

EXHIBIT A – PROJECT DESCRIPTION

Klamath Hydroelectric Project
(FERC Project No. 2082)

PacifiCorp
Portland, Oregon

Version: February 2004

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A1.0 PURPOSE

Exhibit A describes the Klamath Hydroelectric Project (Project) facilities and lands, as stipulated in Title 18 Section 4.51 (b) of the U.S. Code of Federal Regulations:

Exhibit A is a description of the project. This exhibit need not include information on project works maintained and operated by the U.S. Army Corps of Engineers, the Bureau of Reclamation, or any other department or agency of the United States, except for any project works that are proposed to be altered or modified. If the project includes more than one dam with associated facilities, each dam and the associated component parts must be described together as a discrete development. The description for each development must contain:

- (1) The physical composition, dimensions, and general configuration of any dams, spillways, penstocks, powerhouses, tailraces, or other structures, whether existing or proposed, to be included as part of the project;
- (2) The normal maximum surface area and normal maximum surface elevation (mean sea level), gross storage capacity, and usable storage capacity of any impoundments to be included as part of the project;
- (3) The number, type, and rated capacity of any turbines or generators, whether existing or proposed, to be included as part of the project;
- (4) The number, length, voltage, and interconnections of any primary transmission lines, whether existing or proposed, to be included as part of the project (see 16 U.S.C. 796(11));
- (5) The specifications of any additional mechanical, electrical, and transmission equipment appurtenant to the project; and
- (6) All lands of the United States that are enclosed within the project boundary described under paragraph (h) of this section (Exhibit G), identified and tabulated by legal subdivisions of a public land survey of the affected area or, in the absence of a public land survey, by the best available legal description. The tabulation must show the total acreage of the lands of the United States within the project boundary.

A2.0 PROJECT OVERVIEW

A2.1 EXISTING PROJECT FACILITIES

The Klamath Hydroelectric Project (Project) area is located on the upper Klamath River in Klamath County (south-central Oregon) and Siskiyou County (north-central California). The nearest principal cities are Klamath Falls, Oregon, located at the northern end of the Project area; Medford, Oregon, 45 miles northwest of the downstream end of the Project; and Yreka, California, 20 miles southwest of the downstream end. Figure A2.1-1 is a map of the Project area.

The existing Project consists of eight developments, seven of which are on the Klamath River between river mile (RM) 190 and RM 254. One of the developments, Keno dam, is a reregulation dam with no generation facilities. The eighth development is on Fall Creek, a Klamath River tributary at about RM 196. The eight existing Project developments are as follows:

- The East Side Development (3.2 megawatt [MW]) and the West Side Development (0.6 MW) are the facilities farthest upstream, located near RM 254 and within the city limits of Klamath Falls, Oregon. They are associated with Link River dam, which is owned by the U.S. Bureau of Reclamation (USBR) and currently operated by PacifiCorp under USBR's directives. The power plants, transmission lines, and associated water conveyance systems are owned and operated by PacifiCorp.
- The Keno Development is a re-regulating dam facility with no generation capability. At RM 233 in Oregon, it is 21.3 miles downstream of Link River dam. PacifiCorp operates Keno dam to maintain Keno reservoir elevations between 4085.0 and 4086.5 whenever USBR is diverting water to the Klamath Irrigation Project.
- The J.C. Boyle Development consists of a dam, reservoir, and powerhouse (80 MW), which are located within Oregon. The dam is at RM 224.7 and the powerhouse is several miles downstream at RM 220.4.
- The Copco No. 1 Development consists of a dam and power plant located in California at RM 198.6. The Copco No. 1 power plant (20 MW) is located at the base of the dam on the right bank.
- The Copco No. 2 Development is located at RM 198.3 and diverts water to a 5,900-foot-long water conveyance system serving a 27-MW power plant. The Copco No. 2 reservoir above the dam is small and located immediately downstream of the Copco No. 1 dam. Because it has very minimal active storage, the Copco No. 2 powerhouse operates as a "slave" to Copco No. 1.
- The Fall Creek Development is a run-of-river facility with a low diversion dam, a 4,560-foot-long power canal, and a 2,834-foot-long penstock leading to a powerhouse with three Pelton units. The power plant (2.2 MW at 730 feet of head and 50 cfs) is located on Fall Creek, a small Klamath River tributary that flows into the upper end of Iron Gate reservoir. The Fall

Creek Development also includes the Spring Creek diversion, which can provide an additional 16.5 cfs to Fall Creek upstream of the Fall Creek diversion dam.

- The Iron Gate Development consists of a dam, reservoir, and powerhouse (18 MW), and is the farthest downstream (RM 190) development in the Project. The Iron Gate Development also includes the Iron Gate Fish Hatchery, which was constructed at the same time as the power generation facilities. The development is operated to provide stable river flows in the Klamath River downstream of the Project.

There are eight transmission line segments associated with the Project. These segments are described in subsequent sections of this Exhibit A and their locations are shown in Exhibit G maps. One-line diagrams are provided in Figures A2.1-2 and A2.1-3. The Project interconnects with the PacifiCorp 230-kV system at PacifiCorp's Klamath Falls, J.C. Boyle, and Copco No. 2 230-kV substations/switchyards.

Key information about Project facilities is summarized in Table A2.1-1. Additional information about Project facilities and equipment is provided in the remainder of this exhibit.

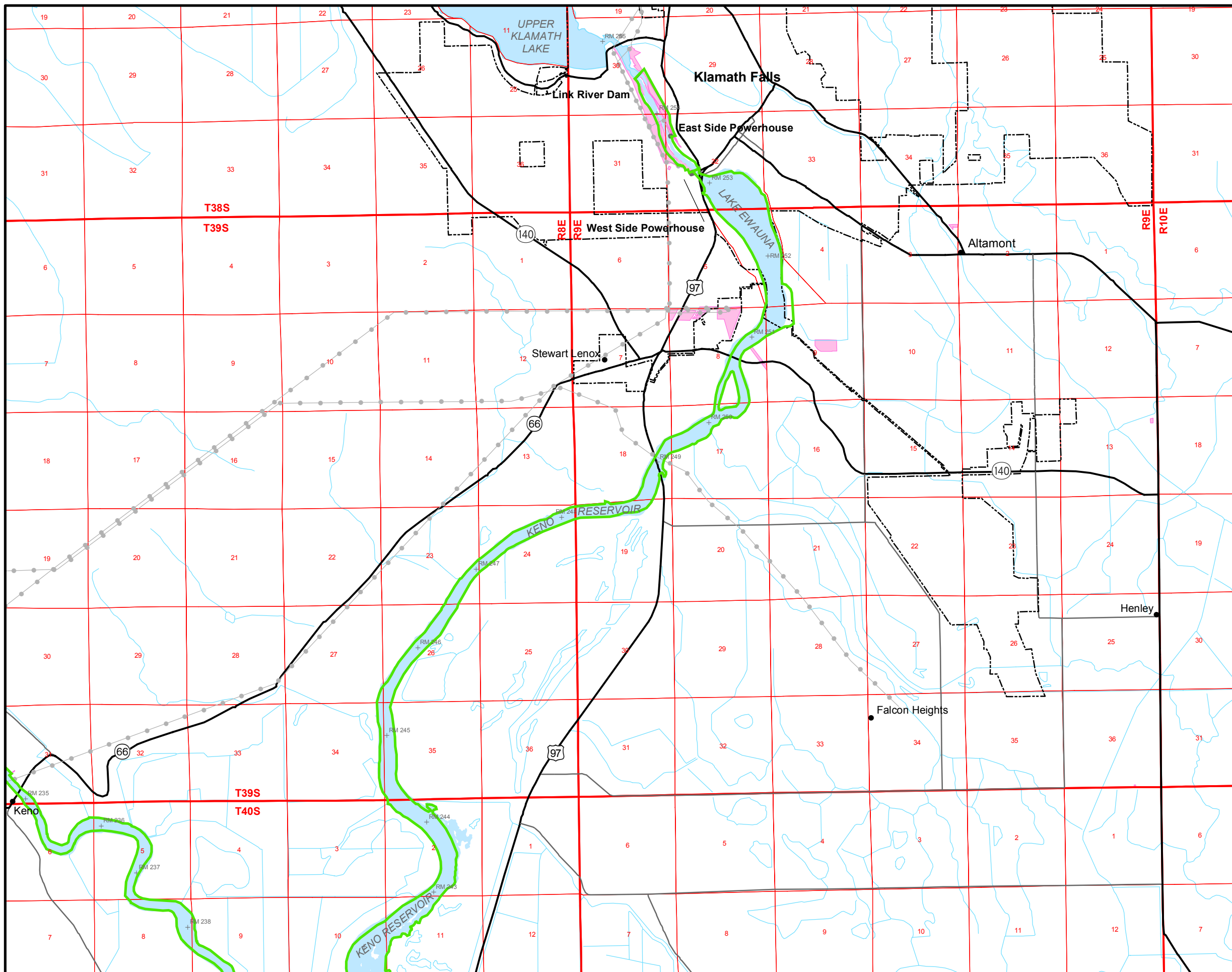
A2.2 PROPOSED PROJECT FACILITIES

During the course of study and in the interim between preparation of the draft license application and this final application, PacifiCorp made a few changes in the proposed Project. The newly proposed Project begins at the J.C. Boyle Development and continues downstream to the Iron Gate Development. The Spring Creek diversion is now included in the Fall Creek development. The East Side, West Side, and Keno developments are no longer part of the Project. PacifiCorp proposes to remove the East Side and West Side developments. Keno dam will remain in operation, but is not included in the FERC Project because the development has no generation facilities and its operation does not substantially benefit generation at PacifiCorp's downstream hydroelectric developments.

The original plan for the Keno Development, prepared in 1956, included provisions for hydropower generation. However, it was deemed to not be economically viable to construct at that time. Recent reassessment of the potential for power generation at Keno by PacifiCorp has resulted in the same conclusion.

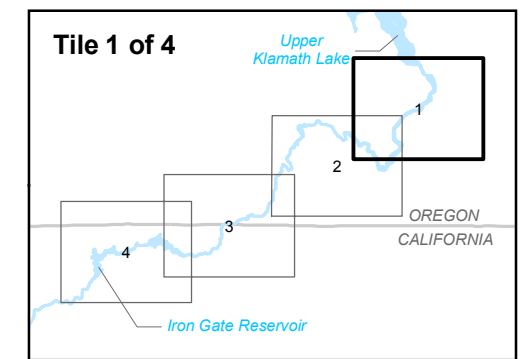
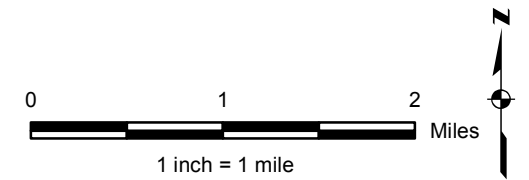
The proposed Project consists of five developments; four are located on the Klamath River mainstem, the other, Fall Creek Development, is located on a Klamath River tributary. The developments include:

- The J.C. Boyle Development consists of a dam, reservoir, and powerhouse (80 MW) that are located within Oregon. The dam is at RM 224.7 and the powerhouse is several miles downstream at RM 220.4.
- The Copco No. 1 Development consists of a dam and power plant located in California at RM 198.6. The Copco No. 1 power plant (20 MW) is located at the base of the dam on the right bank.



