ATTACHMENT H

TACOMA HYDROELECTRIC PROJECT

DESCRIPTION OF PROJECT FEATURES

The Tacoma Hydroelectric Project is located about 20 miles north of Durango, Colorado, on a high intermountain plateau west of the Animas River in La Plata and San Juan Counties. The project was constructed in 1905 and 1906. Water for operation of the facilities originates from three drainage basins: Cascade Creek, Little Cascade Creek, and Elbert Creek. The main water storage reservoir is Electra Lake. The general location of the Project is shown on Figure 1. Maps of the Project facilities are shown in Figure 2 and Figure 3.

Figure 1

Vicinity Map

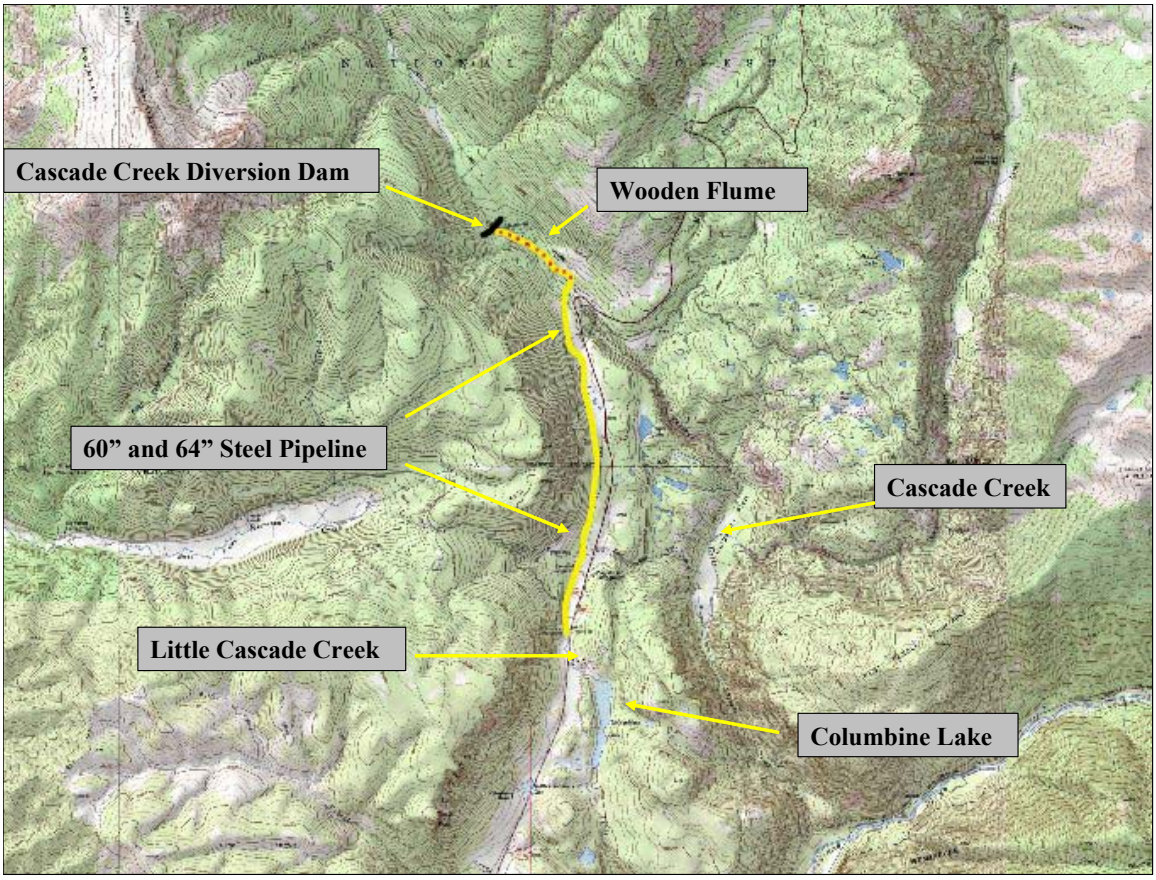
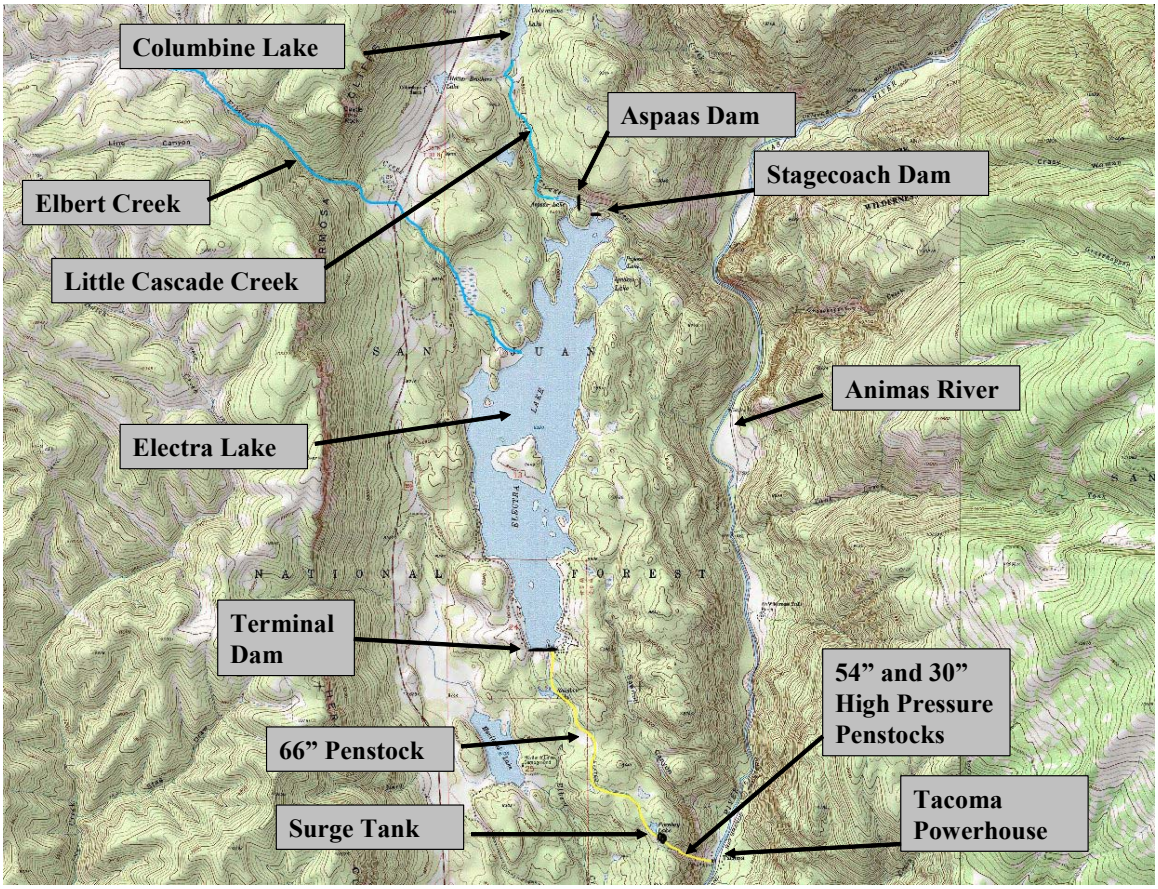


