MONTANA DAMS & HYDROPOWER

INSIDE:

MAY 2020

GreatWest engineering ®

MONTANA DNRC
MT DEPARTMENT OF NATURAL RESOURCES & CONSERVATION

CONTENTS

Section 1

ELECTRICITY AND HYDROPOWER: THE BASICS

MISCONCEPTION	TRUTH
Hydropower can be economically added to all Montana dams.	Hydropower can be expensive to develop at a new site and not all sites are well-suited to hydropower production.
The benefits of hydropower always outweigh the costs.	Even sites well-suited to hydropower production can face challenges due to ancillary costs such as transmission line construction costs and costs to comply with regulations.
Hydropower facilities require massive dams to be economical.	Small dams with steady, reliable flow can be economical. For example, the state of Montana-owned Toston Dam is a relatively small structure that consistently generates revenue.
The bigger a dam is, the more power it can generate.	Although larger (taller) dams typically provide more hydraulic head and greater power potential, power generating capability is also tied to the amount of water allowed to pass through a structure. Downstream release requirements for irrigation and recreation sometimes dictate that water be released in ways that are not conducive to maximum hydropower generation. Note that larger dams do store a greater volume of water that can improve power generating reliability, especially in drought conditions.

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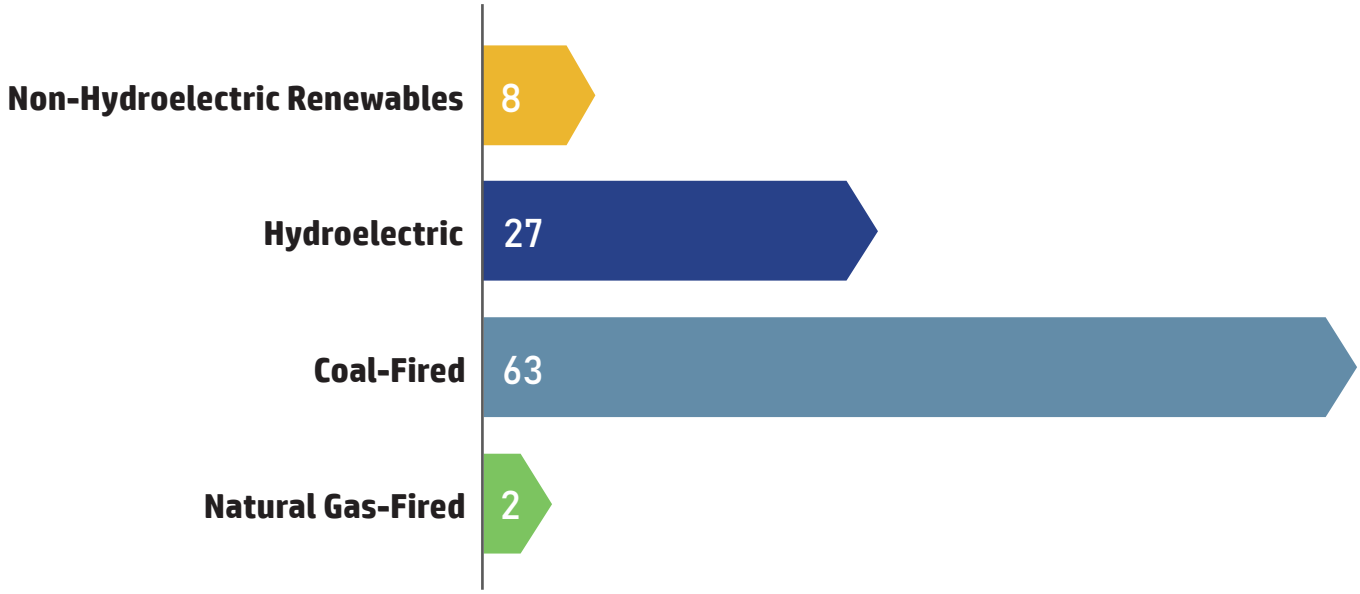
ELECTRICITY AND HYDROPOWER: THE BASICS

Montana Net Electricity Generation by Source
September 2018 (%)



Electrical generation by source. Values sourced from Energy Information Administration, Electric Power Monthly

TOSTON DAM

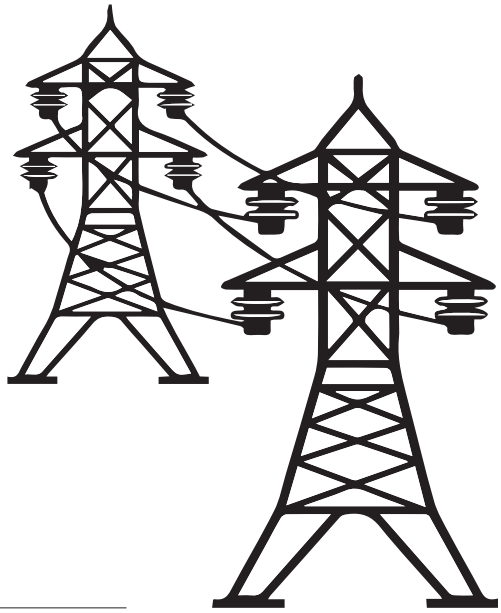
Section 1

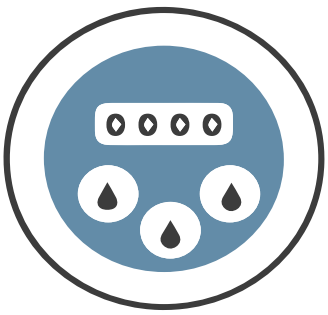
ELECTRICITY AND HYDROPOWER: THE BASICS

UNDERSTANDING POWER AND ENERGY

Watts are a measurement of power, describing the rate at which energy is being generated or consumed. For example, a 15 watt LED light bulb draws 15 watts of power at any particular instance while illuminated.

Megawatts (equal to a million watts), abbreviated MW, are more typically used to measure the output of a power plant or the amount of electricity required by a city.





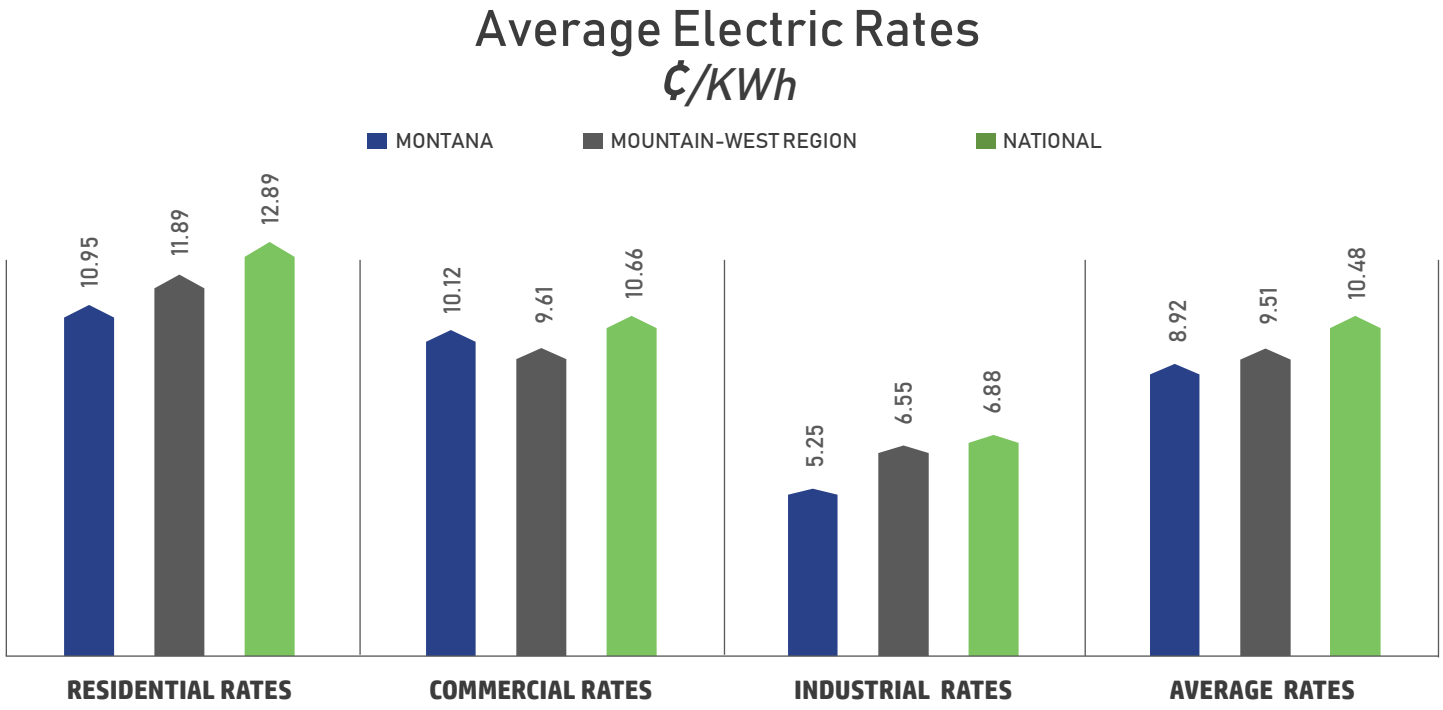
Energy is a measure of work done and is computed by multiplying power x time. Thus a 15 watt lightbulb that is on for two hours consumes 30 watt hours of electrical energy. A megawatt hour, abbreviated MWh, is equal to one megawatt of electricity produced or consumed in one hour.