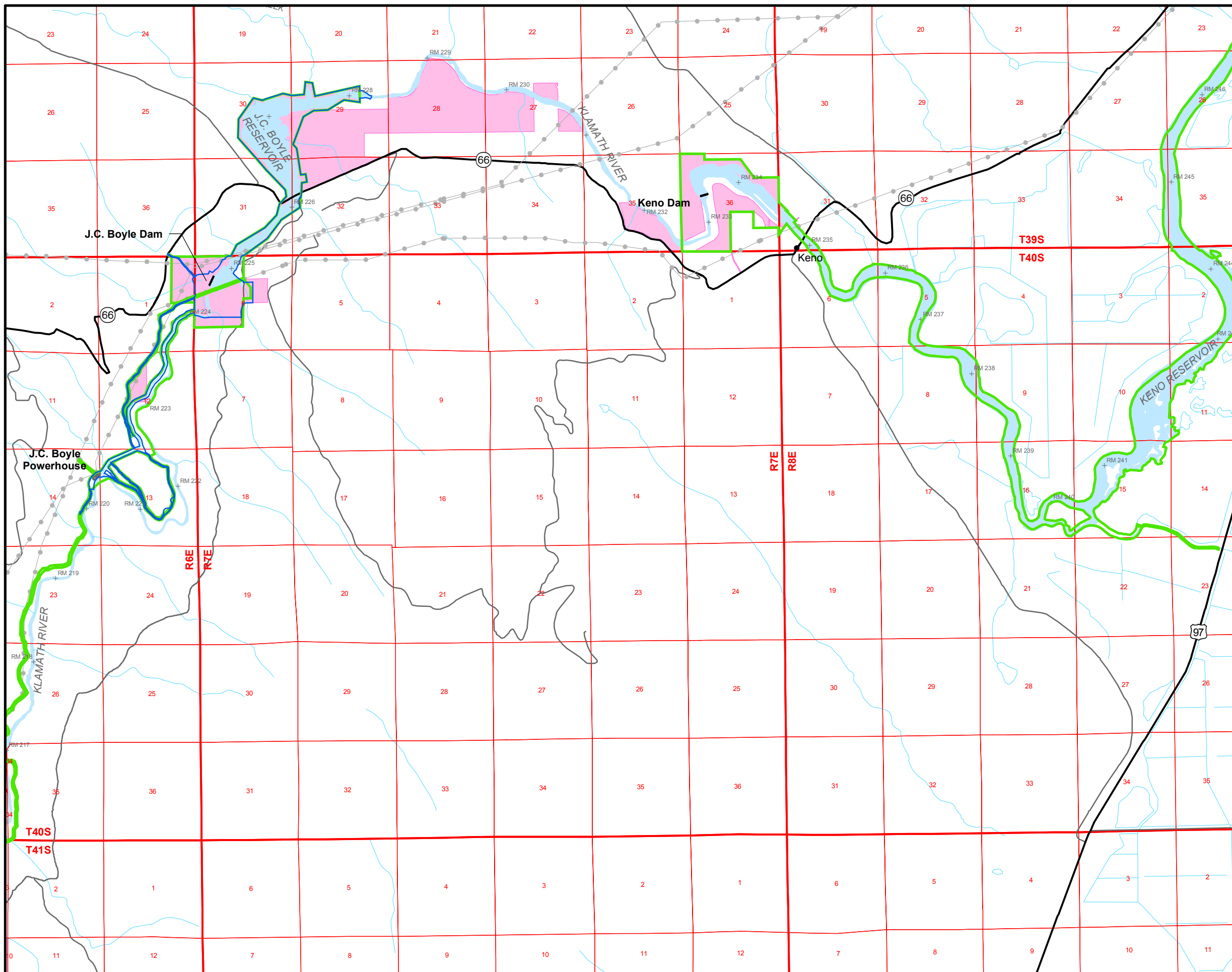
LEGEND

- FISH HATCHERY
- CITY
- CURRENT FERC BOUNDARY
- PROPOSED FERC BOUNDARY
- HIGHWAY
- MAIN ROAD
- TRANSMISSION LINE
- TOWNSHIP/RANGE
- SECTION
- KLAMATH FALLS CITY LIMIT
- STREAM
- LAKE OR RESERVOIR
- PACIFICORP PROPERTY

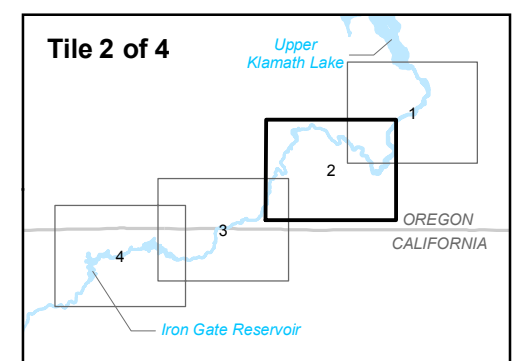
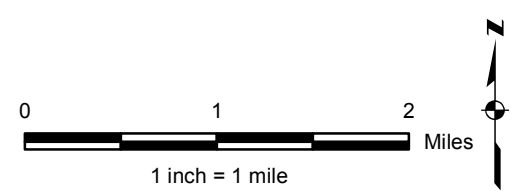


Klamath Hydroelectric Project

Figure A2.1-1 (1 of 4)
Project Area
EXHIBIT A - PROJECT DESCRIPTION

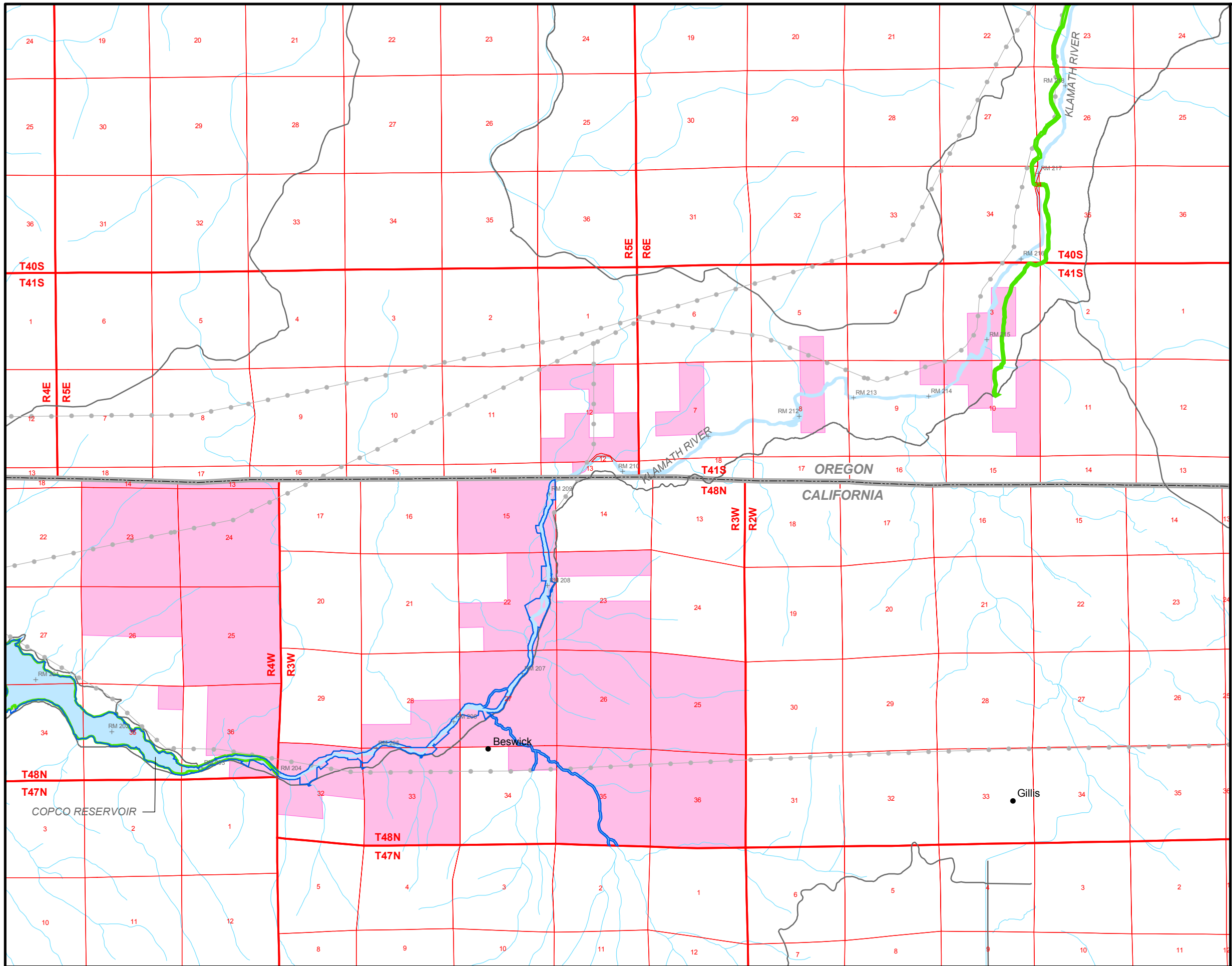


- LEGEND**
- ▲ FISH HATCHERY
 - CITY
 - ▭ CURRENT FERC BOUNDARY
 - ▭ PROPOSED FERC BOUNDARY
 - HIGHWAY
 - MAIN ROAD
 - TRANSMISSION LINE
 - ▭ TOWNSHIP/RANGE
 - ▭ SECTION
 - KLAMATH FALLS CITY LIMIT
 - STREAM
 - ▭ LAKE OR RESERVOIR
 - ▭ PACIFICORP PROPERTY

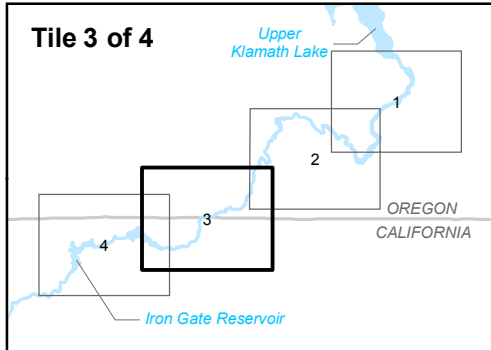
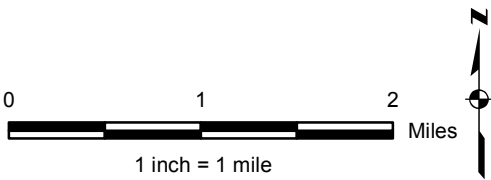


