' of wooden flume box. The flume consists of both bench sections supported by grade or a slight cut in the side hill and elevated sections supported by trestles spanning the ravines. The flume descends from 142½' above sea level (FASL) to 139½ FASL at the top of the surge box; losing only 3' over its entire length.

Basic components of the Pelican flume include a 5' wide by 5½' deep boxed waterway. The box base is typically supported by 4 x6" lateral sill timbers placed every 4' that extend beyond the width of the flume box. On grade sections, the sills are supported by cribbed piers or scrap wood. In trestle sections, the lateral sills are supported by three evenly spaced 6 x 6" longitudinal stringers that span distance between trestles. The trestle supports (bents) are situated 6' to 8' on center and constructed of two vertical 12" to 16" diameter round posts capped with a 12 x 12" timber which then supports the stringers. Cross bracing, both laterally between piers and longitudinally between separate trestles, is accomplished with 3 x 8" diagonal timbers that are through-bolted to the piers with ½-inch diameter bolts and malleable washers. Depending on the span, trestles supporting the flume box range from 6' to 15' tall.

The flume box sidewalls are supported by vertical timbers placed every 4' that are attached to the lateral sills under the box. Bevel-cut knee braces are placed near the base of the vertical posts to prevent outward expansion, and additional blocking is used at the base of the vertical post to prevent spreading. The lateral cross beams are typically attached to the sidewalls with wire spikes. Typically, 4 x 6" timbers span the top of the flume box and are affixed to the vertical sidewall posts for additional lateral support. In many instances threaded ½" diameter by 5' long rod iron bolts at the top of each vertical post span the flume box to connect with the matching vertical post on the opposite side for even more support. The boards that span over the flume box also provide the support for the longitudinally placed 2 x 12" by 12' long deck boards.

Distinct variations were observed in the dimensional lumber sizes used for vertical and lateral bracing and deck construction. Even with these variations, the main components and feeling are retained throughout entire flume system. The character defining features, such as the wood box sidewalls, angled sidewall knee braces, weathered decking planks, and log trestles are maintained along the entire length of the flume. Each flume section is described in more detail below.

1. **Flume Section 1:** Section 1 of the flume starts at the intake head gate and continues approximately 100' to the upstream side of the tunnel. The first 50' spans the vertical cliff to a rock outcrop at the mid-point of Section 1. It then sits on a slight shelf excavated out of the cliff face above the chasm created by the waterfall. The typical U-shaped wooden flume box rests on 4 x 8" and 3 x 5"

cribs and blocks where necessary to maintain grade and support, though the first 20' are supported by a reverse timber truss extending from the dam sub-structure to bridge the vertical face (not visible from the flume). The original 4 x 6" sill boards are intact and extend roughly 16" beyond the width of the flume to support the vertical 4 x 6" sidewall bents with angled knee braces. The sills are on 4' centers.

There are two types of sidewall support bents used throughout the flume: full and half. Full bents consist of vertical 4 x 6" posts that are spiked to the outside of the sidewalls and connected across the top with a 4 x 6" beam that spans the top of the flume box. The full bents include angled knee braces at the base which are nailed to the 16" extensions of the sill beams. These angled braces are one of the main character defining elements of the structure. Half bents consist of likely more recently added 4 x 6" vertical posts that are also nailed to the outside of the sidewalls, but connected across the top to posts on the opposite side with threaded rod iron tension bolts to prevent outward spreading. The half bents in Section 1 are evenly spaced on alternating 4' centers between the full bents. The sidewalls are constructed of 8 or 9 courses of 2 x 6" tongue-and-groove planks on end. The downhill sidewall is capped with a 2 x 4" board to which the handrail is nailed. Some of the vertical posts extend 4" to 6" above the deck.

More recent reinforcements have been added where necessary, and usually involve a 3 x 3" pressure treated posts on each side connected with rod iron tension bolts, or posts built with 2 x 4" boards sandwiching 7/8" plywood. There are also 2 x 8" boards sistered to original bents for more support. Additionally, 5' tall pieces of 4" channel steel have been added to the outside of the sidewalls and through bolted at the top and bottom with rod iron bolts that connect to a matching piece of channel steel on the opposite side. Pieces of the deck have also been replaced as needed with 2 x 12" pressure-treated planks.

Overall, 11 of the 24 original vertical supports in Section 1 are still largely intact as observed on the downhill side of the flume box. The uphill side is obscured by slumping earth and vegetation. The first 20' of the flume box are supported on the uphill side with guy wires threaded through adjustable turnbuckles.

Nearer the tunnel, there is a 15' long kick-out along the uphill side of the deck to allow for storage containers and material staging near the intake. There is also a wire hand railing supported by 1" tubular steel posts on the downhill side of the deck along the length of Section 1. A galvanized pipe houses electrical supply and is suspended on the cliff above the flume and terminates at a metal J-box near the midpoint of Section 1. Power was added in the 1970s. A three-step metal ladder allows access to the small rock outcrop at the midpoint. Even with the modified supports, the flume still retains its historic character in this section.