Section 1

ELECTRICITY AND HYDROPOWER: THE BASICS

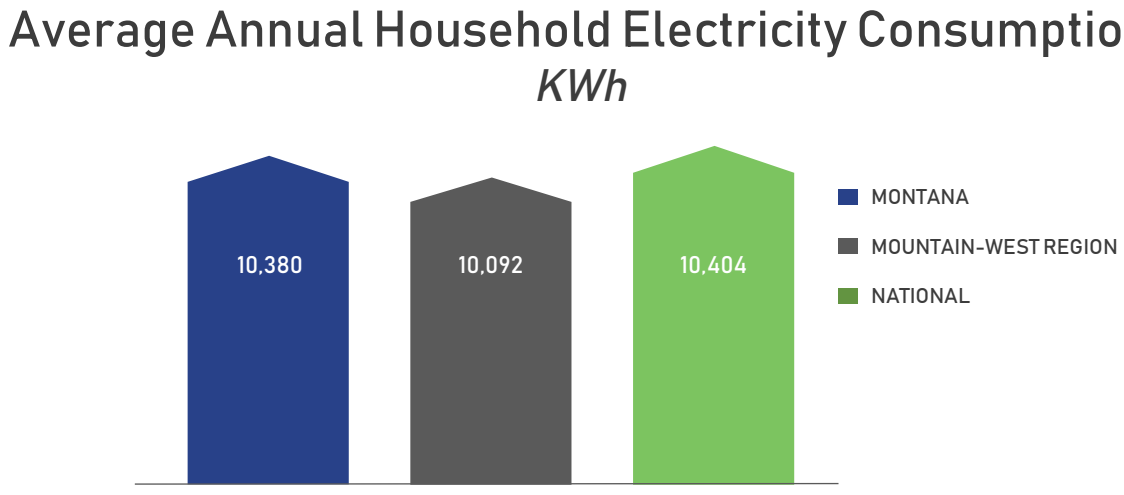
ENERGY COSTS

Energy costs vary by customer type and utility provider but are subject to Montana Public Service Commission (PSC) regulation. Average rates by customer type can be seen in the chart below.



Average Rates of Electricity. 2017 rates published by U.S. Energy Information Administration.

ENERGY CONSUMPTION/DEMAND



Average Yearly Electricity Consumption By Household. 2017 data published by U.S. Energy Information Administration.

Section 1

ELECTRICITY AND HYDROPOWER: THE BASICS

REGULATION: DAM OPERATING SCENARIOS

SELF :: Federally Owned/Operated Dam and Hydro Facilities

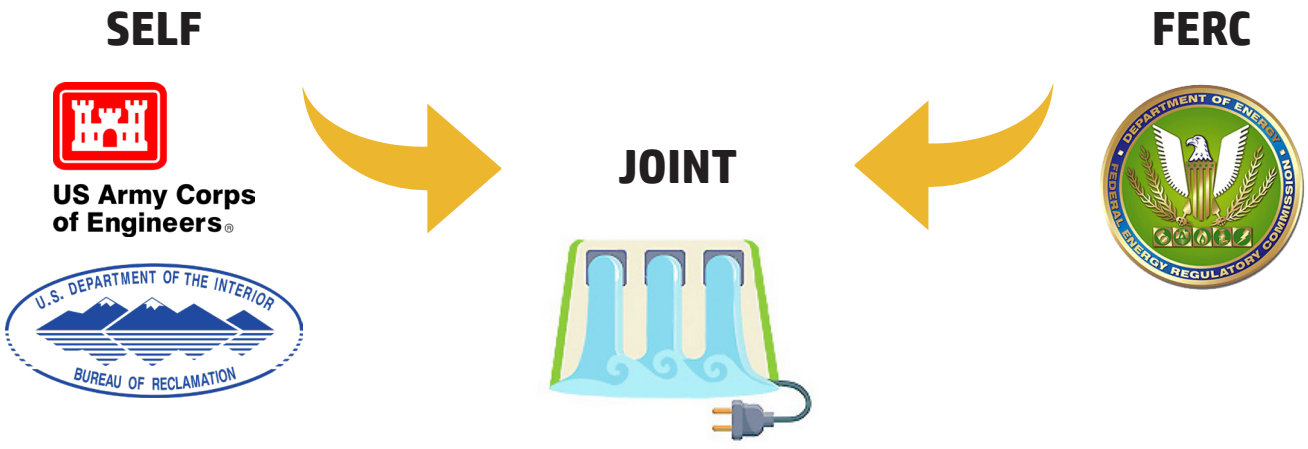
Federally owned and operated dams are authorized by Acts of Congress and do not require additional licenses. Their right to operate is declared through federal law. This means the United States Army Corps of Engineers (USACE) or the United States Bureau of Reclamation (USBR) effectively self-regulate. To comply with the Dam Safety Act, the USACE and USBR have adopted their own unique dam safety programs to manage their facilities. These dam safety programs must abide by all applicable federal regulations.

FERC :: Public or Privately Owned/Operated Dam and Hydro Facility

The Federal Energy Regulatory Commission (FERC) claims jurisdiction over all hydroelectric facilities not under jurisdiction of a federal agency and not meeting FERC exemption requirements. FERC is explained in more detail on pages 7-9.

JOINT :: Federally Owned Dam – Private Hydro Facility

In certain cases, Federally owned and operated dams were not specifically authorized by Congress for hydropower development (i.e. only irrigation, recreation, etc.). When this occurs, the federally owned dam may allow a private hydropower facility to utilize the existing dam infrastructure to generate power. The privately-operated hydropower facility is subject to FERC licensing and regulation. FERC works in conjunction with the federal agency to ensure dam safety programs fit within the existing dam operations. Current federally-owned projects that have existing or proposed private hydropower facilities include Tiber Dam, Gibson Dam, and Clark Canyon Dam.



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ELECTRICITY AND HYDROPOWER: THE BASICS

SELF REGULATION

The United States Bureau of Reclamation and United States Army Corps of Engineers operate independently to ensure the safe operation of their dam facilities and ensure compliance with federal laws and regulations. Federal hydropower does fall under the authority of North American Electric Reliability Corporation (NERC) standards/ requirements for reliability and security of bulk power in North America.

UNITED STATES BUREAU OF RECLAMATION (USBR)

The USBR Dam Safety Program ensures compliance with the Reclamation Safety of Dams Act. USBR has implemented various programs, including the Safety Evaluation of Existing Dams (SEED) program and the Safety of Dams (SOD) program, to ensure public safety is maintained by performing adequate inspections of all facilities and conducting necessary repairs and improvements in a timely fashion.

The USBR Dam Safety Program has evolved due to federal regulations passed in response to dam failures, namely the Teton Dam Failure that occurred in Rexburg, Idaho in 1978, but also due to other incidents such as the Gibson Dam overtopping in 1964.

UNITED STATES ARMY CORPS OF ENGINEERS (USACE)

The USACE Dam safety program is responsible for the safe operations of all USACE dam facilities. The dam safety program requires annual inspections of all dams to identify deficiencies and to continually assess ongoing changes. Inspections occurring every 5 years are more in-depth inspections led by a Professional Engineer to evaluate the annual inspections and identify necessary changes to the operations and maintenance of a particular dam.

The Oroville Dam spillway incident has caused federal and state agencies to reassess their dam safety programs. The Department of Natural Resources and Conservation (DNRC) is currently evaluating results from an external review of the state dam safety program. The external review identified lessons learned from the Oroville incident with application to Montana and made several recommendations for improvement.

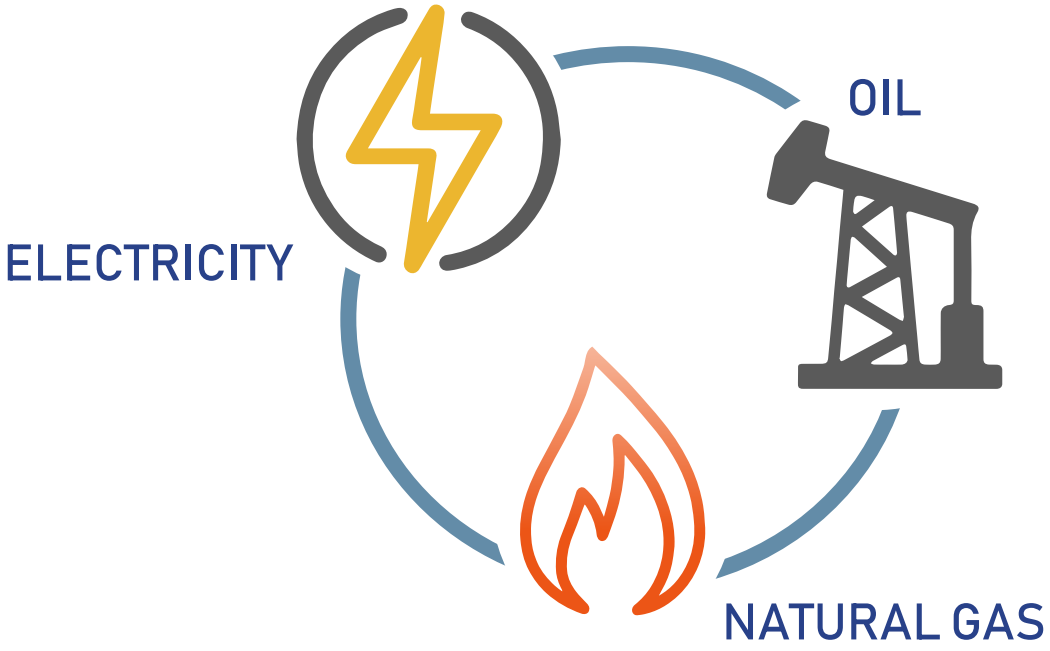
COURTESY DALE KOLKE / CALIFORNIA DEPARTMENT OF WATER RESOURCES

Section 1

ELECTRICITY AND HYDROPOWER: THE BASICS

WHO IS THE FEDERAL ENERGY REGULATORY COMMISSION (FERC)?

The Federal Energy Regulatory Commission, or FERC, is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil. FERC also reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines as well as licensing hydropower projects.