Klamath Hydroelectric Project

Figure A2.1-1 (2 of 4)
Project Area
EXHIBIT A - PROJECT DESCRIPTION

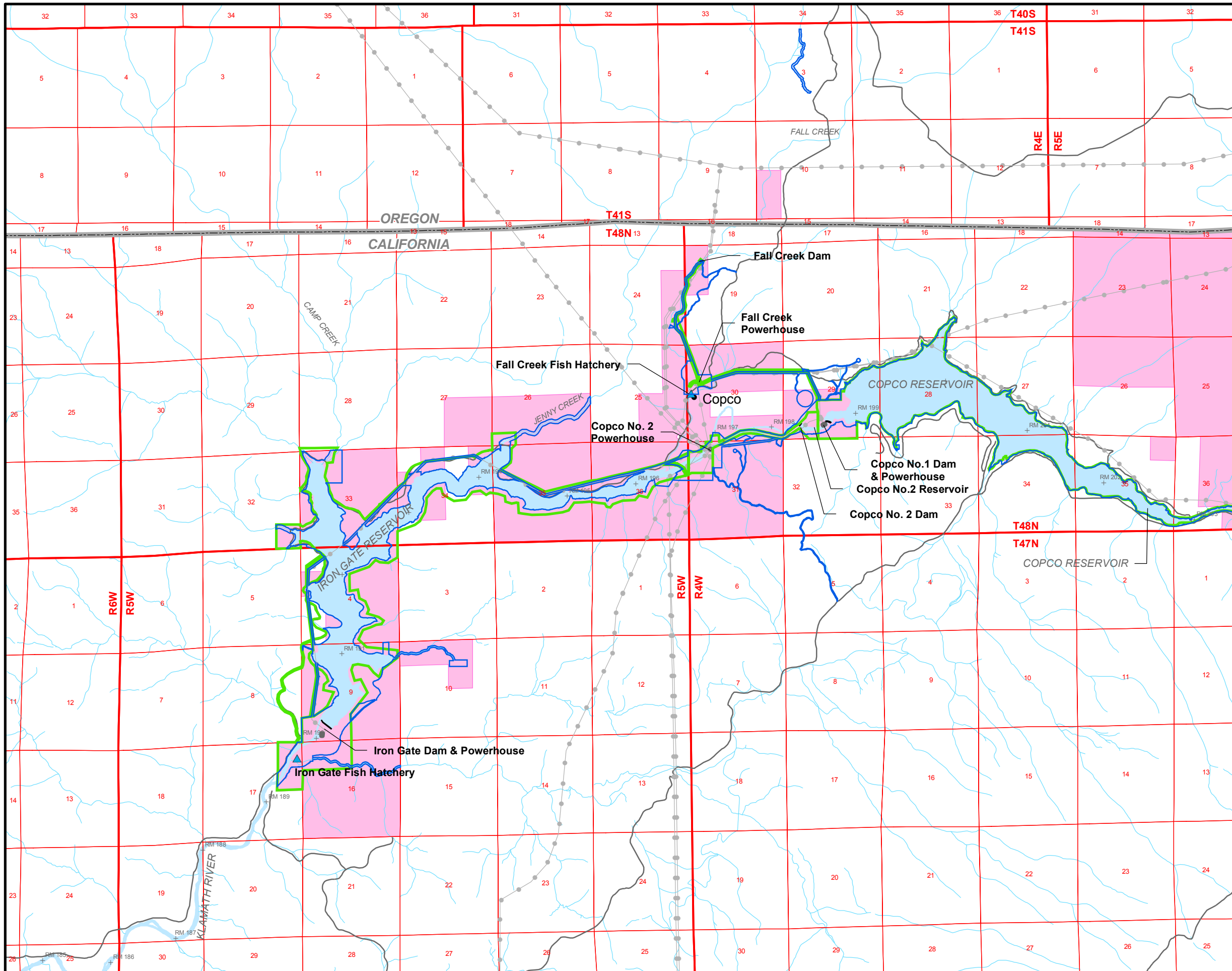


- LEGEND**
- ▲ FISH HATCHERY
 - CITY
 - ▭ CURRENT FERC BOUNDARY
 - ▭ PROPOSED FERC BOUNDARY
 - HIGHWAY
 - MAIN ROAD
 - TRANSMISSION LINE
 - ▭ TOWNSHIP/RANGE
 - ▭ SECTION
 - - - KLAMATH FALLS CITY LIMIT
 - STREAM
 - ▭ LAKE OR RESERVOIR
 - ▭ PACIFICORP PROPERTY

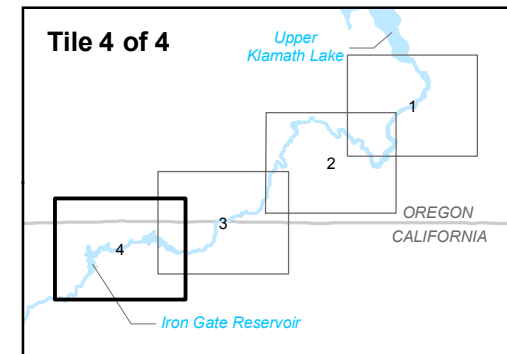
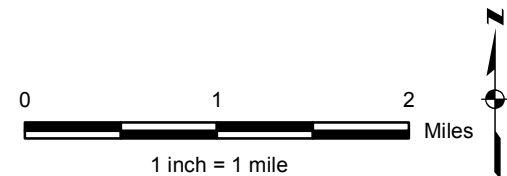


Klamath Hydroelectric Project

Figure A2.1-1 (3 of 4)
Project Area
EXHIBIT A - PROJECT DESCRIPTION



- LEGEND**
- ▲ FISH HATCHERY
 - CITY
 - ▭ CURRENT FERC BOUNDARY
 - ▭ PROPOSED FERC BOUNDARY
 - HIGHWAY
 - MAIN ROAD
 - TRANSMISSION LINE
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 - ▭ SECTION
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 - STREAM
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 - ▭ PACIFICORP PROPERTY



Klamath Hydroelectric Project

Figure A2.1-1 (4 of 4)
Project Area
EXHIBIT A - PROJECT DESCRIPTION

Figure A2.1-2 Transmission Network Diagram

The Federal Energy Regulatory Commission issued Order No. 630 on February 21, 2003. That Order provides guidelines on material that can be classified as Critical Energy Infrastructure Information (CEII) and should be filed with the Commission as confidential information pursuant to 18 CFR 388.112. Therefore, PacifiCorp is not providing a copy of Figure A2.1-2, the transmission network diagram for the Oregon/California area, in Exhibit A because of its potentially sensitive nature. The figure is provided with Exhibit F, which is not available for general distribution.

Figure A2.1-3 Transmission Network Diagram

The Federal Energy Regulatory Commission issued Order No. 630 on February 21, 2003. That Order provides guidelines on material that can be classified as Critical Energy Infrastructure Information (CEII) and should be filed with the Commission as confidential information pursuant to 18 CFR 388.112. Therefore, PacifiCorp is not providing a copy of Figure A2.1-3, the transmission network diagram for the Oregon/California area, in Exhibit A because of its potentially sensitive nature. The figure is provided with Exhibit F, which is not available for general distribution.

Table A2.1-1. Key data regarding the existing Klamath Hydroelectric Project developments.

Item	Link River Dam	Keno Development	J.C. Boyle Development	Copco No. 1 Development	Copco No. 2 Development	Fall Creek Development/ Spring Creek Diversion	Iron Gate Development
General Information							
Owner of the Dam	USBR	PacifiCorp	PacifiCorp	PacifiCorp	PacifiCorp	PacifiCorp	PacifiCorp
Purpose	Water supply; hydropower	Flow regulation	Hydropower	Hydropower	Hydropower	Hydropower; water supply	Hydropower
Completion Date	Dam: 1921 East Side: 1924 West Side: 1908	1967	1958	1918	1925	Fall Creek: 1903 Spring Creek: 1988	1962
Dam Location (river mile)	254.3	233.0	224.7	198.6	198.3	Not applicable	190.1
Powerhouse Location (river mile)	East Side: 253.7 West Side: 253.3	None	220.4	198.5	196.8	Not applicable	190.0
Structural Features of the Dams							
Dam Type	Concrete	Concrete	Earthfill	Concrete	Concrete	Earthfill/Earthfill	Earthfill
Dam Height (ft)	16	25	68	126	33	7/6.5	173
Dam Length (ft)	435	680	693	415	278	95/66	740
Spillway Length (ft)	300	265	115	182	130	32/42 " dia. pipe	685
Number of Spill Gates	31	6	3	13	5	1/1	0
Spill Gate Type	Vertical lift	Tainter	Tainter	Tainter	Tainter	Vertical Lift/Vertical Lift	Ungated
Spillway Crest (ft msl)	4130.0 ^a	4070.0	3781.5	2593.5	2454.0	3253.4/102 (local datum)	2328.0
Spillway Apron (ft msl)	Not applicable	4052.0	3763.5	2483.0	2452.0	3249.5/95 (local datum)	2164.0
Gross Head (ft) at Spillway	13	18	18	111	21	3.9/6.5	164
Spillway Energy Dissipaters?	No	No	Yes	Yes	No	No/No	Yes
Upstream Fish Passage Ladders?	Yes	Yes	Yes	No	No	No/No	No ^b

Table A2.1-1. Key data regarding the existing Klamath Hydroelectric Project developments.