2. **Flume Section 2 (Tunnel):** The water passes through a 90' long tunnel bored through a basalt and granite outcrop. Though some design drawings suggest that the wood flume box continues through the tunnel, it clearly stops and the water

passes directly through the bedrock and then re-enters the flume box on the downhill side. Log cribbing protrudes from the downstream portal supporting the back (top) of the tunnel. Stairs constructed of pressure treated lumber ascend up from the flume deck on each end of the tunnel and provide access to a single-track trail that follows the tunnel alignment. This trail crosses a comparatively flat area of solid ground that is used for storing and staging maintenance equipment and replacement parts. The tunnel was excavated by local miners using hand tools.

3. **Flume Section 3:** Section 3 is approximately 80' long. It starts at the downhill portal of the tunnel and extends to a point where the flume box transitions from being on-grade to a trestle supported section. Section 3 is distinguished by being on-grade and having earth or bedrock on both sides creating a wide notch through which the flume box passes. The sills, side supports, sidewalls, and decking are consistent with those described for Section 1. Unlike Section 1, however, there are no handrails on the deck of Section 3 and the electric supply line is strung 10' above the flume between 2" galvanized poles that are bolted to the top of the cross beam supports that span the top of the flume box. The wire is strung through both glass and porcelain insulators.

   Other variations in Section 3 include fewer replaced and or additional bents on each side of the flume box. There are also no angled knee braces at the bottom of the sidewall supports in Section 3 and most of the bents are connected with the opposite side using the rod iron bolts, though 4 x 6" timbers span the box to provide deck joists on every other bent. These timbers are toe-nailed to the top of the side walls on the uphill side of the vertical bent posts. There are 37 bents on 2' centers.

   The decking in Section 3 also appears to be older and more weathered with fewer replaced boards than observed in Section 1. The deck is comprised of four wide 2 x 12" planks placed longitudinally across the full bent supports. Less water pressure and stress in this section has resulted in less modification, though some of bents have newer through bolts, and the inside of the flume box was lined with ¾" plywood to prevent seepage through the original tongue-and-groove boards.

4. **Flume Section 4:** Section 4 is marked by the transition from on-grade construction to an approximately 205' long trestle supported section of the flume box. The deck in this section is 3 boards wide as opposed to the 4 boards-wide deck in Section 3. A large portion of Section 4 failed in 1988 when 6 trestles washed out. Both sidewalls were reconstructed using 10 courses of 3 x 6" double tongue-and-groove planks, and the trestles were rebuilt using the original materials (overall, only 7 of the trestle pilings throughout the entire flume have been replaced since the 1970s). There is also a wood handrail constructed of 2 x 4" boards on each side of the flume deck in Section 4 and 5, and the power line continues through both sections to the surge box shack.

Even with the reconstruction, in-kind materials and methods were used, and the flume retains its historic character throughout Section 4. Small-scale reinforcement include the addition of steel gussets used to attach the vertical bent posts to the horizontal 3 x 6" cross members spanning the top of the flume box and angle iron bolted to the base of the vertical bent posts. The full bents are interspersed with channel steel bents through bolted to the opposite side with threaded rod iron bolts. Where necessary, guy wires and adjustable turnbuckles are bolted to the uphill cliff face to prevent the flume box from sliding down slope. These modifications are not readily visible and do not affect the overall appearance of the flume.

Section 4 also affords the best opportunity to inspect the underside of the flume box and trestle construction technique. As noted before, the flume box sills sit on three longitudinal 6 x 6" timbers that span the distance between each trestle. Individual trestles are constructed of two log poles ranging from 12" to 16" in diameter. These poles are either pile driven or otherwise propped on the rocks and angled to create a wider base and more stability. The poles are capped with an 8 x 10" timber on with the 6 x 6" joists are attached. The trestle piles are cross-braced with 2 x 12" boards creating an X pattern on each trestle. In many instances, additional 2 x 12" boards span between adjacent trestles for longitudinal support. The bracing is attached to the poles using 6" spikes. Trestles are spaced on roughly 8' centers and the tallest trestles in Section 4 are approximately 12' to 15' tall. A significant amount of wood scraps were observed on the downhill side of the flume suggesting continued replacement and discard of flume sections.

5. **Flume Section 5:** Section 5 is a continuation of Section 4 in terms of materials, sidewall construction, bents, deck, handrails, power supply, and trestles. It is distinguished by a change in direction from Section 4 where the flume box turns around an outcrop in the slope and heads towards Pelican. It is at this point that Lisianski Inlet become visible from the flume deck. The largest difference, other than setting and direction, in Section 5 is the height of the trestles, which are up to 20' tall in this section to accommodate traversing a very steep slope. The approximately 220' long section has one bend in it before terminating at the surge box.