Information sourced from www.ferc.gov

Section 1

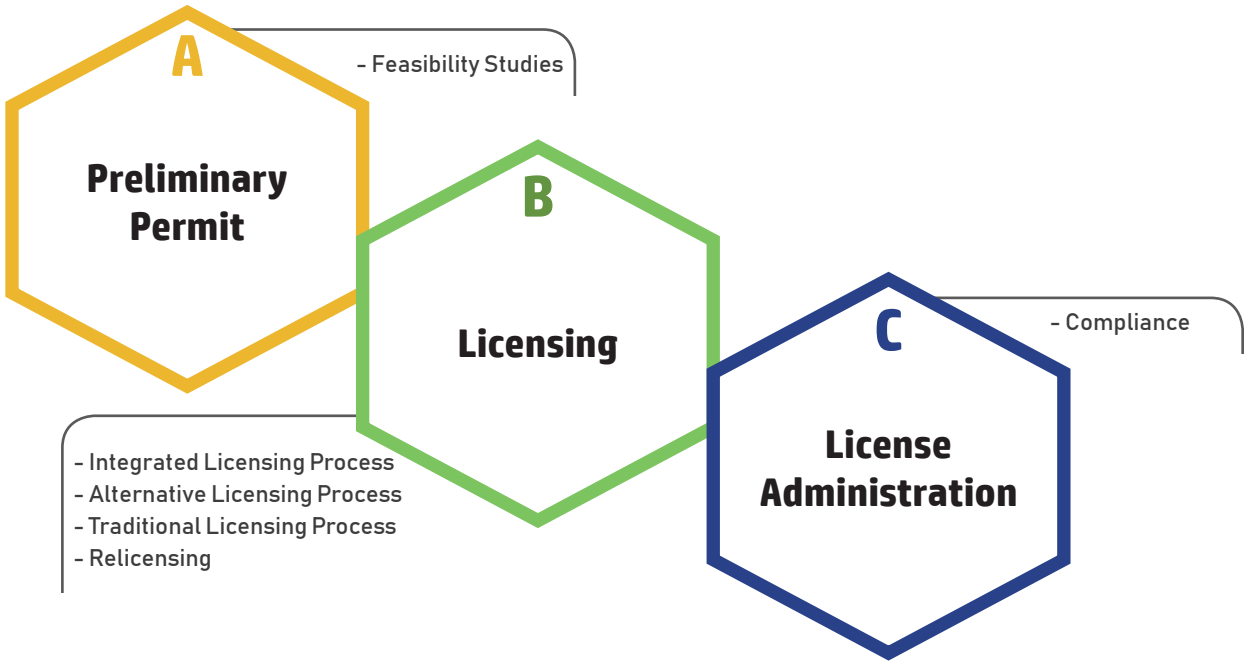
ELECTRICITY AND HYDROPOWER: THE BASICS

FERC HYDROPOWER REGULATION

FERC's Responsibilities include:

- Regulating non-federal hydroelectric power projects that affect navigable waters, connect to the interstate power grid or are sited off federal lands.
- Issuing preliminary permits to study a potential hydropower site;
- Processing hydropower license applications and project exemptions from licensing;
- Preparing environmental documents; and
- Ensuring dam and public safety.

THE FERC PROCESS



A PRELIMINARY PERMITTING

FERC issues preliminary permits for studying the development of new hydropower facilities. Preliminary permits give the permit-holder priority to file for a license.

B LICENSING

FERC issues operating licenses that allow licensees to construct and operate hydropower facilities. Operating licenses are issued after a thorough examination to determine the benefits of the project and the impact of the facility on the surrounding environment. The process for FERC to issue a license usually takes several years.

The relicensing process begins when the licensee files a notice of intent (NOI) and pre-application document (PAD) with FERC. These documents must be filed between 5 to 5.5 years before the license expires.

C LICENSE ADMINISTRATION

FERC ensures compliance with the operating license. This includes safety inspections and document review.

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ELECTRICITY AND HYDROPOWER: THE BASICS

LICENSING EXEMPTIONS
FERC licenses all non-federally operated hydroelectric power projects under the Federal Power Act (FPA). A license is required for all new and existing hydroelectric power facilities. License exemptions are rare and difficult to obtain. Possible exemptions are listed below.

Up to 40MW Conduit Exemption
Water systems are eligible for a conduit exemption if they install energy recapturing devices in place of pressure reducing valves and other energy dissipating devices. Small conduit hydroelectric facilities, generally up to 40 MW, are eligible for exemption from FERC licensing if:

- The applicant/operator has all real property interests necessary to develop and operate the project
- The facility is not on federal lands
- The conduit is operated primarily for non-hydroelectric purposes

Up to 10MW Exemption
New hydroelectric facilities added to an existing dam or other structure may be exempt if the proposed generating capabilities are 10 MW or less. Other requirements include:

- The project must be located at a non-federal, pre-2005 dam or natural water feature
- The applicant/operator has all real property interests (outside of federal lands) necessary to develop and operate the project

FERC DAM SAFETY COMPLIANCE

Compliance with FERC safety standards is expensive because of the following:

- Extensive reporting and record keeping
- Developing, maintaining and testing Emergency Action Plans (EAPs)
- Inspection of the dam evey 5 years by an independent consultant prequalified by FERC
- Other responsibilities (i.e. QC Programs, Monitoring Instruments, Warning & Safety Devices, power/communication lines, testing spillway gates)
- Dam must meet rigorous design standards

Section 1

ELECTRICITY AND HYDROPOWER: THE BASICS

POWER TRANSMISSION/SALES

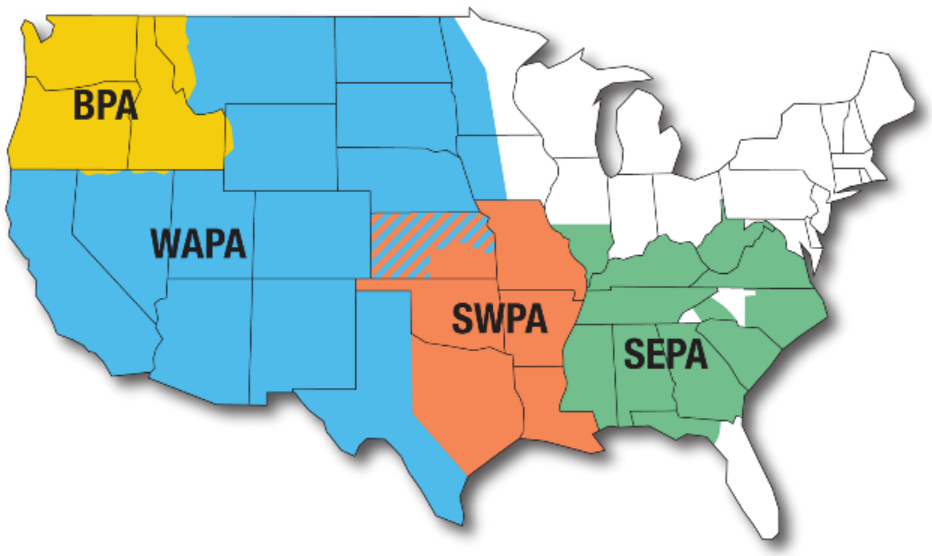
When new facilities look to market available power, they must negotiate the rate at which they will sell their power to a local utility or a larger utility capable of transmitting the power into the grid. Generally, larger facilities have more negotiating leverage to determine rates while smaller facilities may fall into predetermined rate categories with little room for negotiation.

POWER MARKETING ADMINISTRATIONS (PMAs)

Power generated by federally owned and operated facilities is marketed and sold through one of four Power Marketing Administrations (PMAs). Power generated by federally owned facilities and sold through PMAs is mandated by federal law to be sold as cheaply as possible to cover operating expenses but to forgo a profit.

COLUMBIA RIVER BASIN VS. UPPER MISSOURI RIVER BASIN

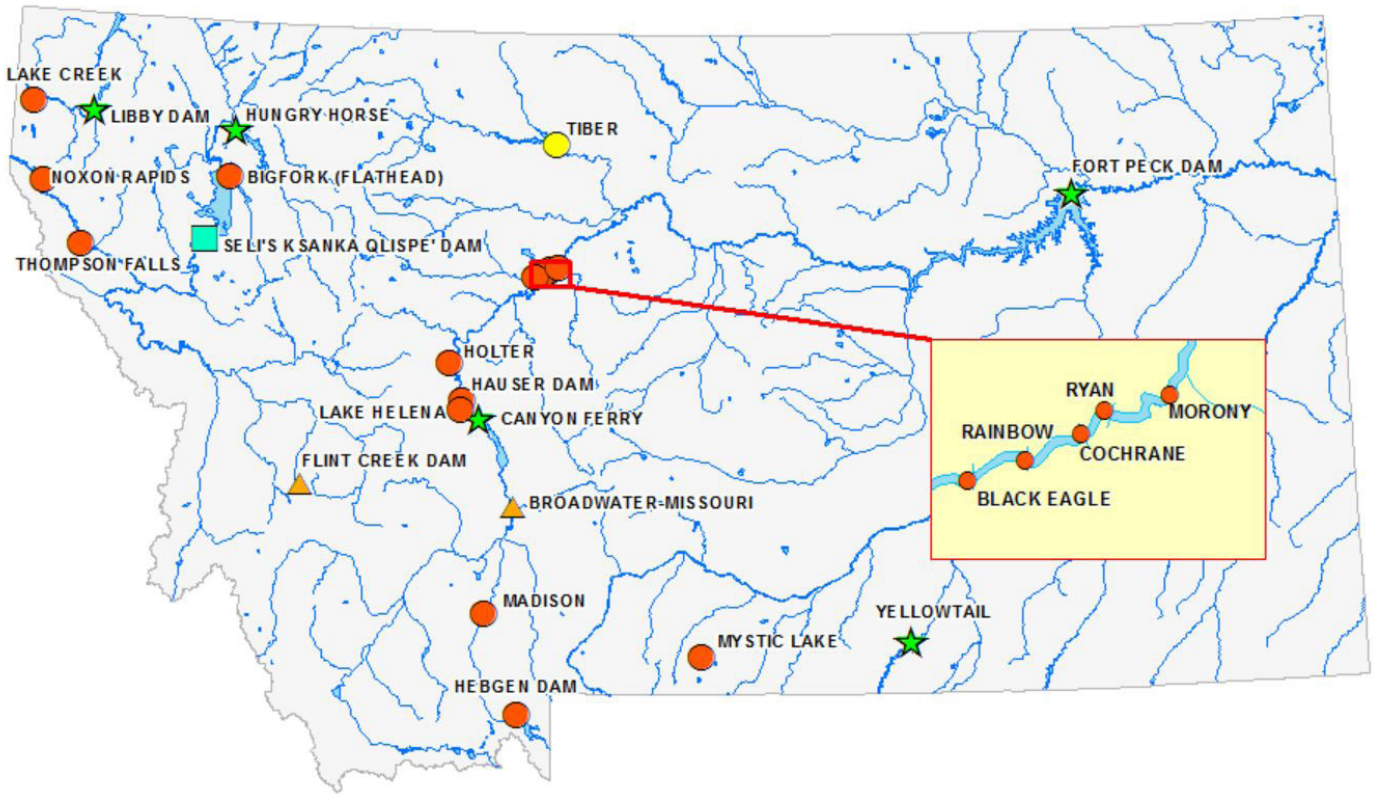
In Montana, power produced by federally operated hydroelectric dams in the Columbia River Basin (west of the Continental Divide) is marketed through Bonneville Power Administration (BPA). Power produced by federally operated dams in the Upper Missouri River Basin (east of the Continental Divide) is marketed through Western Area Power Administration (WAPA).