Item	Link River Dam	Keno Development	J.C. Boyle Development	Copco No. 1 Development	Copco No. 2 Development	Fall Creek Development/ Spring Creek Diversion	Iron Gate Development
Juvenile Bypass Facilities?	No	Not applicable	Yes	No	No	No/No	No
Reservoir Information							
Reservoir Common Name	Upper Klamath Lake	Keno Reservoir	J.C. Boyle Reservoir	Copco Reservoir	Copco No. 2 Reservoir	No reservoir/ no reservoir	Iron Gate Reservoir
Distance to Upstream Dam (miles)	---	24.0	5.6	26.1	0.3	Not applicable/ not applicable	8.2
Reservoir Length (miles)	---	22.5	3.6	4.5	0.3	Run of river/ run of river	6.8
Maximum Surface Area (acres) ^c	90,000	2,475	420	1,000	40	Run of river/ run of river	944
Normal Maximum Depth (ft) from Normal Maximum Surface Elevation	Data not available	19.5	41.7	115.5	28	Unknown/5 ft	162.6
Maximum Depth Elevations (ft msl) from 2001-2002 Study ^d	---	4,065.5	3,751.8	2,492.0	---	No reservoir/ no reservoir	2,165.4
Normal Maximum Operating Surface Elevation (ft msl)	4,143.3	4,085.0	3,793	2,607.5	2,483.0	3,250.5/100.2 (local datum)	2,328.0
Normal Minimum Operating Surface Elevation (ft msl)	4137.0	Data not available	3,788	2601.0	Data not available	3250.5/100 (local datum)	2,324.0
Normal Annual Operating Fluctuation (ft)	6.3	0.5	5	6.5	Data not available	0/1	4.0
Total Storage Capacity (ac-ft) ^e	629,780	18,500	3,495	46,867	73	No reservoir/ no reservoir	58,794
Current (2001-2002) Estimate of Gross Storage Capacity ^d	NA	NA	NA	33,724	NA	No reservoir/ no reservoir	50,941
Active Storage Capacity (ac-ft)	486,830	495	1,724	6,235	Negligible	0/0	3,790
Average Flow (cfs) ^f	1,428	1,624	1,511	1,885	1,885	40/165	1,852

Table A2.1-1. Key data regarding the existing Klamath Hydroelectric Project developments.

Item	Link River Dam	Keno Development	J.C. Boyle Development	Copco No. 1 Development	Copco No. 2 Development	Fall Creek Development/ Spring Creek Diversion	Iron Gate Development
Retention Time (days)							
At Average Flow	185	6	1.2	12	0.020	<1 hour/ <1 hour	16
At 710 cfs	372	13	2.5	32	0.052	<1 hour/ <1 hour	42
At 1,500 cfs	176	6	1.2	15	0.025	<1 hour/ <1 hour	20
At 3,000 cfs	88	3	0.6	8	0.012	<1 hour/ <1 hour	10
At 10,000 cfs (extreme event)	26	1	0.2	2	0.004	<1 hour/ <1 hour	3
Power Generation Features							
Fish Screens	East Side: None West Side: None	Not applicable	Yes; four Rex traveling band screens	None	None	None/ none	None
Trash Racks	East Side: at entrance of wood-stave flow line; 28 x 28 ft with 2 3/4-inch spacing West Side: before canal headgates, 16 x 5 ft with 2.75-inch spacing; before penstock, 12 x 18 ft with 2-inch spacing	Not applicable	At intake to power canal 4 vertical traveling screens (0.25-mesh). Before tunnel and penstocks, 60 x 17.9 ft with 2-inch bar spacing.	Two 44 x 12.5 ft with 3-inch bar spacing	36.5 x 48 ft with 2-inch bar spacing	At entrance to penstock, 17.5 x 10.7 ft with 3-inch bar spacing/ none	At penstock entrance, 17.5 x 45 ft with 4-inch bar spacing

Table A2.1-1. Key data regarding the existing Klamath Hydroelectric Project developments.

Item	Link River Dam	Keno Development	J.C. Boyle Development	Copco No. 1 Development	Copco No. 2 Development	Fall Creek Development/ Spring Creek Diversion	Iron Gate Development
Diversion to Powerhouse	East Side: 1,729 ft wood-stave flow line; 1,362 ft steel flow line; surge tank West Side: 5,575 ft earthen canal; 140 ft steel penstock	Not applicable	Gated intake to 638-ft steel flow line; 2-mile concrete canal; small forebay; 2 steel penstocks	Three penstocks at the dam	Wood-stave flow line and rock tunnel to two steel penstocks	4,560-ft waterway to 42-inch (reducing to 30-inch) diameter penstock/ 6,850-ft waterway to Fall Creek	Gated intake tower to penstock at dam
Number of Turbines	East Side: 1 West Side: 1	None	2	2	2	3/0	1
Turbine Type	East Side: Vertical Francis West Side: Horizontal Francis	None	Vertical Francis	Horizontal Francis	Vertical Francis	Pelton/ not applicable	Vertical Francis
Turbine Generator Nameplate Capacity (MW)	East Side: 3.2 West Side: 0.6	None	Unit 1: 40 Unit 2: 40	Unit 1: 10 Unit 2: 10	Unit 1: 13.5 Unit 2: 13.5	Fall Creek: Unit 1: 0.5 Unit 2: 0.45 Unit 3: 1.25	18
Total Nameplate Generating Capacity (MW)	3.8	None	80	20	27	Fall Creek: 2.2	18
Gross Head (ft) at Powerhouse	East Side: 47 West Side: 48	None	463	123	152	Fall Creek: 730	158
Total Turbine Hydraulic Capacity (cfs)	East Side Rated: 1,200 Min: 200 West Side: 250	None	Rated: 2,850 Max: 3,000 Min: Unit 1: 344 Unit 2: 407	Rated: 3,200 Max: 3,560 Min: Unit 1: 241 Unit 2: 467	Rated: 3,200 Max: 3,250 Min: 258	Fall Creek: Rated: 60 Max: 30 Min: 2	Rated: 1,550 Max: 1,735 Min: 296

Table A2.1-1. Key data regarding the existing Klamath Hydroelectric Project developments.

Item	Link River Dam	Keno Development	J.C. Boyle Development	Copco No. 1 Development	Copco No. 2 Development	Fall Creek Development/ Spring Creek Diversion	Iron Gate Development
Powerhouse Construction	East Side: reinforced concrete structure West Side: reinforced concrete and wood structure	None	Reinforced concrete structure	Reinforced concrete substructure with a concrete and steel superstructure	Reinforced concrete structure	Reinforced concrete substructure with steel superstructure enclosed by metal siding/ not applicable	Reinforced concrete structure
Transmission Lines							
Line Designation	56-8	None	98	15, 26-1, 26-2	None	3 (two sections)/ not applicable	62
Length (mi)	0.36	None	0.24	1.23, 0.7, 0.7	None	1.65 total/ not applicable	6.55
Voltage (kV)	69	None	69	69, 69, 69	None	Both 69/ not applicable	69
Interconnections	Plant to tap on line 18	None	Plant to tap on line 18	Line 15 from Copco No. 1 switchyard to Copco No. 2 plant, line 26-1 from Copco No. 1 plant to switchyard, line 26-1 from Copco No. 1 plant to switchyard	None	Plant to tap point on line 18 (very short), Plant to Copco No. 1 switchyard/ not applicable	Plant to Copco No. 2

Table A2.1-1. Key data regarding the existing Klamath Hydroelectric Project developments.

Item	Link River Dam	Keno Development	J.C. Boyle Development	Copco No. 1 Development	Copco No. 2 Development	Fall Creek Development/ Spring Creek Diversion	Iron Gate Development
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- ^a The spillway crest at Link River dam is adjustable with stop logs; normal full pool elevation is shown.
- ^b Two existing fish ladders serve the Iron Gate fish hatchery, but do not allow passage past the dam.
- ^c Pool elevations for these values are unknown.
- ^d Data from the Draft Bathymetry and Sediment Classification of the Klamath Hydropower Project Impoundments, J.M. Eilers and C.P. Gubala of JC Headwaters, Inc. prepared for PacifiCorp, March 2003.
- ^e Total storage capacity is at normal full pool.
- ^f Data for Keno is from USGS Gage 11509500. All other data are average daily turbine flows plus spill flows for 1994 through 1997 provided by PacifiCorp.

- The Copco No. 2 Development is located at River Mile 198.3 and diverts water to a 5,900-foot-long water conveyance system serving a 27-MW power plant. The Copco No. 2 reservoir is small, located immediately downstream of the Copco No. 1 dam. Because it has very minimal active storage, the Copco No. 2 powerhouse operates as a “slave” to Copco No. 1.
- The Fall Creek Development is a high head project, 9,400-foot-long water conveyance system and run-of-river power plant (2.2 MW) located on Fall Creek, a small Klamath River tributary that flows into the upper end of Iron Gate reservoir. A portion of the water available for power generation comes into the Fall Creek basin from a diversion dam and canal on Spring Creek.
- The Iron Gate Development consists of a dam, reservoir, and powerhouse (18 MW), and is the farthest downstream (RM 190) development of the Project. The development is operated to provide stable river flows in the Klamath River downstream of the Project.

There are seven transmission line segments associated with the Project. These segments are described in a subsequent section of this Exhibit A and their locations are shown in Exhibit G maps. The Project interconnects to the PacifiCorp 230-kV system at PacifiCorp’s Klamath Falls, J.C. Boyle, and Copco No. 2 230-kV substations/switchyards.

Key information about Project facilities is summarized in Table A2.1-1. Additional information about Project facilities and equipment is provided in the remainder of this exhibit.

A2.3 PROPOSED FERC PROJECT BOUNDARY

The proposed FERC Project boundary is described in Exhibit G of the license application. The FERC Project boundary encloses those lands necessary for operation and maintenance of Project facilities and for resource enhancement measures proposed to be included in the future FERC license. The proposed FERC boundary as described in Exhibit G includes certain changes from the boundary specified in the current FERC license. Notably, the proposed FERC boundary no longer includes the East Side and West Side developments, or the Keno dam and related facilities, which are not used for hydroelectric generation purposes and therefore are not within FERC relicensing jurisdiction. The proposed FERC boundary also no longer includes some features (mainly roads) that are not necessary for operation and maintenance of the Project. The proposed FERC boundary now includes some new lands that are necessary for Project operations and for long-term protection of enhancement areas.

PacifiCorp owns and manages approximately 91.2 percent of the proposed FERC Project boundary area, including the land containing most of the Project powerhouses, portions of the transmission lines, conduits, canals, and dam facilities, and land underlying the Project reservoirs, Klamath River, and tributary streams. Approximately 4.2 percent of the Project boundary area is federally owned, 3.6 percent state owned, and 0.6 percent privately owned. Portions of the J.C. Boyle canal and the entire powerhouse are located on BLM land. The Spring Creek diversion dam and ditch are also located on BLM land.

Contemporary land use in the Project area and adjacent properties includes hydroelectric generation, livestock grazing, recreation, and timberlands.

A2.4 LANDS OF THE UNITED STATES

The lands of the United States enclosed by the Project boundary are listed in Table A2.4-1 with township/range/section descriptions and total areas in acres. Acreages were calculated using geographical information system (GIS) ArcInfo® software. It should be noted that the parcel and FERC boundary GIS data used to calculate ownership acreages are not survey accurate and some discrepancies may exist. Surveys will be completed prior to the issuance of the final license to determine final federal acreage.

Table A2.4-1. Lands of the United States.