Figure 2 Above: Upper Tacoma Project

Figure 3 Below: Lower Tacoma Project



The Cascade Creek diversion facilities provide the major water supply component for the Tacoma Project. These facilities consist of an approximately 10-ft high concrete diversion dam on Cascade Creek with a normal water level at approximately 8,900 ft; 4,200 feet of 10-foot-diameter, semi-circular, elevated wooden flume; a 1,400-foot-long, 60-inch-diameter steel inverted siphon crossing Cascade Creek; all of which occupy United States Forest Service lands; and a 14,500-foot-long, 64-inch-diameter steel pipeline that crosses primarily private property, including the Cascade Village and Durango Mountain Resort developments.

The Cascade Creek Diversion Dam is located approximately 4,000 ft upstream of the U.S. Highway 550 crossing of Cascade Creek and 4 miles upstream of the confluence of Cascade Creek and Lime Creek at Purgatory Flats. The inverted siphon crosses over Cascade Creek immediately upstream of U.S. Highway 550.

Water from Cascade Creek is diverted and transported through the Cascade Creek diversion facilities and is released into Little Cascade Creek. A gaging station recording flows exiting the Cascade Creek diversion pipe is located at the outlet of the pipe before the flow enters Little Cascade Creek. This open channel carries the water across primarily privated property to Aspaas Lake. The water is then diverted by the Aspaas Dam into Electra Lake, which is formed by Terminal Dam on the main channel of Elbert Creek. Electra Lake is located primarily on private property with portions of the eastern edge on Forest Service lands. An 11,400-foot long steel pipeline (penstock) extends from Electra Lake, through Forest Service lands to the Tacoma powerhouse, which is on private property. The maximum static head between Electra Lake and the Tacoma powerhouse is 1,077 feet.