D. **Surge Box:** The surge box is one of the character defining components of the entire system as it is perched on a cliff overlooking the penstock and Lisianski Inlet. The flume box enters the top of, and on the upstream side of, the surge box at an approximately 30 degree angle. The box itself is approximately 10' deep and measures 14 by 14' feet. It is constructed on a concrete and rock foundation. The walls of the box consist of approximately 60 flat-laying 2 x 4" stacked boards with overlapping corners. The outside of the walls are reinforced at their midpoint and near the corners with 4" channel still. The 36" diameter opening is in the downstream and lower corner of the surge box.

The surge box is completely decked with 2 x 6" and 2 x 8" boards with a perimeter hand railing constructed of 2 x 4" boards, some of which are pressure-treated and obvious scabbed-on replacements. Directly above the penstock opening is the steep ramp that descends from the lip of the surge box to the catwalk adjacent to the wood stave pipe. There is an electrical winch motor and control box with an angle iron frame rough centered on the surge box deck with a street lamp situated over the iron frame. This motor was added in the 1970s to power a trolley cart that ran on the penstock catwalk.

A 6½ x 7', single-story, shed-roofed, plywood structure is built over the flume just above the surge box. The wood framed shed with corrugated metal roof houses a few hand-tools, but functions primarily to cover the intake and overflow gates just upstream from the surge box. The entrance to the shed is on the north side through a corrugated metal door (roof panel). There are three mechanically operated devices controlled in the shed. The first is an electrically operated metal grate on the upstream side of the shed that prevents debris from entering the surge box. The brush grate is chain driven with an electrical switch in the shed. Approximately 4' behind the brush gate is a vertical head gate with a hand-powered wheel that can adjust the level or completely stop water from entering the surge box. The iron wheel itself was broken at the time of the survey, and a handyman jack was rigged to operate the main gate. Thirdly, on the downhill edge of the flume box between the brush grate and the main head gate into the surge box is a relief gate that allows water to discharge out the side of the flume when the head gate is closed. This vertical gate is also hand powered, though the original mechanism is broken and a ½-ton come-along is used to raise and lower the relief gate. In combination with the intake gate at the dam, these four mechanical devices control the water level and flow into the penstock pipe.

After the fire in the early 1980s that destroyed the original power plant, another brush gate and small, approximately 2 x 4' and 4' deep, surge box was built adjacent to the main surge box. Water is diverted into this smaller surge box through its own brush gate and it then feeds a PVC pipe running parallel to the main wood stave penstock. The pipe provides Pelican with a potable water supply.

E. **Penstock:** The penstock pipe exits the base of the surge box and drops 102' in a straight line to the power house. The pipe measures 36" inside diameter with a slight neck down at the point it enters the powerhouse. The pipe is a continuous wire bound wood stave pipe; wire bound referring to the adjustable rod iron hoops every 4" to 6" along the entire 300' length for additional support. The butt-end of many of the pipe boards are joined with Kelsey joints, which essentially act as seam crimps between boards. On occasion, these Kelsey joints erode and fall into the penstock and subsequently end up in the turbines. During the field documentation, numerous leaks were visible along the entire pipe, and many were expediently covered using tarps and plastic bags.

Wood stave pipe was the preferred choice in the 1920s and 1930s for numerous water conveyance needs, particularly penstocks and flumes. Douglas fir was the primary wood used in the Pacific Northwest, and it appears to be the choice for the Pelican penstock. Wood stave pipe was comparably cheap as compared to iron pipe, and was often used in power supply situations due to the small frictional resistance of the smooth finished surface.

The penstock pipe is supported by 39 trestles which are consistent in design with the trestle support under flume Sections 4 and 5 discussed above. The trestles span two wash out areas, the upper one being 18' tall and the lower being 22' tall just before joining the powerhouse, and the pipe is roughly on-grade at its midpoint. The trestles are spaced on 8' centers and both laterally and longitudinally cross-braced with 3 x 8" planks. There are two courses of cross-bracing on the taller trestles. The major differences are not in design, but in dimensional size; the vertical poles range between 16" and 22" in diameter, and are capped with 10 by 10" timbers (as opposed to the 6 x 8" timbers under the flume). Furthermore, there are wood cradles nailed to the caps which house the round wood stave pipe. Additional longitudinal reinforcement is achieved by 6 x 8" ties placed on each side of the pipe spanning between trestles. These ties are spliced to form a continuous top stringer. The trestle caps extend further on the north side of the penstock to support the catwalk that runs the entire length of the pipe. The catwalk is constructed of side-by-side 2 x 12" boards with a hand rail on the outside. There is also a piece of angle iron bolted to the catwalk that served as a track for the electrical trolley added in the 1970s.