Meridian	Township/Range/ Section	Owner	Area (acres)	Project
Willamette	40S /6E/1	BLM	17.0	J.C. Boyle
Willamette	40S/6E/12	BLM	27.5	J.C. Boyle
Willamette	40S/6E/13	BLM	31.8	J.C. Boyle
Willamette	40S/6E/14	BLM	5.7	J.C. Boyle
Total			82.0	J.C. Boyle
Mt. Diablo	48N/4W/34	BLM	0.7	Copco
Total			0.7	Copco
Willamette	41S/4E/3	BLM	9.7	Fall Creek/Spring Creek
Total			9.7	Fall Creek/Spring Creek
Mt. Diablo	47N/5W/4	BLM	23.9	Iron Gate
Mt. Diablo	48N/5W/34	BLM	39.8	Iron Gate
Total			63.7	Iron Gate
Totals			156.1	All

A3.0 EAST SIDE AND WEST SIDE DEVELOPMENTS

A3.1 INTRODUCTION

The existing Project includes the East Side and West Side developments as described below. The proposed Project will not include these developments. For further information regarding the decommissioning of the East Side and West Side developments, see Section A3.6, Proposed Minor Modifications.

A3.2 OVERVIEW

Link River dam marks the upstream boundary of the current Klamath Hydroelectric Project at RM 254.3. The dam is owned by the U.S. Bureau of Reclamation (USBR). Under a contract set to expire in 2006, PacifiCorp operates and maintains the dam at USBR's direction to meet, in order of priority: (1) Endangered Species Act (ESA) requirements, (2) Tribal Trust requirements, (3) irrigation needs, and (4) hydroelectric purposes. Because the dam and its reservoir (Upper Klamath Lake) are not Project facilities, they are described only generally in this exhibit. For more information about Link River dam contractual agreements between USBR and PacifiCorp, refer to Section B2.2 of Exhibit B—Project Operations and Resource Utilization.

Link River dam is the point of water diversion for the East Side and West Side Developments, which are owned and operated by PacifiCorp.

The dam has a pool- and weir-type fish ladder with a vertical slot entrance. USBR owns the ladder and PacifiCorp currently operates it. The ladder is approximately 105 feet long, contains 11 pools, and rises approximately 13 feet in elevation. Ladder flow depends on the Upper Klamath Lake water surface elevation and is adjusted manually with stop logs by PacifiCorp operators.

Water for the East and West Side powerhouses is diverted via intake gates on the east and west ends of the dam. The gates feed canals and flowlines dedicated to each powerhouse.

Key information about the East Side and West Side powerhouses is summarized in Table A2.1-1.

A3.3 EAST SIDE WATER CONVEYANCE SYSTEM AND POWERHOUSE

PacifiCorp owns and operates the East Side Development including the water conveyance system from the Link River dam to the powerhouse. The facilities consist of 670 feet of single-wall mortar and stone canal below Link River dam; an intake structure; 1,729 feet of 12-foot-diameter, wood-stave flowline; 1,362 feet of 12-foot-diameter, steel flowline; a surge tank; and a powerhouse on the east bank of Link River. There is no turbine bypass valve at the powerhouse. Maximum diversion capacity for the East Side powerhouse is 1,200 cubic feet per second (cfs).

There are no fish screens at either the Link River dam or at the East Side flowline intake. There is no trash rack at the Link River dam diversion. A steel bar trash rack (28 feet by 28 feet with 2.75-inch bar spacing) is in place at the pipeline intake structure.

The powerhouse is a reinforced-concrete structure housing a single vertical Francis turbine with rated discharge of 975 cfs, and a rated capacity of 4,250 horsepower (hp) at 47 feet of net head. The synchronous generator has a rated capacity of 4,000 kilovolt amperes (kVA) at 0.8 power factor (3.2 MW).

Three single-phase, 1,000-kVA, 4,330/66,000-volt (V) transformers at the powerhouse step-up the generator voltage.

A3.4 WEST SIDE WATER CONVEYANCE SYSTEM AND POWERHOUSE

PacifiCorp owns and operates the West Side Development including the water conveyance system from the Link River dam to the powerhouse. The facilities consist of a 5,575-foot-long concrete-lined and unlined canal below Link River dam; a spillway and discharge structure; an intake; 140 feet of 7-foot-diameter steel flowline; and a powerhouse on the west bank of the Link River. There is no turbine bypass valve at the powerhouse. An additional gate structure is incorporated into the canal near the intake at Link River dam. Maximum diversion capacity for the West Side canal is 250 cfs. The ungated overflow spillway is approximately 390 feet upstream from the penstock intake structure. The spillway also contains a small gated release structure to facilitate draining of the canal.

There are no fish screens at the Link River dam diversion or at the flowline intake. Trash racks are located in front of the Link River dam diversion. Each rack is 16 feet high and 5 feet wide and has 2.75-inch bar spacing. A second trash rack is located at the flowline entrance. It is 12 feet high and 18 feet wide, and has 2-inch bar spacing.

The West Side powerhouse is a reinforced concrete and wood structure housing a single, horizontal, pit-type Francis turbine with rated discharge of 250 cfs and a rated capacity of 1,040 hp at a net head of 46 feet. The open frame synchronous generator has a rated capacity of 600 kVA at 1.0 power factor (0.6 MW).

Three single-phase, 500-kVA, 2,300/66,000-V transformers at the powerhouse step-up the generator voltage.

A3.5 TRANSMISSION LINES

From the East Side powerhouse, a 69-kV transmission line, approximately 0.36 mile long (PacifiCorp Line 56-8), crosses over the Klamath River and connects to PacifiCorp's Line 11.

A3.6 PROPOSED MINOR MODIFICATIONS

A3.6.1 Facility Removal

PacifiCorp is proposing to remove both the East Side and West Side developments from service. The decommissioning would include modifications at the Link River dam face, removal/reconfiguration of the water conveyance system, and removal of all electrical, chemical, and other potential public hazards that exist related to power generation. The powerhouse structures will not be removed, but will be disabled, with all electrical components removed and secured from public access.

The following is a description of the proposed work to decommission the East Side and West Side developments.

A3.6.2 East Side Development

All seven gates that supply water to the East Side diversion at Link River dam will be rendered inoperable by removing the individual gate lifting devices. Concrete will be added to the backside of the gates, sealing the intakes. An access ramp will be constructed from the dam site to allow for concrete removal and fill of the existing forebay.

The 1,730-foot woodstave-portion of the flowline will be dismantled and removed from the site. The steel penstock (1,362 feet), surge tank, and support structures will be removed. The powerhouse will have all wooden materials removed. Any components containing chemical or hazardous materials will be removed from the site, including transformers, bushings, tanks, lead bearings, and asbestos based insulating products. All windows and doors will be sealed to prevent public access. The incoming water line and the battery bank will be removed. Following removal of the penstock, the penstock outlet will be sealed at the powerhouse assuring that access is prevented.

The transmission line (No. 56-8) from East Side powerhouse to a tap-point on transmission line 11 will also be removed.

A3.6.3 West Side Development

Four of the six steel slide gates that control flow at the Link River dam intake at the West Side canal will be made inoperable through removal of the lifting devices. The gates will be secured in place with concrete, with backfill being placed immediately below the dam. The site will be restored and fill areas planted to prevent erosion. The 5,575 feet of canal leading to the West Side penstock will be filled and regraded to the natural contour. Both the spillway (400 cubic yards) and the intake (180 cubic yards) concrete will be removed. The 140-foot penstock, including the support structures, will also be removed.

The powerhouse will have all wooden materials removed. Any components that contain chemical or hazardous materials will be removed from the site including transformers, bushings, tanks, lead bearings, and asbestos based insulating products. All windows and doors will be sealed to prevent public access. The incoming water line and the battery bank will be removed. Following the removal of the penstock, the penstock outlet will be sealed at the powerhouse, assuring that access is prevented.

The small powerhouse-related substation and transmission lines leading to the larger nearby substation will be removed. The larger West Side substation will remain in place; it is not associated with the West Side hydroelectric development.

A4.0 KENO DEVELOPMENT

A4.1 INTRODUCTION

The existing Project includes the Keno development. During the course of study, PacifiCorp has identified a few changes to the proposed Project. In the future, Keno dam will remain in operation. However, it is not included in the proposed FERC Project as the development has no generation facilities, and its operation does not substantially benefit generation at PacifiCorp's downstream hydroelectric developments. PacifiCorp has determined that hydropower cannot be economically added to the Keno Development. Information on the Keno development is provided here for reference purposes, as it is a part of the existing Project.

A4.2 OVERVIEW

Keno dam is a reregulating facility owned by PacifiCorp. It is located at approximately RM 233, which is approximately 21 miles downstream of Link River dam. The facility does not include power-generating equipment. For the existing Project, PacifiCorp operates Keno dam under a contract with USBR (see Exhibit B, Section B8.3, Ownership and Contractual Obligations).

A4.3 DAM

Keno dam is a combination of earth embankment and reinforced-concrete, non-overflow, and spillway sections. The dam crest elevation is El. 4,070 feet msl and is approximately 680 feet long and 10 feet wide (curb to curb across the concrete section). The reinforced-concrete portion of the dam is 680 feet long. The dam height is approximately 25 feet above the excavated foundation. A grout curtain runs the length of the dam axis.

The ogee-type spillway section has a crest elevation of El. 4,070 feet msl and is 265 feet wide and has six 40-foot-wide spill gates. Normal maximum water surface is El. 4,086.5. The spillway apron extends approximately 60 feet downstream from the toe of the spillway ogee section. The estimated spillway capacity is 25,000 cfs at water surface El. 4,080 and with all six gates open.

There is a 24-pool weir and orifice type fish ladder at the Keno dam. This fish ladder gains 19 feet in elevation over a length of approximately 350 feet. Key information about Keno dam is summarized in Table A2.1-1.

A4.4 RESERVOIR

The Keno reservoir has a surface area of 2,475 acres at El. 4,085 feet msl and a total storage capacity of 18,500 acre-feet. Key information about Keno reservoir is summarized in Table A2.1-1.

A4.5 PROPOSED MINOR MODIFICATIONS

There are no proposed modifications to the Keno Development.

A5.0 J.C. BOYLE DEVELOPMENT

A5.1 OVERVIEW

The J.C. Boyle Development consists of a reservoir, a combination embankment and concrete dam, a water conveyance system, and a powerhouse on the Klamath River between about RM 228 and RM 220, which is downstream of the Keno dam and upstream of the Copco No. 1 dam. The purpose of the J.C. Boyle facility is to generate hydroelectric power.

A5.2 DAM

The embankment dam is a 68-foot-tall (at its maximum height above the original streambed) earthfill structure with a 15-foot side crest and a length of 413.5 feet at El. 3,800.0 feet msl. The concrete portion of the dam is 279 feet long and is composed of a spillway section, an intake structure, and a 115-foot-long gravity section of 23 feet maximum height between the intake block and the left abutment.