A. Project Dams

The four dams that are included in the Tacoma Hydroelectric Project are the Cascade Creek Diversion Dam, Aspaas Dam, Stagecoach Dam, and Terminal Dam.

Cascade Creek Diversion Dam

The existing Cascade Creek Diversion Dam was constructed in 1923. The structure consists of an approximately 10-ft high concrete dam constructed across Cascade Creek with a diversion works on the north (left) side of the dam delivery flows to the Cascade flume. The crest of the dam is an ogee section with wooden flashboards which passes flood flows. The dam is equipped with a 25-inch by 28-inch low-level sluice gate for bypassing flows completely around the structure, and a larger 7-foot-wide by 9-foot-high radial gate for sluicing of gravels and trash from the area in front of the intake screen. The intake is equipped with a motorized, self-cleaning, traveling trash screen. Downstream of the screen is a secondary sand and gravel sluicing mechanism, consisting of baffles, a low-level 24-inch by 24-inch sluice gate, which discharges sands and gravels back to Cascade Creek, and a radial gate that prevents flows from entering the flume during sluicing operations. The original flume capacity was approximately 450 cfs. Due to localized shifting of portions of the wooden flume, the current capacity is limited to approximately 350 cfs.

Aspaas Dam

Aspaas Dam is a small zoned-earthfill embankment located on Little Cascade Creek near the north end of Electra Lake. Water diverted from Cascade Creek into Little Cascade Creek by the Cascade Creek diversion facilities, and the natural flows in Little Cascade Creek, are diverted into Electra Lake at Aspaas Dam. Seepage through the embankment and foundation is controlled by a select impervious core, which extends through the foundation soils to the top of bedrock. The crest length is 274 feet, the crest width varies from 17 to 18 feet, and the maximum dam height is about 27 feet. Aspaas Lake impounds about 24 acre-feet of water at the normal maximum operating level of 8,377 feet. The corresponding reservoir surface area is about 4 acres. The crest of the dam is at Elevation 8387, providing about 10 feet of surcharge storage.

The Aspaas Lake level is maintained by a rock-cut diversion channel leading from Aspaas Reservoir to Electra Lake. This channel also serves as the spillway for Aspaas Dam. The diversion channel is about 14 feet wide at the control section at Elevation

8,375.0 feet. Aspaas Dam is equipped with a 6-inch-diameter, pressurized PVC pipe outlet installed and anchored inside a 30-inch-diameter, reinforced concrete pipe (RCP). The PVC pipe extends through a concrete bulkhead into the intake structure. Both pipes extend about 123 feet under the Aspaas Dam embankment and terminate in a concrete manhole. The downstream end of the PVC pipe is equipped with a 6-inch-diameter butterfly valve. Discharge from the valve is directed through a 24-inch-diameter RCP outlet pipe that extends from the manhole to the downstream channel. The 6-inch-diameter valve is normally closed so that all flows are diverted into Electra Lake.

The 30-inch-diameter RCP pipe provides a means to detect leakage, which may occur from the pressurized 6-inch PVC outlet pipe. It can also convey any outlet leakage through the embankment without adversely affecting the dam.

Stagecoach Dam

Stagecoach Dam is a rock-filled timber crib structure, constructed across a natural saddle at the north end of Electra Lake. According to drawings, the original dam fill was approximately 15 feet wide and 20 feet high. Earth and rock were placed against the upstream and downstream faces of the structure. The 140-foot-long crest of Stagecoach Dam serves as the spillway for Electra Lake. The spillway is armored with treated, tongue-and-groove timber planking. The sidewalls and entrance to the spillway are also constructed of timber and were rebuilt during a 1980 reconstruction. The crest of the Stagecoach Dam overflow section is at Elevation 8377.0. The sidewalls of the spillway chute are approximately 5 feet high.

Terminal Dam

Terminal Dam was originally constructed as a rock-filled timber crib structure between 1903 and 1906. Due to excessive seepage and deterioration, the dam and most of its major appurtenances were reconstructed in 1980 and 1981.

Terminal Dam is a zoned, rock-fill embankment dam with an impermeable asphalt membrane on the upstream face and an asphalt paved crest. The maximum rock

sizes comprising the embankment are 12 inches, 24 inches, and 48 inches in nominal diameter for Zones I, II, and III, respectively. Large rocks, up to 8 feet in nominal diameter, were placed in Zone IV, located on the downstream slope of the dam. The dam has a crest length of 1,270 feet, crest width of 22 feet, and a maximum height of about 62 feet. A 3-foot-high reinforced concrete parapet wall is provided along the upstream edge of the dam crest.