Source: Power marketing administrations of the United States.
Source: https://www.wapa.gov/regions/Pages/pma-map.aspx

Section 2

EXISTING MONTANA HYDROPOWER DAMS



PRIVATELY OWNED DAMS
Privately Operated Hydropower
FERC Regulated[2]

FEDERALLY OWNED DAMS
PrivatelyOperated Hydropower
FERC Regulated[2]

STATE/LOCALLY OWNED DAMS
State/Locally Operated Hydropower
FERC Regulated[2]

RESERVATION OWNED DAMS
Reservation Operated Hydropower
FERC Regulated[2]

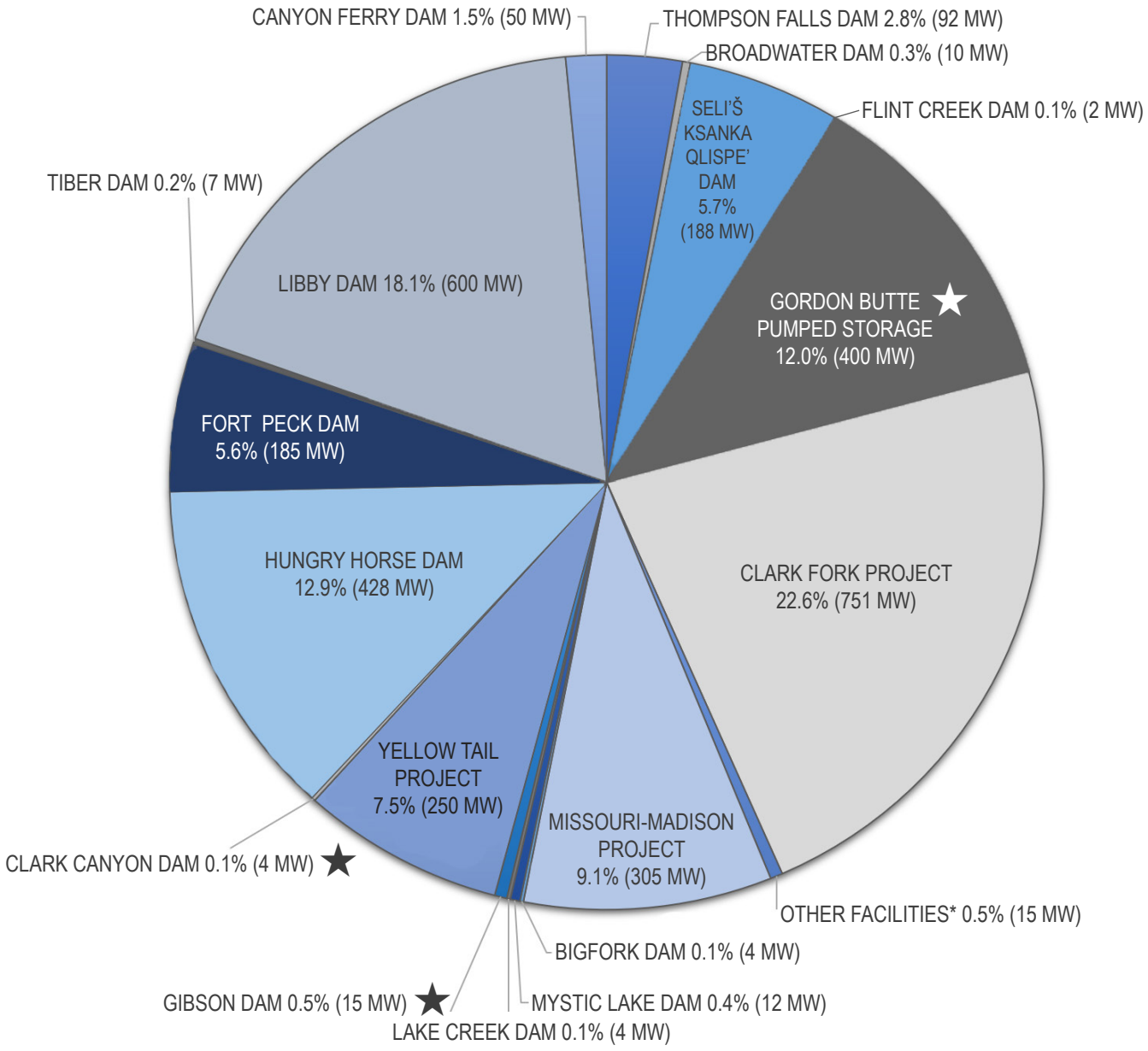
FEDERALLY OWNED DAMS
Federally Operated Hydropower
Self-Regulated

[2]FERC - Federal Energy Regulatory Commission

Section 2

EXISTING MONTANA HYDROPOWER DAMS

Currently Licensed Hydropower Breakdown
(by % Authorized Capacity)

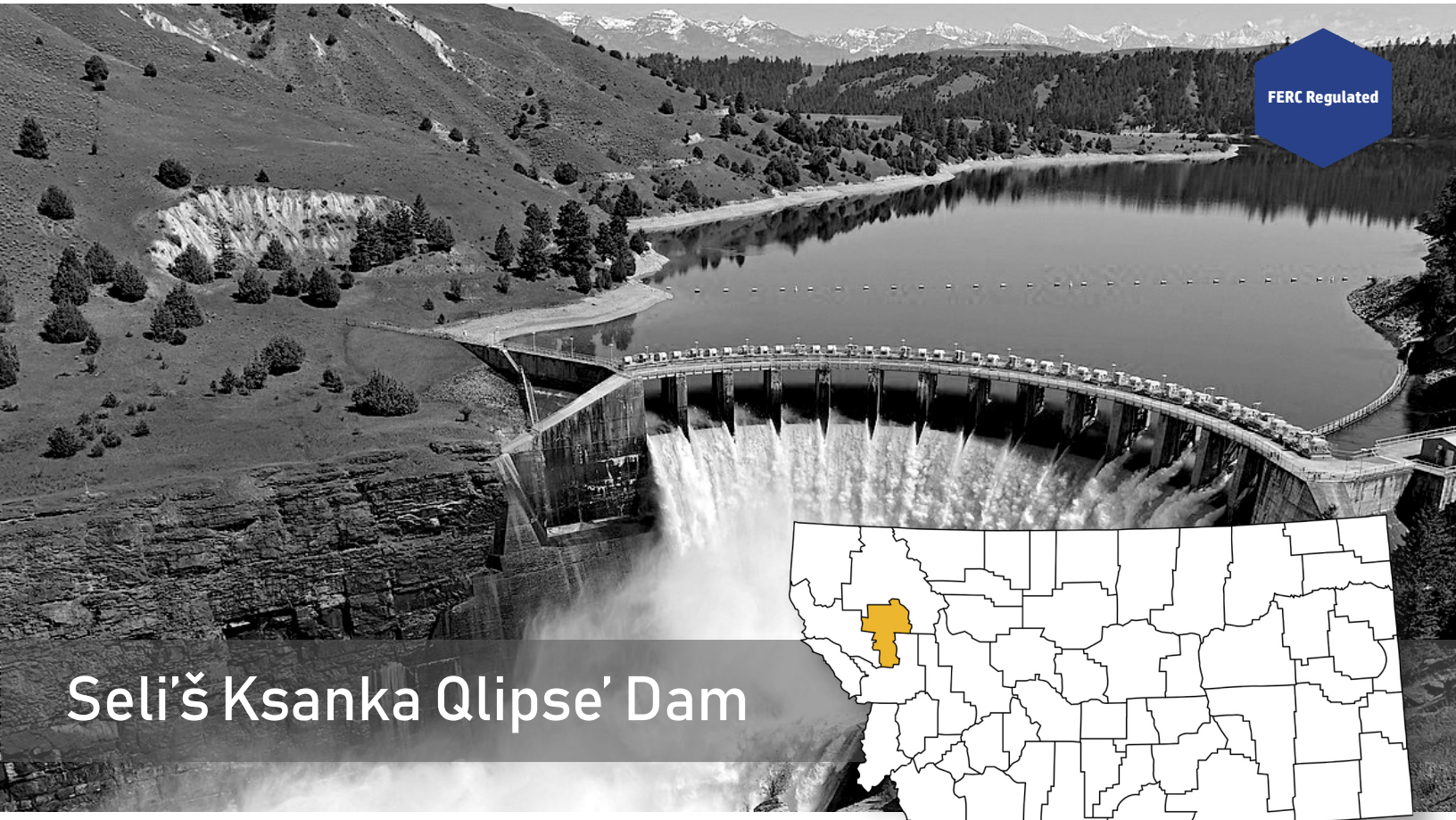


★ Denotes those facilities licensed but not yet operational.

*Other facilities include hydropower generating facilities on irrigation ditches or other alternative sources of hydropotential.