The spillway is a concrete gravity ogee overflow section with three 36-foot-wide by 12-foot-high radial gates. The spillway crest is at El. 3,781.5 feet msl and normal pool is 0.5 feet below the top of the gates (El. 3,793.5). The spillway bay discharges onto a 13-foot-long concrete apron stepped at three elevations generally following the profile of the bedrock surface. Below the apron is a vertical drop of 15 feet maximum height to the discharge channel, which was excavated in rock. The discharge channel is generally unlined. The estimated spillway capacity at water surface El. 3,793 feet msl with all three gates open is 14,850 cfs.

A 24-inch fish screen bypass pipe provides approximately 20 cfs of instream flow below the dam.

The intake structure is located to the immediate left of the spillway and consists of a 40-foot-high reinforced concrete tower. It has four 11-foot, 2-inch-wide openings to the reservoir, each of which has a steel trash rack followed by a vertical traveling screen (0.25-inch mesh) with high-pressure spray cleaners. Spray along with any screened fish are collected and diverted downstream of the dam. A fabricated metal building was added to the intake structure in 1989.

Behind the intake traveling screens is an entrance to the 14-foot-diameter steel flowline, the downstream end of which is equipped with a 14-foot by 14-foot automated fixed wheel gate. A bulkhead gate is also provided at the upstream end of the 14-foot flowline.

A pool and weir fishway approximately 569 feet long with 63 pools is located at the dam for upstream fish passage. The fishway operates over a gross head range of approximately 55 to 60 feet.

The water conveyance infrastructure between the dam and the powerhouse has a total length of 2.56 miles. From the intake structure, the water flows through a 638-foot long, 14-foot-diameter, steel flowline. The flowline is supported on steel frames where it spans the Klamath River and discharges into an open power canal. The power canal is 2 miles long along a bench cut in the face of the river canyon. Depending on the terrain, the canal is either a double- or single-walled concrete flume. The power canal is provided with overflow structures at the upstream and

downstream ends and terminates in a forebay. The forebay overflow section is equipped with float-operated gates, which release water during the hydraulic surge from the canal following any load rejection at the powerhouse. The released water discharges through a short, concrete-lined chute and returns to the bypass reach.

Water for power generation is drawn from the forebay through a 60-foot-wide and 17.9-foot-high trash rack with 2-inch bar spacing before entering a 15.5-foot-diameter, concrete-lined, horseshoe-section tunnel, which is 1,660 feet long. The last 57-foot length of the tunnel before the downstream portal is steel lined with the liner bifurcating into two 10.5-foot-diameter steel penstocks. The bifurcation is encased in a concrete anchor block, and a steel surge tank is mounted on the thrust block. Descending to the powerhouse, the penstocks reduce in two steps to 9 feet in diameter. Each penstock is 956 feet in length and is supported by ring girders seated on concrete footings.

Key information about J.C. Boyle dam is summarized in Table A2.1-1.

A5.3 RESERVOIR

The J.C. Boyle dam impounds a narrow reservoir of 420 surface acres (J.C. Boyle reservoir). The normal maximum and minimum operating levels are between El. 3,793 feet and El. 3,788 feet msl, a range of 5 feet. The reservoir contains approximately 3,495 acre-feet of total storage capacity and 1,724 acre-feet of active storage capacity.

Key information regarding J.C. Boyle reservoir is summarized in Table A2.1-1.

A5.4 POWERHOUSE

The conventional outdoor-type reinforced concrete powerhouse is located approximately 4.3 river miles downstream of the dam on the right bank of the river.

There are two vertical-Francis turbines. Both have a rated discharge of 1,425 cfs and are rated 56,000 hp at 440 feet of net head. Both generators are rated at 42,500 kVA at 0.95 power factor (40 MW). Key information about J.C. Boyle powerhouse is summarized in Table A2.1-1.

Two three-phase, 42,300-kVA, 11,000/236,000-V transformers step up the generator voltage for transmission interconnection.

A5.5 TRANSMISSION LINES

The power from the powerhouse is transmitted a very short distance to the J.C. Boyle substation. There is also a second line that pre-dates the substation. The 0.24-mile 69-kV transmission line (PacifiCorp line 98) connects the plant to a tap point on PacifiCorp's Line 18. This line is currently unenergized.

A5.6 PROPOSED MINOR MODIFICATIONS

A surface collection system (gulper) is proposed for the J.C. Boyle forebay to exclude fish from the power intake and to facilitate downstream fish passage. The system will include a full-depth guide net barrier extending from the fishway exit to the left bank. A floating barge will provide

approximately 200 cfs of attraction flow and surface collection of downstream migrants. Collected fish will be conveyed past the dam via a 24-inch bypass pipe with a flow of approximately 20 cfs. A general arrangement drawing of the facilities is presented in Exhibit F.

The guide net design parameters will follow NOAA Fisheries SW Region criteria for fingerlings including a maximum approach velocity of 0.4 fps, net opening size of 0.25 inch or less, and a minimum open area of 40 percent. The guide net will be removable for floods or on a seasonal basis. The surface collector will meet similar criteria for salmonid fry, including a maximum approach velocity of 0.4 fps, a sweeping velocity of 2 times the approach velocity, maximum screen openings of 1.75 mm, and a minimum open area of 27 percent. The bypass pipe will meet criteria requirements for a minimum water depth of 0.75 feet, and minimum velocity of 2 fps. The outfall will be sited near the location of the existing bypass pipe outfall.

Modifications are also proposed for the J.C. Boyle fish ladder. The existing bar spacing on the fishway exit pool trashrack will be increased to facilitate the passage of adult fish. An additional weir will also be added to the fishway entrance pool to decrease the height of the existing step.

It is proposed that two synchronous bypass valves be provided at the J.C. Boyle powerhouse so that downstream ramping rate requirements can be maintained after a unit trips off-line and the use of the emergency wasteway just upstream from the power tunnel can be minimized. The modifications will include two 9.5-foot diameter stainless steel shutoff butterfly valves and two 4-foot diameter stainless steel fixed cone valves. Normally, the butterfly valves will be in the open position, but will close automatically in the event of an operational failure of the respective fixed cone valve. A hooded discharge structure and energy dissipation structure will also be included to prevent large amounts of spray that could negatively impact switchyard equipment downstream of the powerhouse. A general arrangement drawing of the proposed modification is presented in Exhibit F. This bypass facility may need to be modified to meet new instream flow requirements downstream of the J.C. Boyle powerhouse. During non-peaking operations, an additional 100 cfs flow release at the powerhouse is planned. This can be accomplished with a small hydro turbine or modifications to the proposed synchronous bypass valves.

A5.7 PLANNED GENERATION ENHANCEMENTS

PacifiCorp has periodically implemented capital investments for the purpose of enhancing the generation capabilities of existing turbine-generator units on the Klamath Project. In each of these cases, the driver for the overhaul/upgrade of a turbine and/or generator has been a need to replace major components that have reached the end of their useful life. While turbine technology has not changed significantly in many years, the advent of more powerful computers and numerical flow analysis has allowed for optimization of turbine runner designs resulting in efficiency and capacity gains associated with a turbine overhaul incorporating a runner replacement. In this manner, PacifiCorp has been able to take advantage of the new design and analysis technology to obtain incremental gains to the efficiency and capacity for the units on the Klamath River.

The existing J.C. Boyle Development includes two vertical Francis turbine generator units. Unit No. 1 underwent an overhaul in 1994 primarily due to maintenance concerns for the unit that include a runner replacement resulting in a unit efficiency improvement of approximately 3.2 percent and a capacity improvement of approximately 17.6 percent. No generator work was

included at this time, and the maximum operating point for the unit remains limited by generator capability. The Unit No.2 turbine is original equipment.

Planning has identified opportunities similar to those experienced with the overhaul and runner replacement for Unit No.1 for J.C. Boyle Unit No.2. It is expected that Unit No.2 will require a major overhaul and runner replacement within the life of the new Klamath Project license. The specific details of the design for a new runner for Unit No.2 will depend greatly on decisions regarding minimum flows, ramping rates, and water rights.

Other options for improvements in generation at the J.C. Boyle project involve rewinds of the turbine generators and the replacement of major electrical equipment such as generator breakers, generator buss, and step-up transformers. It is expected at this time that the replacement/upgrade of these components will be implemented as they approach the end of their useful life. At each opportunity, PacifiCorp will evaluate the component limitations and attempt to take advantage of any improvements in the overall generating facilities efficiency and capacity with an upgrade to the component being replaced.

A6.0 COPCO NO. 1 DEVELOPMENT

A6.1 OVERVIEW

The Copco No. 1 Development consists of a reservoir, dam, spillway, intake, and outlet works and powerhouse located on the Klamath River between approximately RM 204 and RM 198 near the Oregon-California border. Copco No. 1 is downstream of the J.C. Boyle dam and upstream of Copco No. 2 dam. The purpose of the facility is to generate hydroelectric power.

A6.2 DAM

The Copco No. 1 dam is a concrete gravity arch structure with a 462-foot radius at the crest. As originally designed, the spillway crest was approximately 115 feet above the original river bed. After construction began, the river gravel was found to be over 100 feet deep at the dam site; this material was excavated and then backfilled with concrete, making the total height of the dam 230 feet, measured from the lowest depth of excavation to the spillway crest, and 250 feet to the top of the spillway deck.

The crest length between the rock abutments is approximately 410 feet. The upstream face of the dam is vertical at the top, then battered at 1 horizontal to 15 vertical. The downstream face is stepped, with risers generally about 6.0 feet in height.

The ogee-type spillway is located on the crest of the dam. It is divided into 13 bays controlled by 14-foot by 14-foot Tainter gates. The spillway crest is located at El. 2,593.5 feet msl. The normal operating reservoir water level is 1.5 feet below the top of the gates at El. 2,606.0 feet msl. The estimated spillway capacity at water surface El. 2,607.5 feet msl with all 13 gates open is 36,764 cfs.

Two intake structures are located at approximately invert El. 2,575.0 feet msl in the dam near the right abutment. The left intake houses four vertical lift gates. Two 10-foot-diameter (reducing to 8-foot-diameter) steel penstocks feed Unit No. 1 in the powerhouse. The right intake houses four vertical-lift gates. A single, 14-foot-diameter (reducing to two 8-foot-diameter) steel penstock feeds Unit No. 2. Facilities exist at the intake for future expansion of the powerhouse, but there are no plans to expand the Project capacity. There are two side-by-side trash racks, which measure 44 feet wide, 12.5 feet high, and have bar spacings of 3 inches, in front of each intake.

The low-level sluice outlet has been abandoned.

Key information about Copco No. 1 dam is summarized in Table A2.1-1.

A6.3 RESERVOIR

The Copco No. 1 reservoir is approximately 1,000 acres in extent and contains approximately 15,200 acre-feet of total storage capacity at elevation 2,607.5 and approximately 6,235 acre-feet of active storage capacity. The normal maximum and minimum operating levels are between El. 2,607.5 and El. 2,601.0 feet, respectively, a range of 6.5 feet. Key information about Copco No. 1 reservoir is summarized in Table A2.1-1.