F. **General Site Description:** The Pelican Hydroelectric Water Conveyance System was constructed above a steeply incised ravine connecting a glacially perched lake with tide water. The flume itself traverses near-vertical slopes en route to the surge box before a steeply pitched drop to the power house below. The vegetation is typical of southeast Alaska temperate rainforest, and includes predominantly spruce and cedar trees with a dense understory of devils club, wild rose, sedges, various grasses, and moss. At a broader scale, the system is perched above Lisianski Inlet and, when it's not raining, there are commanding views up, down, and across the inlet at the coastal mountains.

Part III. Sources of Information

A. Primary Sources

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B. Secondary Sources

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1996c 'Neighbors' Joined in Pelican's Founding. *The Daily Sentinel*, March 5, 1996.
1996d Pelican Took Root With School, P.O. *The Daily Sentinel*, March 6, 1996.
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C. Likely Sources Not Yet Investigated

Research for the historical context and available historic drawing investigated primarily the holdings at the UAF Rasmuson Library, Alaska Polar Regions Archives (see list below for specific collections investigated).

There may be collections at the Alaska State Archive in Juneau, the UAA Consortium Library in Anchorage, or the University of Washington Libraries that contain pertinent information. However, the databases and catalogs for these institutions available online were searched and turned up no significant leads on information relevant to the Pelican power plant.

D. Current Photographs

Documentation in the summer of 2009 included obtaining current digital photographs of the Pelican Hydroelectric Plant Historic Water Conveyance System meeting National Register standards (see: National Register of Historic Places Photograph Policy Expansion available online at: http://www.nps.gov/history/nr/policyexpansion.htm). The standards involve high-resolution images (uncompressed .TIF files) that are too cumbersome for inclusion as an attachment to this report. Instead, this report contains a photo-log and .JPEG "contact sheets" derived from the source .TIF electronic image files. The source electronic image files and photo log will be burned on a CD (consistent with the guidance on digital photograph records issued by the U.S. National Archives and Records Administration (NARA) to accompany the submittal of this narrative report to the NARA branch in Anchorage, Alaska.

E. Historic Drawings

High-resolution scanned images of the available original drawings were completed. The images are in PDF format for easy digital transfer and review. The original drawings will be returned to the Pelican Utility District. All other recipients will get a digital version of the drawing and index on CD or DVD with the photographs. Drawings include:

1. Pelican Cold Storage Company, Flume, R.R. Poppleton, Inc, Seattle, October 28, 1938.
2. H.W. Beecher, Consulting Engineer, Head Box and Penstock Details, Pelican Cold Storage Co., Lisianski Inlet, December 19, 1941.
3. Federal Power Commission, Exhibits J and K, Pelican Cold Storage Company, Lisianski Inlet, July 31, 1942
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6. Pelican Utility Company, Minor Project Improvements Near Pelican, Toner and Nordine, July 31, 1967.
7. Proposed Rehabilitation of Flume Serving Hydroelectric Plant, Pelican Utility Company, Toner and Nordine, October 11, 1967.

8. Pelican Seafoods, Inc., Pelican Creek Hydroelectric Intake & Dam Upgrade, Polarconsult Alaska, Inc., 1993 (series of 7 drawings).

F. Historic Photographs

Historic Photographs of the Pelican, the flume, and flume construction were found on Vilda, the Alaska Digital Archive and in the Alaska Polar Regions Collections at the University of Alaska Fairbanks. Historic photographs will be submitted separately on CD or DVD. The key to historic photographs from Rasmuson Polar Regions Archives (notations hand written on back of photo set):

Pelican_UAF_1: P.H. Tailrace
Pelican_UAF_2: Tide lands beyond P.H.
Pelican_UAF_3: Power House
Pelican_UAF_4: P.H. tailrace and creek
Pelican_UAF_5: Penstock Festry at lower end flume
Pelican_UAF_6: 36" penstock to P.H.
Pelican_UAF_7: H.G.
Pelican_UAF_8: 36" Penstock
Pelican_UAF_9: 36" Penstock
Pelican_UAF_10: Outboard end Leffee turbine generator 500 K.W. (not fully developed).
Pelican_UAF_11: Leffee turbine relief valve
Pelican_UAF_12: 36" Penstock

Vilda Historic Photos Include:

Pelican Aerial ca. 1940s
Pelican Dock, ca. 1938
Pelican Sawmill, ca. 1938

G. Informal Oral Interviews

NLUR would like to extend thanks to the following people for generously sharing their time, resources, and stories about Pelican:

Tom Whitmarsh, now-retired chief engineer for PUD from 1975-2009
Roscoe Max, Pelican resident since 1943
Norm Carson, Pelican resident and local history aficionado
Patricia Phillips, Pelican resident, Mayor
Mike West, CE2 Engineers, Construction Superintendent

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