The spillway for Electra Lake is at Stagecoach Dam. There have been no significant spills over Stagecoach Dam since its modification in 1980. The water level in Electra Lake is generally maintained at or below Elevation 8377 by regulating diversions from Cascade Creek and through operation of the outlet works, which includes both bypass releases to Elbert Creek and releases to the Tacoma penstock.

The outlet works intake structure is located about 75 feet upstream from the centerline of the dam and is equipped with a steel trash rack. The outlet works at Terminal Dam is a 54-inch-diameter steel pipe with a total length of 429 feet from the intake to the downstream valve vault. Most of the pipe is installed within a 9-foot-diameter horseshoe tunnel excavated through bedrock under the dam. The upstream 90 feet of tunnel is backfilled with concrete, completely encasing the steel pipe. Reservoir releases can be controlled by a 48-inch-diameter, motor-operated butterfly valve that is located in the outlet works valve vault. This valve is usually maintained in the open position. Outflows from Electra Lake for power generation are regulated at the powerhouse. The 48-inch diameter valve can be remotely operated from the powerhouse via a telemetry system. An 8-inch-diameter, fixed cone valve is provided immediately upstream from the 48-inch-diameter valve. This bypass valve is used to maintain a minimum flow in Elbert Creek and is usually kept partially open.

Electra Lake, the reservoir created by Terminal dam, impounds about 22,000 acre-feet at normal maximum water surface (elevation of 8377 ft). The corresponding surface area is approximately 800 acres. The crest of the dam is at Elevation 8382 and the crest of the parapet wall is at Elevation 8385, providing 8 feet of surcharge storage.

B. Spillways

As described previously, Stagecoach Dam functions as an uncontrolled spillway for Terminal Dam. The rock-cut diversion channel from Aspaas Lake into Electra Lake is the spillway for Aspaas Dam. The concrete ogee overflow section on the Cascade Creek Diversion Dam is the primary spillway for this dam.

C. Tacoma Powerhouse

The Tacoma Powerhouse contains three generating units with a total generating capacity of 8 megawatts (MW). The powerhouse is a steel-frame brick building with inside dimensions of approximately 108 feet long, 64 feet wide, and 30 feet tall. Prior to entering the powerhouse, the 54-inch-diameter penstock bifurcates into 48-inch and 36-inch-diameter branches. The 48-inch-diameter branch was intended to serve a future generating unit but is currently fitted with a blind flange that terminates at a thrust block. The 36-inch-diameter branch of the penstock bifurcates to supply two 4,000 HP Pelton turbines, which drive the generators for Units No. 1 and No. 2, each rated at 2,250 kW. These turbines and generators are located in the northeast corner of the building and the transformer and switch gear for Units No. 1 and No. 2 are in the northwest corner of the building.

The older, 30-inch-diameter penstock supplies flow to a 5,000 HP Pelton turbine, which drives the generator for Unit No. 3, rated at 3,500 kW. The switchgear for Unit No. 3 and the enclosed control room for the powerhouse are located in the southwest corner of the building. The powerhouse contains a 15-ton bridge crane. The tailrace for the Tacoma Powerhouse discharges to the Animas River. Normal access to the powerhouse is via the Durango-Silverton narrow-gauge railroad.

D. Intakes and Outlet Works

Key project diversion facilities include the Cascade Creek flume, siphon, and pipeline, located downstream of the Cascade Creek Diversion Dam; and the Tacoma penstock, located downstream of Terminal Dam.

Cascade Creek Flume

The Cascade Creek flume is a 10-foot-diameter, semi-circular, wooden flume, having a total length of 4,200 feet from the diversion dam to the Cascade Creek Pipeline inlet. For much of its length, the flume is on simple timber supports founded on wooden cribs constructed on the natural grade. Portions of the flume are supported on timber bents founded on concrete footings. The flume slopes at a uniform grade of about 2 feet per 1,000 feet.

Cascade Creek Siphon and Pipeline

The Cascade Creek siphon and pipeline are constructed from steel pipe. The entire pipeline and siphon is about 15,863 feet long from the pipeline intake to the outlet. The pipeline is 64 inches in diameter. The siphon section is 60 inches in diameter and 1,400 feet long.

Tacoma Penstock

The Tacoma Penstock begins about 25 feet downstream from the 48-inch-diameter butterfly valve. The penstock is a 66-inch-diameter, welded-steel pipeline, with a length of 9,590 feet to a bifurcation structure located above the Tacoma Powerhouse. At this structure, the penstock bifurcates into two high-pressure, welded steel penstocks, with diameters of 54 and 30 inches. These penstocks are 2,056 feet long. The 66-inch and 54-inch diameter portions of the penstock were installed during a reconstruction of the Tacoma Project in 1981. The 30-inch-diameter penstock was installed in 1949.