A6.4 POWERHOUSE

The Copco No. 1 powerhouse is a reinforced-concrete substructure with a concrete and steel superstructure enclosed by metal siding located at the base of Copco No. 1 dam on the right bank. The two turbines are double-runner, horizontal-Francis units, each with a rated discharge of 1,180 cfs, and rated at 18,600 hp at a net head of 125 feet. The generators are rated at 12,500 kVA at 0.8 power factor (10 MW). There are no turbine bypass valves.

Unit 1 has three single-phase, 5,000-kVA, 2,300/72,000-V transformers to step-up the generator voltage for transmission interconnection. Unit 2 has three single-phase, 4,165-kVA, 2,300/72,000-V transformers to step up the generator voltage for transmission interconnection.

Key information about the Copco No. 1 powerhouse is summarized in Table A2.1-1.

A6.5 TRANSMISSION LINES

Copco No. 1 plant has two associated 69-kV transmission lines. PacifiCorp Line 15 connects the Copco No. 1 switchyard to Copco No. 2, approximately 1.23 miles to the west. PacifiCorp lines 26-1 and 26-2, each approximately 0.07 mile in length, connect Copco No. 1 powerhouse to the Copco No. 1 switchyard.

A6.6 PROPOSED MINOR MODIFICATIONS

There are no proposed modifications to the Copco No. 1 Development as part of the relicensing of the Project.

A6.7 PLANNED GENERATION ENHANCEMENTS

The existing Copco No.1 Development includes two horizontal Francis turbine generator units. Unit No.11 underwent an overhaul in 1996 due to maintenance concerns for the turbine runner. This project included a runner replacement resulting in a unit efficiency improvement of approximately 3.2 percent and a capacity improvement of approximately 11 percent. The maximum operating point for the unit remains limited by generator capability. The Unit No.12 turbine is original equipment.

It is expected that Unit No.12 will require a major overhaul and runner replacement within the life of the new Klamath Project license. The specific details of the design for a new runner for Unit No.12 will depend on decisions regarding the operation of the overall Klamath River Project, with specific attention to Iron Gate's minimum flow requirements and ramping rates. Efficiency and capacity improvements for Unit No.12 are expected to be very similar to those experienced with the overhaul of Unit No.11.

The generators for Unit No. 11 and Unit No.12 were rewound in 1962 and 1973 respectively. It is expected these units will need to be rewound again within the term of the new license. The replacement of other major electrical equipment such as generator breakers, generator buss, and step-up transformers can be expected to be necessary as they reach the end of their useful life. At each opportunity, PacifiCorp will evaluate the component limitations and attempt to take advantage to any improvements in the overall generating facilities efficiency and capacity with an upgrade to the component being replaced.

A7.0 COPCO NO. 2 DEVELOPMENT

A7.1 OVERVIEW

The Copco No. 2 Development consists of a diversion dam, small impoundment, a water conveyance system, and a powerhouse. The dam is located approximately $\frac{1}{4}$ mile downstream of Copco No. 1 dam at RM 198.3. The purpose of the Copco No. 2 facilities is to generate hydroelectric power.

A7.2 DAM

The Copco No. 2 dam is a concrete gravity structure with an intake to the flowline on the left abutment and a 145-foot-long spillway section with five Tainter gates. The dam is 33 feet high, has an overall crest length of 335 feet and a crest width of 9 feet. The crest elevation is El. 2,493 feet msl. The dam has a 132-foot-long earthen embankment with a gunite cutoff wall. The dam has a manual gate controlling a sluiceway adjacent to the intake. A corrugated metal flume provides approximately 5 cfs of instream flow in the bypass reach. The concrete gravity spillway section crest elevation is 2,473 feet msl. The estimated spillway capacity at water surface El. 2,483 feet msl is 13,060 cfs with the five gates open.

The intake structure incorporates trash racks and a roller-mounted (caterpillar) bulkhead gate. The trash rack is 36.5 feet by 48 feet and has 2-inch bar spacing.

The flow line to the powerhouse consists of portions of 2,440 feet of concrete-lined tunnel, 1,313 feet of wood-stave pipeline, an additional 1,110 feet of concrete-lined tunnel, a surge tank, and two steel penstocks. The diameter of the tunnel and wood stave pipeline sections is a constant 16 feet. The two penstocks, one 405.5 feet long and one 410.6 feet long, range from 16 feet in diameter at the inlet to 8 feet in diameter at the turbine spiral cases.

Key information about Copco No. 2 dam is summarized in Table A2.1-1.

A7.3 RESERVOIR

The reservoir created by the Copco No. 2 dam is approximately $\frac{1}{4}$ -mile long and has a storage capacity of 73 acre-feet. At the normal water surface elevation of El. 2483 feet msl, there is very minimal active storage. El. 2,483 feet msl is both the maximum and minimum normal water surface. As a result, Copco No. 2 generation tracks Copco No. 1 generation.

Key information about Copco No. 2 reservoir is summarized in Table A2.1-1.

A7.4 POWERHOUSE

The powerhouse is a reinforced concrete structure that houses two vertical-Francis turbines. Each turbine has a rated discharge of 1,338 cfs and a rated capacity of 20,000 hp at 140 feet of net head. The synchronous generators are rated 15,000 kVA at 0.9 power factor (13.5 MW).

There are three single-phase, 10/20-megavolt ampere (MVA), 6,600/72,000-V transformers for each generator to step up the voltage. There are also three single-phase, 10/20-MVA, 73,800/230,00-V step-up transformers for interconnection to the transmission system.

Key information about Copco No. 2 powerhouse is summarized in Table A2.1-1.

A7.5 TRANSMISSION LINES

A 69-kV transmission line (PacifiCorp Line 15) connects the Copco No. 2 powerhouse to the Copco No. 1 switchyard, approximately 1.23 miles to the west.

A7.6 PROPOSED MINOR MODIFICATIONS

It is proposed that the existing instream flow bypass located on the left side of the spillway be automated to provide a constant release of 10 cfs below the Copco No. 2 dam. An automated level sensor and gate operator will be added to control the instream flow releases. A general arrangement drawing of the instream flow bypass is presented in Exhibit F.

A7.7 PLANNED GENERATION ENHANCEMENTS

The existing Copco No.2 Development includes two vertical Francis turbine generator units. Unit No. 21 underwent an overhaul in 1996 due to maintenance concerns for the turbine runner. This project included a runner replacement resulting in a capacity improvement of approximately 19 percent over the original runner's capacity and approximately 36 percent over the limited operation of the original runner's current capability. The maximum operating point for the unit remains limited by generator capability. Unit No. 22 turbine remains original equipment.

It is expected that Unit No. 22 will require a major overhaul and runner replacement within the life of the new Klamath Project license. The specific details of the design for a new runner for Unit No. 22 will depend on decisions regarding the operation of the overall Klamath River Project, with specific attention to Iron Gate's minimum flow requirements and ramping rates. Efficiency and capacity improvements for Unit No. 22 are expected to be very similar to those experienced with the overhaul of Unit No. 21.

The generators for Unit No. 21 and Unit No. 22 were rewound in 1955. It is expected these units will need to be rewound again within the term of the new license. The replacement of other major electrical equipment such as generator breakers, generator buss, and step-up transformers can be expected to be necessary as they reach the end of their useful life. At each opportunity, PacifiCorp will evaluate the component limitations and attempt to take advantage of any improvements in the overall generating facilities efficiency and capacity with an upgrade to the component being replaced.

Another major project component that may require replacement within the term of the new Klamath Project license includes the wood stave flowline. The existing flowline was installed as part of the original project. It is currently considered to be in satisfactory condition and through proper maintenance is expected to remain so for a number of years. However, PacifiCorp's experience with wood stave indicates it is unlikely the flowline life will extend through the new project license period. It is likely the flowline would be replaced on the same alignment with steel pipe of a similar diameter.

A8.0 FALL CREEK DEVELOPMENT

A8.1 OVERVIEW

The Fall Creek Development is located on Fall Creek, a tributary to the Iron Gate reservoir, approximately 0.4 miles south of the Oregon-California border. Additional diversion facilities are located on Spring Creek. The facilities on Fall Creek consist of a concrete and timber flashboard spillway structure, an earth- and-rock-filled diversion dam, 4,560 feet of earthen and rock-cut power canal, 2,834 feet of steel penstock, and a powerhouse. The purpose of the Fall Creek Development is to generate hydroelectric power.

An associated feature of the Fall Creek development is an earthen diversion dam located on Spring Creek. Spring Creek is a tributary of Jenny Creek, located adjacent and to the west of Fall Creek. When in use, it diverts up to 16.5 cfs from Spring Creek into a tributary of Fall Creek. This flow supplements the flow in Fall Creek at the Fall Creek diversion dam.

A8.2 DAMS

A8.2.1 Fall Creek

Fall Creek dam is a 5-foot-high, earth-filled embankment with a concrete and timber flashboard spillway structure. The overall crest length is 130 feet with a crest elevation at El. 3,253.4 feet msl and a crest width of 12 feet. The concrete spillway section is 32 feet wide.

At a normal water surface elevation of El. 3,251 feet msl, there is no active storage in the diversion pond. A small hole in one of the spillway stop logs provides 0.5 cfs of instream flow in Fall Creek below the dam.

The 18-foot-long CMP culvert power canal headworks includes a manual slide gate. The adjacent gated 36-inch CMP is used to sluice sediment from in front of the headworks.

The 4,560-foot-long earth and rock power canal is 9 feet wide. At the design flow of 50 cfs, the water depth is 3 feet. At the entrance to the penstock is a trash rack that is 17.5 feet long by 10.7 feet wide with 3-inch bar spacing. The 42-inch-diameter penstock (reducing to 30-inch-diameter), approximately 2,834 feet long, drops over the hillside to the powerhouse.

Key information about Fall Creek dam is summarized in Table A2.1-1.

A8.2.2 Spring Creek

The Spring Creek dam is a small earthen embankment approximately 7 feet high and 10 feet wide that spans the entire stream width (approximately 66 feet). Water from Spring Creek is diverted through an earthen canal that discharges to the Fall Creek drainage. The canal includes a 36-inch diameter CMP culvert headworks with manual slide gate. An adjacent 42-inch diameter CMP culvert with manual slide gate and grated inlet is used to bypass flows downstream and to maintain a constant water surface elevation in the reservoir.

Key information about the Spring Creek dam is summarized in Table A2.1-1.