Section 2

EXISTING MONTANA HYDROPOWER DAMS



Seli'š Ksanka Qlipse' Dam

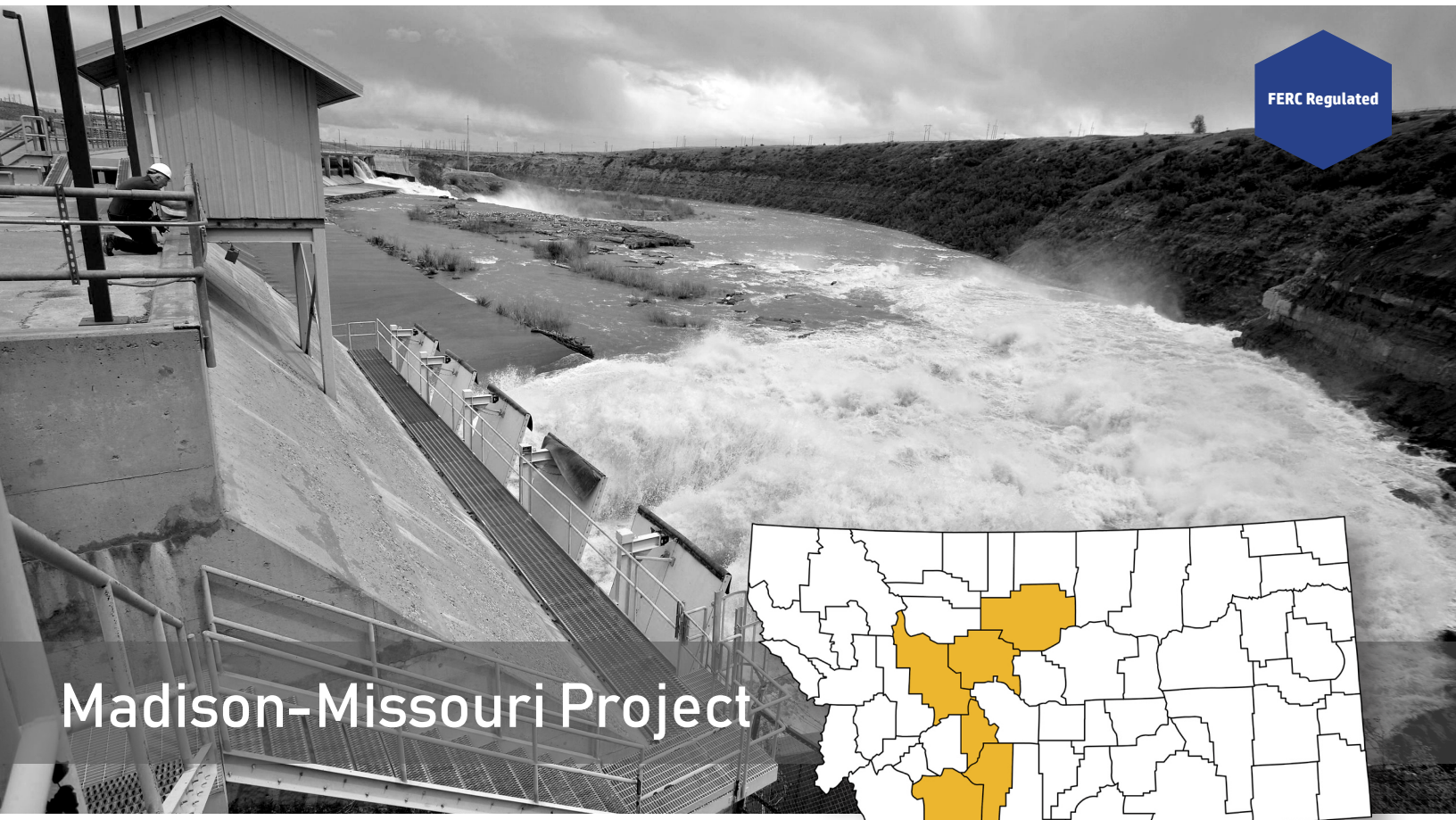
Installed Capacity: 208 MW
Authorized Capacity: 188 MW
Annual Generated Power (2015): 1,073,292 MWh
Estimated Retail Value of Power: $95,740,000[3]

The Seli'š Ksanka Qlipse' Dam (formerly known as Kerr Dam) is owned by the Confederated Salish and Kootenai Tribes (CSKT) and jointly operated with Energy Keepers, LLC, a corporation owned by the CSKT. Construction of the dam was initiated in 1930 by the Rocky Mountain Power Company, a subsidiary of the Montana Power Company, and finished in 1938. When the original 50-year FERC operational license was due to be relicensed, the CSKT sought to obtain control of the license from the Montana Power Company. After a series of legal battles, the new license was issued with the stipulation that Montana Power Company would maintain ownership and operation responsibilities for the first 30 years of the license; however, CSKT would be added to the license as a co-licensee. In 1999, Montana Power Company transferred its share to PPL Montana, LLC. PPL Montana then sold its stake to Northwestern Energy in 2014. At the conclusion of the 30-year period on September 5, 2015, CSKT became the sole-licensee, and assumed ownership and operational responsibility for the final 20 years of the license. As part of the transfer, the CSKT paid the conveyance price of $18.3 million to Northwestern Energy. CSKT has since added Energy Keepers, LLC, a corporation owned by the CSKT, as a colicensee to market the generated power throughout the west.

[3] Based on $0.0892/KWh (average power rate in Montana)

Section 2

EXISTING MONTANA HYDROPOWER DAMS



Madison-Missouri Project

Madison Dam · Hauser Dam · Holter Dam
Black Eagle Dam · Rainbow Dam · Cochrane Dam
Ryan Dam · Morony Dam · Hebgen Lake Dam

Dam Owner/Operator: NorthWestern Energy Corporation
Authorized Capacity: 305.21 MW
Annual Generated Power (2017): 1,964,959 MWh
Estimated Retail Value of Power: $175,274,343[4]
Power Transmission: NorthWestern Energy (Self)

The Madison-Missouri Project is a series of 9 dams on the Madison and Missouri Rivers, owned and operated by NorthWestern Energy. The FERC operating license was last renewed in 2000 and is valid until 8/31/2040. NorthWestern Energy purchased the Madison-Missouri Project Dams along with several others as part of a 2014 transaction with PPL Montana.

[4]Based on $0.0892/KWh (average power rate in Montana)

Section 2

EXISTING MONTANA HYDROPOWER DAMS

Dam Owner/Operator: Montana Department of Natural Resources
Authorized Capacity: 9.66 MW
Annual Generated Power: 56,000 MWh
Annual Power Generation Revenue (2014): $4.2 Million
Annual Operating, Maintenance and Debt Repayment Costs (approximate): $2.9 Million
Power Transmission: NorthWestern Energy (Purchaser)

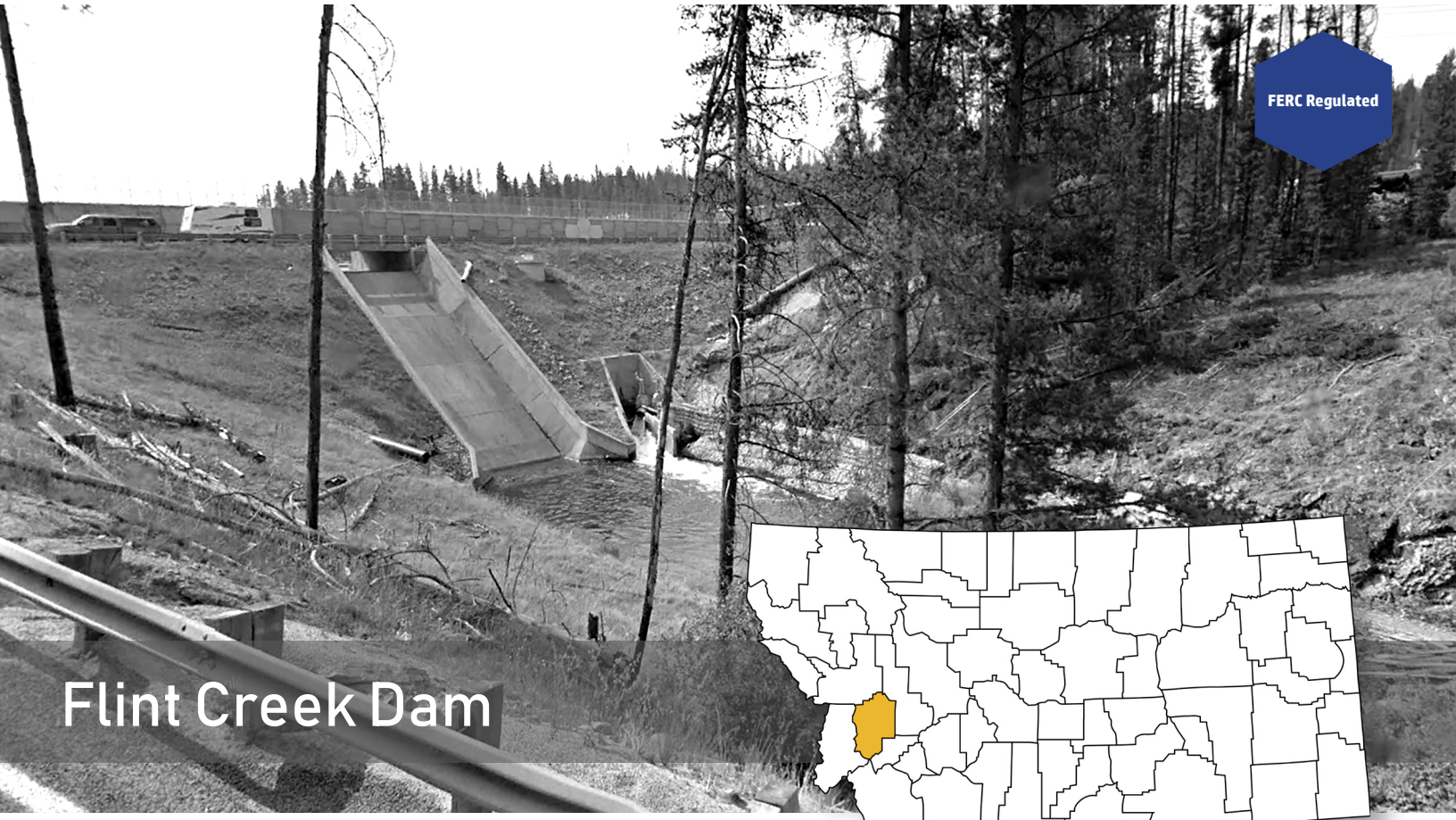
The Broadwater Power Project on the Toston Dam is a Montana-State owned dam and hydroelectric facility and is operated by the DNRC. The electricity produced is sold to NorthWestern Energy and the revenue is deposited to the state's hydropower account which goes toward covering operating expenses as well as funding other State Water Projects Bureau (SWPB) infrastructure projects. In 2014, approximately $1.3 Million was available for use toward other projects.