The 66-inch-diameter portion of the penstock is constructed above ground and supported by full encasement, concrete thrust blocks at each horizontal pipe bend and by ring girders supported on concrete piers, spaced at about 80-foot centers, between the thrust blocks. The ring girders are supported on steel rocker bearings, which allow for

thermal expansion and contraction of the pipe. The nominal slope of the 66-inch pipeline is approximately 6.6 feet per 1,000 feet. The 54-inch and 30-inch-diameter high-pressure penstocks are installed slightly below natural ground level. The upper portions of the penstocks are covered with a concrete "Fabriform" blanket, which was installed in 1985. The Fabriform blanket stabilizes the steep hillside and provides protection to the penstocks from occasional rock falls and erosion of the penstock bedding. The high-pressure penstocks have a nominal slope of 57 feet per 100 feet.

A 12-foot-diameter, 116-foot-tall surge tank is located on the 66-inch penstock approximately 8,900 feet downstream from the 48-inch-diameter control valve at Terminal Dam. The surge tank is located near Forebay Lake. Forebay Lake is a small impoundment that is no longer a part of the power facilities.

Releases from Electra Lake for power production are normally controlled by the needle valves on the Pelton turbines at the Tacoma Powerhouse. Emergency shut-off valves for the 54-inch and 30-inch-diameter penstocks are provided immediately below the bifurcation structure. These valves isolate the high-pressure portions of the penstocks and usually are kept open.

E. Description of Project Operation

The operation of the project is impacted greatly by the amount of precipitation occurring during the winter months. Operations can also be impacted to a lesser degree by stream flows in previous years. The following is a description of project operation during a normal water year.

The project utilizes flows from Cascade Creek, Little Cascade Creek and Elbert Creek. Water from Cascade Creek is diverted at the Cascade Diversion Dam and transported through the Cascade flowline to Little Cascade Creek. From Little Cascade Creek, water is diverted by Aspaas Dam into Electra Lake. Elbert Creek discharges into Electra Lake. The Cascade Creek diversion dam is operated in a run-of-river mode.

Available flows are diverted to Electra Lake up to the maximum capacity of the diversion facilities.

During normal water years, Electra Lake is filled by runoff during the spring and early summer. The level of Electra Lake has not reached the spillway elevation in recent history. Runoff conditions typically exist from late April through July, with peak runoff flows occurring in mid-June. During the runoff period, the plant is operated at a constant daily output, otherwise known as a base load schedule. Over a number of weeks, base load generation is increased gradually to match inflow into Electra Lake until the plant reaches maximum output and inflow exceeds the capacity of the plant. At this point, the flow in excess of the plant capacity is utilized to fill Electra Lake. Beginning in August, the plant is operated at a reduced capacity in base load mode in order to maintain the level of Electra Lake to within several feet of the spillway crest. In August and September, the output of the plant is gradually reduced as stream flows subside.

Following the end of the runoff season, the plant is operated on a peaking schedule from Monday through Friday. Under the peaking schedule, the plant is operated at a higher load on-peak from 10:00 a.m. to 10:00 p.m. and at a lower output off-peak from 10:00 p.m. to 10:00 a.m. The plant output during the on-peak and off-peak periods is adjusted periodically to maintain the water level in Electra Lake within several feet of the normal maximum elevation. Beginning in late November to early December, the output of the plant is increased during the on-peak and off-peak periods to gradually draw down the water level in the reservoir during the winter months to get ready for the next spring runoff. The output of the plant is further increased at the end of the winter to reach the minimum normal operating pool level as runoff approaches. The plant operation reverts to the base load mode in mid-April. The maximum reservoir elevation corresponds to a staff gauge reading of 32 feet and the minimum normal operating level occurs at a staff gauge reading of 10-12 feet. The staff gauge reading indicates the vertical distance from the water surface elevation to the top of the reservoir outlet pipe.

G. Recreational Opportunities

The primary recreational opportunities associated with the Tacoma Project are hiking, fishing, picnicking, and boating at Electra Lake and fishing along the Little Cascade Creek open channel. Other opportunities include those allowed in the surrounding Forest Service lands such as hiking and cross-country skiing. Recreational facilities at Electra Lake include a contact station, parking lot, docking facilities for rental boats, fish cleaning station, and picnic and sanitary facilities. These facilities are operated on a "first-come, first-serve" basis. No overnight use facilities are provided.