A8.3 POWERHOUSE

The powerhouse is a reinforced-concrete substructure with a steel superstructure enclosed by corrugated metal siding. It houses three horizontal shaft Pelton turbines. Unit No. 1 has a rated discharge capacity of 14 cfs and a rated output of 1,000 hp at 730 feet of net head. The Unit No. 1 generator is rated 500 kVA at 1.0 power factor (0.5 MW). Unit No. 2 has a rated discharge capacity of 21 cfs and a rated output of 1,500 hp at 730 feet of net head. The Unit No. 2 generator is rated 450 kVA at 1.0 power factor (0.45 MW). Unit No. 3 has a rated discharge capacity of 25 cfs and a rated output of 1,800 hp at 730 feet of net head. The Unit 3 generator is rated 1,250 kVA at 1.0 power factor (1.25 MW). The combined hydraulic capacity of the three turbines is 50 cfs.

There are three single-phase, 833-kVA, 2,300/72,000-V step-up transformers at the powerhouse.

Key information about the Fall Creek powerhouse is summarized in Table A2.1-1.

A8.4 TRANSMISSION LINES

The Fall Creek plant has two associated 69-kV transmission line segments. Line 3 connects the Fall Creek plant to Copco No. 1 switchyard, approximately 1.65 miles to the east. There is also a very short segment of Line 3 that connects the plant to a tap point on Line 18, which runs nearly overhead.

A8.5 PROPOSED MINOR MODIFICATIONS

Canal screens and fish ladders are proposed for both the Fall Creek and Spring Creek diversions. The canal screens will be diagonal-type screens meeting NOAA Fisheries SW Region criteria for salmonid fry, including a maximum approach velocity of 0.4 fps, a sweeping velocity of 2 times the approach velocity, maximum screen openings of 1.75 mm, and a minimum open area of 27 percent. The bypass pipes will be 12 inches in diameter with 2.5 cfs of flow each. General arrangement drawings of the canal screens are presented in Exhibit F.

The Fall Creek fish ladder will be a pool- and weir-type ladder consisting of six pools. The pools will be constructed from rock and include a 0.5-foot vertical jump for each pool. The existing flashboards will be notched at the exit pool to permit a fishway flow of 2.5 cfs.

The Spring Creek fish ladder will be a timber or concrete pool- and weir-type ladder consisting of eight pools. The pools will be 4 feet by 5 feet in plan with 0.5-foot vertical jumps. A fishway control structure consisting of a 24-inch diameter CMP culvert and manually-operated slide gate will provide 2.5 cfs of fishway flow. General arrangement drawings of the fish ladders are presented in Exhibit F.

A Parshall flume is also proposed for the Spring Creek canal to permit measurement of diverted flows.

A8.6 PLANNED GENERATION ENHANCEMENTS

As with the larger developments on the Klamath Project, PacifiCorp will monitor the performance of the generation equipment at the Fall Creek development over the term of the new license and either overhaul or replace equipment as needed.

A9.0 IRON GATE DEVELOPMENT

A9.1 OVERVIEW

The Iron Gate Development consists of a reservoir, an earth embankment dam, an ungated side-channel spillway, intakes for the diversion tunnel and penstock, a steel penstock from the dam to the powerhouse, and the powerhouse. It is located on the Klamath River between approximately RM 196.8 and RM 190, approximately 20 miles northeast of Yreka, California. It is the farthest downstream hydroelectric facility of the Klamath Hydroelectric Project. The purpose of the Iron Gate facilities is to generate hydroelectric power.

A9.2 DAM

Iron Gate dam is a zoned earthfill embankment. The dam has a height of 189 feet from the rock foundation to the dam crest at El. 2,343.0 feet msl. The crest is 20 feet wide and approximately 740 feet long. It has a central, vertical-asymmetrical clay core. The dam is founded on a sound basalt rock foundation. There is a grout curtain in the bedrock beneath the impervious core.

There are fish trapping and holding facilities located on the random fill area at the dam toe. The top of the random fill area is at El. 2,189.0 feet msl. High- (El. 2,310.0 feet msl) and low-level (El. 2,250 feet msl) intakes for the fish facility water are incorporated into the dam.

In 2003, modifications were made to Iron Gate Dam to raise the dam crest elevation from El. 2343 feet msl to El. 2348 feet msl. The modifications included construction of a concrete wall extension along the dam crest, anchored into the existing dam structure. Additional riprap materials were placed on the upstream face of the dam to protect those areas inundated by the higher reservoir elevations. This work included shotcrete protection at the top of the spillway and spillway chute.

The spillway is excavated in rock at the right dam abutment. It is an ungated chute spillway with a side channel entrance. The spillway crest is at El. 2,328.0 feet msl, 15 feet below the dam crest. The spillway crest is 727 feet long and consists of a concrete ogee and slab placed over the excavated rock ridge. The upper part of the channel is partly lined with concrete. At the end of the chute, a flip-bucket terminal structure is located approximately 2,150 feet downstream of the toe of the dam. Key information about Iron Gate dam is summarized in Table A2.1-1.

The diversion tunnel used during construction was driven through bedrock in the right abutment and is still in place. The tunnel terminates in a reinforced concrete outlet structure at the downstream toe of the dam. Control of the flow in the tunnel is provided by a slide gate approximately 112 feet upstream of the dam axis. The gate is housed in a reinforced concrete tower accessible by bridge from the dam crest. The intake is a reinforced concrete structure equipped with trash racks and is submerged on the floor of the reservoir approximately 380 feet upstream from the dam axis. Operation of the gate controlling flow through the tunnel is limited to emergency use during high flow events. If needed for such purposes, the tunnel can pass up to approximately 5,000 cfs.

The intake structure for the powerhouse is a 45-foot-high, free-standing, reinforced-concrete tower, located in the reservoir immediately upstream of the left dam abutment. It is accessed by a

foot bridge from the abutment. It houses a 14-foot by 17-foot slide gate, which controls the flow into a 12-foot-diameter, welded-steel penstock. The penstock is concrete-encased where it penetrates the dam approximately 35 feet below the normal maximum reservoir level. The penstock is supported on concrete supports down the dam abutment. There is a trash rack at the penstock entrance, which is 17.5 feet by 45 feet with 4-inch bar spacing.

A9.3 RESERVOIR

The reservoir formed upstream of the Iron Gate dam is approximately 944 surface acres and contains approximately 58,794 acre-feet of total storage capacity (at El. 2,328.0 feet msl) and 3,790 acre-feet of active storage capacity. The normal maximum and minimum operating levels are between El. 2,328.0 feet msl and El. 2,324.0 feet msl, respectively, a range of 4 feet.

Key information about Iron Gate reservoir is summarized in Table A2.1-1.

A9.4 POWERHOUSE

The powerhouse is located at the base of the dam on the left bank.

The Iron Gate powerhouse consists of a single vertical Francis turbine. The turbine has a rated discharge capacity 1,735 cfs, with a rated output of 25,000 at a rated net head of 154 feet. The synchronous generator is rated 18,947 kVA at 0.95 power factor (18 MW). In the event of a turbine shutdown, a synchronized Howell-Bunger bypass valve located immediately upstream of the turbine diverts water around the turbine to maintain flows downstream of the dam.

There is a single three-phase, 18,947-kVA, 6,600/69,000-V step-up transformer at the powerhouse to interconnect the PacifiCorp transmission system.

Key information about Iron Gate powerhouse is summarized in Table A2.1-1.

A9.5 TRANSMISSION LINES

Iron Gate plant has one associated 69-kV transmission line. Line 62 runs along the north side of Iron Gate reservoir for approximately 6.55 miles, to the Copco No. 2 switchyard.

A9.6 IRON GATE FISH HATCHERY

The Iron Gate fish hatchery was constructed in 1966 and is located downstream of Iron Gate dam, adjacent to the Bogus Creek tributary. The hatchery complex includes an office, incubator building, rearing ponds, fish ladder with trap, visitor information center, and employee residences. Up to 50 cfs is diverted from the Iron Gate reservoir to supply the 32 raceways and fish ladder.

The hatchery produces Chinook salmon, steelhead trout, and coho salmon. Annual production goals are 6 million Chinook, 200,000 steelhead, and 75,000 coho. The hatchery is operated by the California Department of Fish and Game. Eighty percent of operations and maintenance costs are funded by PacifiCorp.

A9.7 PROPOSED MINOR MODIFICATIONS

Minor modifications proposed for the Iron Gate Development include the purchase of a mass-marking trailer for use at the hatchery. The mass-marking trailer is a portable building containing automated fish-marking equipment.

Modifications to Iron Gate dam may be required to facilitate the release of low-level reservoir water, pending the outcome of water quality investigations. These modifications may include retrofit of the existing low-level outlet and bulkhead gate. Further discussion is provided in Section A9.8.

A9.8 PLANNED GENERATION ENHANCEMENTS

Iron Gate is PacifiCorp's newest hydroelectric development, with a capacity greater than 10 MW. The development includes one vertical Francis turbine generator unit. Maintenance records indicate the need for a turbine overhaul in the next couple of years. Given the uncertainty associated with the establishment of the minimum instream flow and required releases from the Iron Gate Development (ongoing ESA consultation between USBR and NOAA Fisheries), PacifiCorp has elected to defer the overhaul and runner replacement until future flows are identified. This will allow for the design of a runner that best meets the needs of the proposed operational constraints for the Iron Gate Development. It is expected that a unit overhaul and runner replacement for Iron Gate will result in efficiency gains from 3-7 percent and a capacity improvement from 10-15 percent.

Improvements in generation at the Iron Gate Development may include rewind of the turbine generator and the replacement of major electrical equipment such as generator breakers, generator buss, and step-up transformers. It is expected at this time that the replacement/upgrade of these components will be implemented as they approach the end of their useful life. At each opportunity, PacifiCorp will evaluate the component limitations and attempt to take advantage of any efficiency and/or capacity improvements while replacing and upgrading the various components

Depending on future release requirements for the Iron Gate Development, a number of alternatives for the release of minimum instream flows from Iron Gate dam are under consideration by PacifiCorp. Dam safety work was recently completed and included the installation of an additional 5 feet of height to the dam's crest. No change will occur to the operating level of the reservoir. PacifiCorp is currently working with the State of California to identify what modifications may be necessary to the low-level outlet tunnel to enable the tunnel to assist with the draining of the reservoir during an emergency. PacifiCorp is also evaluating options for the release of required minimum instream flows that exceed the capacity of the existing generating unit. Work on this issue is in the very early stages, and specific details about how these facilities might be configured are not available at this time. It is possible that the installation of a low-level release mechanism could involve the addition of a small generating unit. The criteria for design are not expected to be available until all criteria for the future operation of the Iron Gate Development have been determined and incorporated into the new Klamath Project license.

A10.0 INFORMATION SOURCES

Eilers, J.M. and C.P. Gubala. 2003. Draft Bathymetry and Sediment Classification of the Klamath Hydropower Project Impoundments. Prepared for PacifiCorp by JC Headwaters. March 2003.