The current Toston Dam FERC operating license will expire in June 2024 and the relicensing process has started.

Hydropower revenue from the Toston Dam provided $4.5 million to the Ruby Dam rehabilitation costs. Payments on an additional $6 million loan for the Ruby Dam project will also be covered with hydropower revenue.

Section 2

EXISTING MONTANA HYDROPOWER DAMS



Flint Creek Dam

Dam Owner/Operator: Granite County, Montana
Authorized Capacity: 2 MW
Annual Generated Power(Estimated): 10,000 MWh
Estimated Retail Value of Power: $892,000[5]
Annual Operating and Maintenance Costs: $461,739
Power Transmission: Local Utilities (Purchaser)

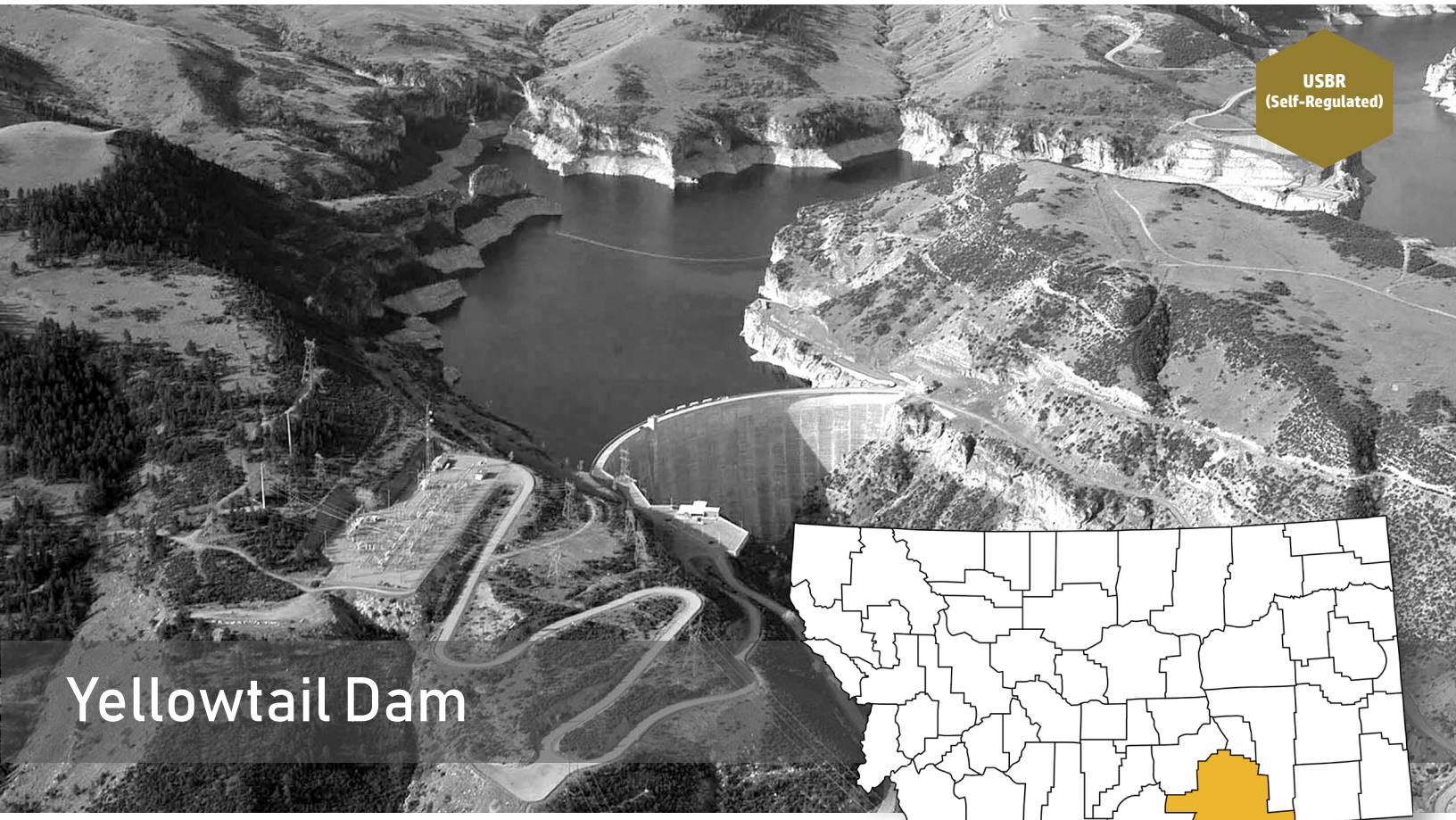
The Flint Creek Dam is owned and operated by Granite County, Montana. Power generated at the facility is sold through local utilities. The Flint Creek Dam operates as a run of the river facility due to the many preexisting water rights on Flint Creek. Water is released through Flint Creek Dam with regard to the primary demands while hydropower generation is of secondary importance.

A run of the river facility operates with respect to the natural channel flows or is dictated by other primary demands (i.e. downstream irrigation, recreation, aquatic organism habitat, etc.). Run of the river facilities operate as an ancillary benefit to the dam and hydropower generation does not dictate the water release schedule. Unlike hydropower facilities that prioritize hydropower generation that can adjust their power output to supplement the power grid during peak usage periods, run of the river facilities cannot adjust their power generation to meet power demands.

[5]Based on $0.0892/KWh (average power rate in Montana)

Section 2

EXISTING MONTANA HYDROPOWER DAMS



Yellowtail Dam

Dam Owner/Operator: United States Bureau of Reclamation
Installed Capacity: 250 MW
Annual Generated Power: 510,564 MWh
Estimated Retail Value of Power: $14,152,834[6]
Power Transmission: Western Area Power Administration (WAPA)

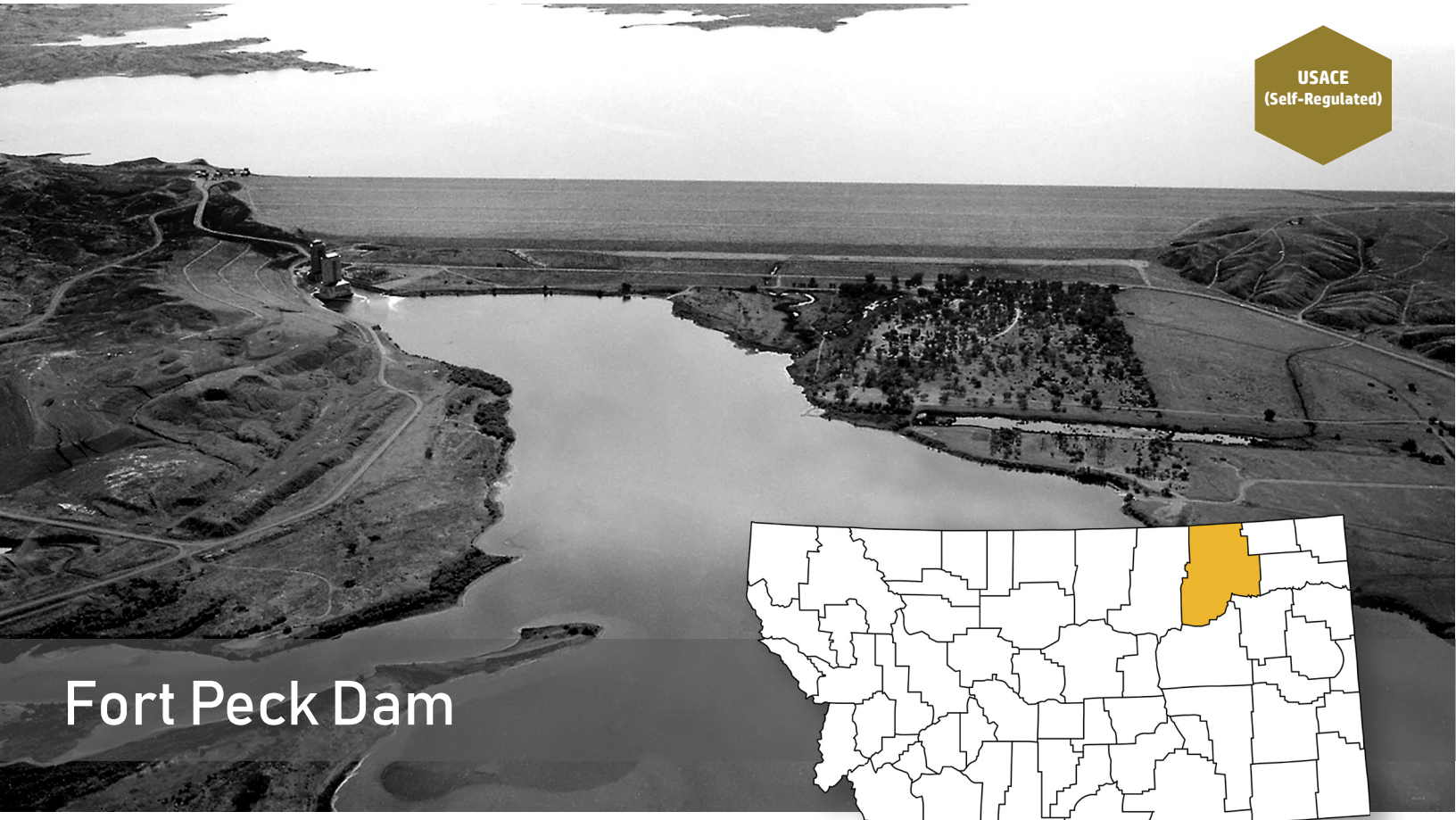
The Yellowtail Dam Project was authorized by congress under the Flood Control Act in 1944 as part of the Pick-Sloan Plan, an effort to manage the upper Missouri River Basin. The project includes two dams, the larger, main Yellowtail Dam with the hydroelectric generating facility and the smaller Afterbay Dam which regulates the irregular release of water downstream after it has passed through the main dam. As a federally owned and operated facility, the power is sold through the Western Area Power Association (WAPA) at cost and generates no net profit.

The Crow Tribe was given the exclusive right to develop a new hydropower facility at the nearby Yellowtail Afterbay Dam through a water right settlement in 2010. Since USBR is already authorized to produce hydropower at the facility, FERC does not have jurisdiction and the tribe is required to work through USBR to develop the facility. The project is currently on hold while the tribe and USBR work through technical and power sales issues. The proposed facility is a 7.5 MW plant.

[6]Power generated at Yellowtail Dam is sold through WAPA at cost. Based on its location, the power is subject to two regional power rates; $0.024/KWh (Upper Great Plains Region), $0.03144/KWh (Rocky Mountain Region) with 50% of the power being sold through each region.

Section 2

EXISTING MONTANA HYDROPOWER DAMS



Fort Peck Dam

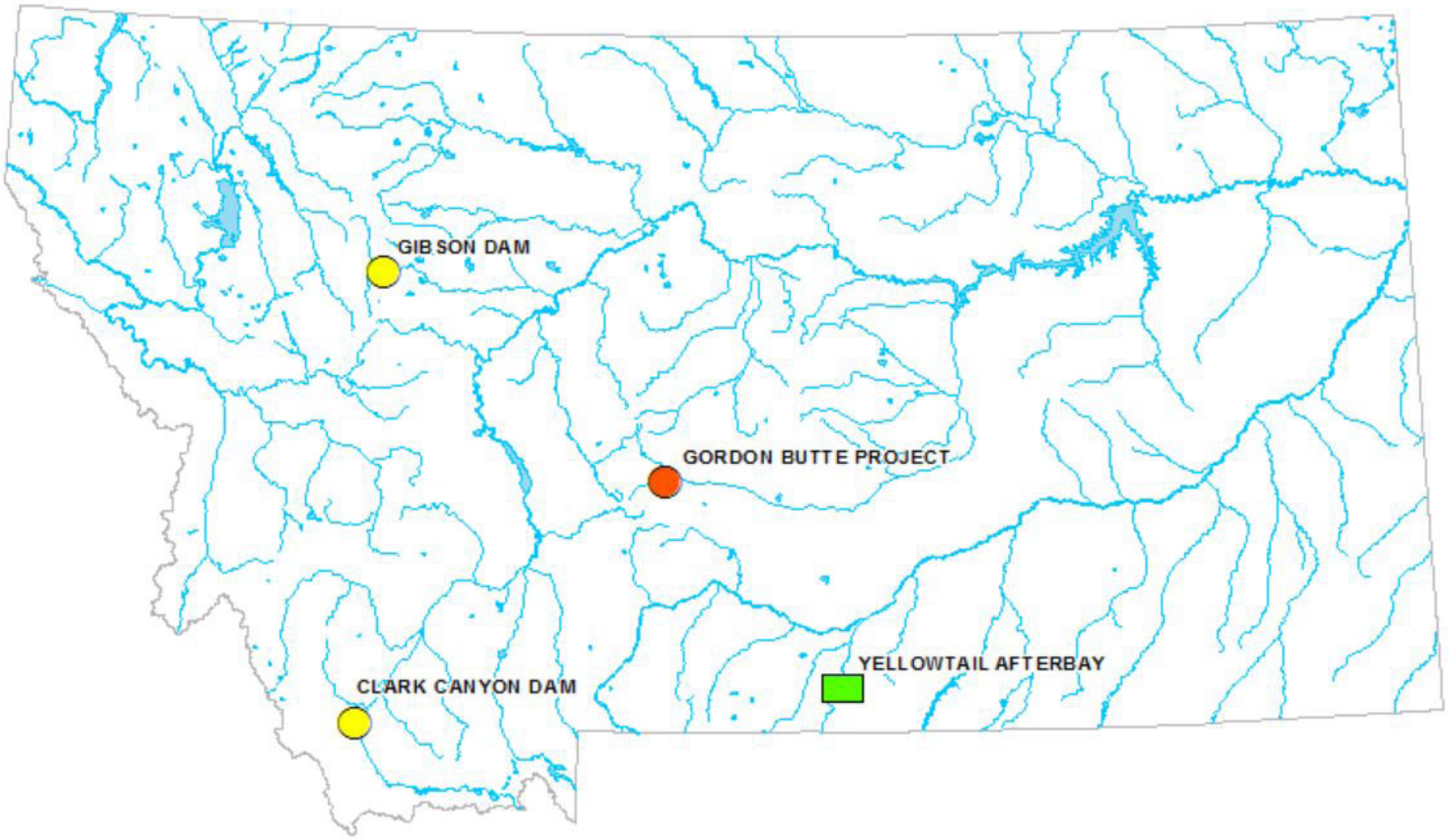
Dam Owner/Operator: United States Army Corps of Engineers
Installed Capacity: 185.25 MW
Annual Generated Power: 1,048,000 MWh
Estimated Retail Value of Power: $25,152,000.007[7]
Power Transmission: Western Area Power Administration (WAPA)

The Fort Peck Dam was authorized by Congress under the Fort Peck Power Act in 1933 as part of the New Deal. Construction began shortly thereafter and work on the dam concluded in 1940. The hydroelectric facility began generating electricity in July 1943. The power generated at Fort Peck Dam is marketed and sold by the Western Area Power Administration.

[7]Based on Pick-Sloan Power Rate of $0.024/KWh

Section 3

PROPOSED MONTANA HYDROPOWER DAMS



PRIVATELY OWNED DAMS
Privately Operated Hydropower
FERC Regulated

FEDERALLY OWNED DAMS
Privately Operated Hydropower
FERC Regulated

FEDERALLY OWNED DAMS
Reservation Operated with USBR
Oversight

Section 3

PROPOSED MONTANA HYDROPOWER DAMS

Gordon Butte Pumped Storage Project

Conceptual Rendering via GE.com

Dam Owner/Operator: GB Energy Park, LLC
Authorized Capacity: 400 MW
Annual Generated Power (Estimated): 1,300,000 MWh
Estimated Retail Value of Power: $220,500,000
Annual Operating and Maintenance Costs (Estimated): $173,189,862[9]
Potential Power Purchaser(s): NorthWestern Energy, Puget Sound Energy, Portland General Electric, Avista Corp and PacifiCorp
FERC License Issued: 12/14/2016
FERC License Expires: 11/30/2066

The Gordon Butte Pumped Storage Project is a privately funded, closed-loop hydroelectric facility. The project involves the construction of two large reservoirs: one located approximately 1000 feet above the lower reservoir. Once filled, water will be pumped from the lower reservoir to the upper reservoir during periods of excess (inexpensive) power in the grid. During periods where additional power is needed to supplement the grid, water will be diverted out of the upper reservoir through hydroelectric generating turbines and then into the lower reservoir where it is stored until it can be pumped back into the upper reservoir. The project is anticipated to provide a more reliable method of storing renewable energy than wind and solar. Wind and solar are weather dependent and do not provide continuous power, especially during peak demand periods.

[9]Annual power revenue and annual operating and maintenance costs sourced from FERC Operating License P-713642

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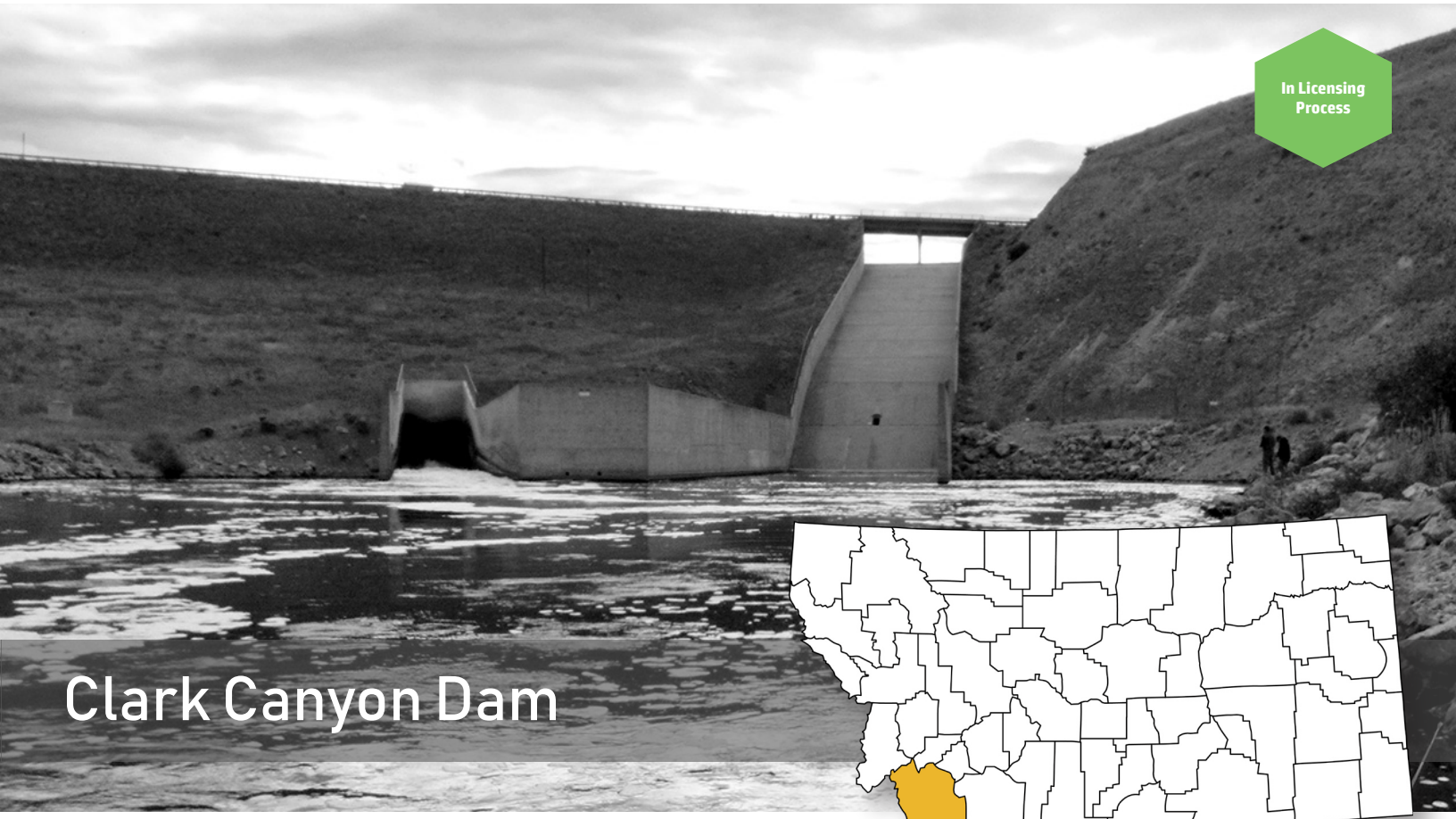
PROPOSED MONTANA HYDROPOWER DAMS



Clark Canyon Dam

Dam Owner/Operator: United States Bureau of Reclamation, Clark Canyon Hydro, LLC.
Dam Specs: 2,950 Feet Long, 147.5 Feet Tall
Authorized Capacity: 4.7 MW
Annual Generated Power (Estimated): 15,695 MWh
Estimated Retail Value of Power: $877,350[10]
Potential Power Purchaser: Idaho Power
FERC License Issued: 3/31/2017
FERC License Expires: 2/28/2067

The Clark Canyon Dam hydroelectric facility is a privately owned hydroelectric project that will utilize an existing USBR dam. Because the hydroelectric facility will be a private facility on a federally owned and operated dam, a FERC-issued operating license is required, however; the USBR will be involved in operations and oversight of the facility. The proposed facility will be a run-of-river generator with power being routed to Idaho Power.

[10]Taken from: FERC Operating License No. P-12429-001

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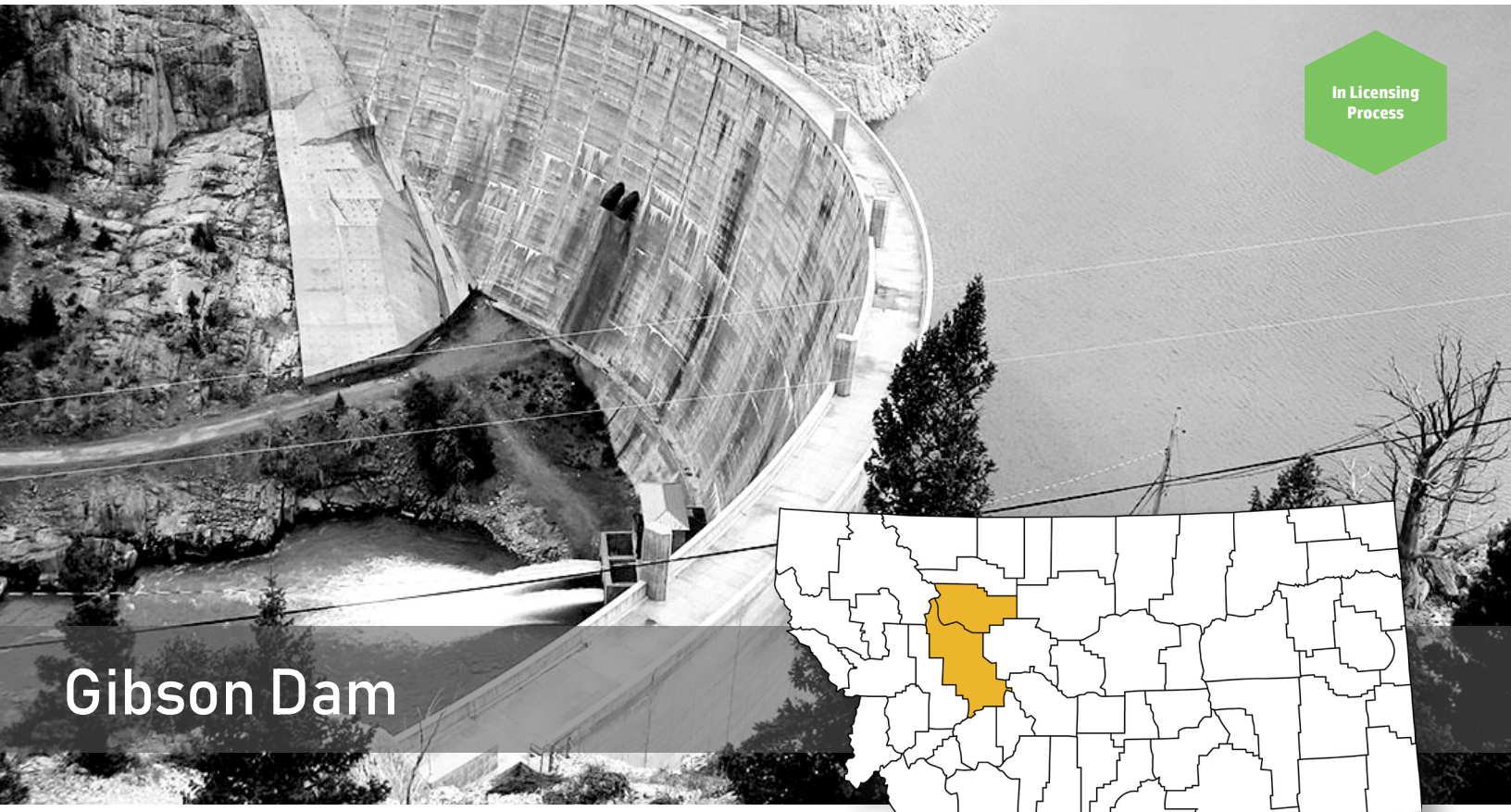
PROPOSED MONTANA HYDROPOWER DAMS



Gibson Dam

Dam Owner/Operator: United States Bureau of Reclamation/ Gibson Dam Hydroelectric Company, LLC
Authorized Capacity: 15 MW
Annual Generated Power (Estimated): 40,000 MWh
Estimated Retail Value of Power: $1,663,200
Annual Operating and Maintenance Costs (Estimated): $3,600,330[11]
Potential Power Purchaser: Local Utilities
FERC License Issued: 1/12/2012
FERC License Expires: 12/31/2061

Article 301 of the FERC operating license requires the licensee to commence construction of the project within two years from the issuance of the license and to complete construction within five years from the issuance date of the license.

The Gibson Dam Hydroelectric Project is a proposed development to add hydropower generating capabilities to an existing USBR dam facility. The dam was originally planned to provide irrigation and hydroelectric power to the surrounding area but construction of the power plant never occurred. Although the new hydropower facility will utilize some existing dam infrastructure, the project requires a new powerhouse for two 1.5MW turbines and two 6 MW turbines. New transmission lines will connect the facility to the energy grid. A provision of the FERC operating permit stipulates the new transmission lines through the Sun River Canyon shall be buried to maintain the natural aesthetic and to mitigate possible fire hazards associated with overhead transmission lines. On October 18, 2013, FERC granted the licensee an extension of the deadlines to commence and complete construction to January 12, 2016, and January 12, 2019, respectively. With the project still on hold, the license expired in 2016. Since then, legislation was passed and signed into law on July 27, 2018, to extend the construction commencement date for up to six years.

[11]Based on the economic analysis performed as part of the FERC license issued on January 12, 2012.

Section 4

FUTURE PROJECTS - FEASIBILITY & ECONOMICS

DEVELOPING A HYDROPOWER FACILITY[12]

Determining the feasibility of developing a new hydropower generating facility at a new impoundment facility or of utilizing an existing dam facility is subject to the following considerations:

Power Potential
How much power can the new facility generate?

Hydropower depends on two main factors:

1. Head (height of water in reservoir above the dam outlet)
2. Flow of water available

Depending on how much flow is available, the minimum amount of head required for a viable hydro system varies. However, a site with low head and low flows seldom offers cost-effective hydroelectric power.

Benefits Evaluation
How much revenue can the proposed facility produce? This is a function of the existing power rates in the area.

Cost Estimate
How much will the new facility cost to build, operate, and maintain? This includes all facilities, civil works, turbines, generators, power plant mechanical and electrical facilities, transformers, and transmission lines.

Benefit-Cost Analysis
Will the facility be able to pay off the bond and generate a profit?

Constraints Analysis
Is the new facility located in an area that may have additional rules and regulations to be followed? Examples include: National Wildlife Refuges, Wild and Scenic Rivers, National Parks, Wilderness Study Areas, Critical Habitat Areas, National Forests, and Indian Lands.

Environmental Analysis
An analysis is required for all proposed hydropower projects to determine the impact the proposed facility will have on the surrounding environment. This includes the facility's impact to the geology and soils, water use and quality, aquatic resources, wildlife and botanic resources, threatened or endangered species, recreation, aesthetics, cultural resources, tribal resources, land use, and socioeconomics.

Other Considerations
Are there other ancillary benefits of the facility? The hydroelectric facility may offer irrigation, flood control, recreation, or water supply benefits.

[12]Analysis criteria taken from the USBR Hydropower dam feasibility study
https://www.usbr.gov/power/AssessmentReport/USBRHydroAssessmentFinalReportMarch2011.pdf

Section 4

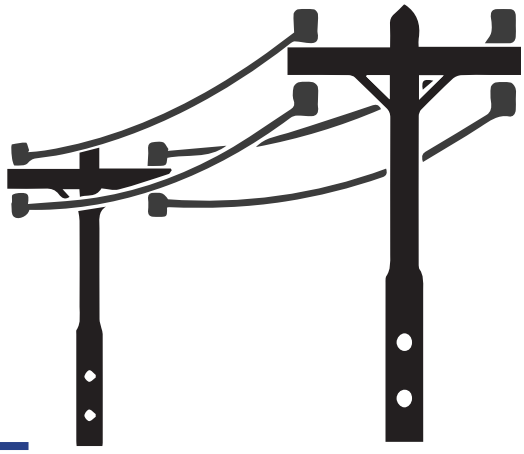
FUTURE PROJECTS - FEASIBILITY & ECONOMICS

COMMON CHALLENGES WHEN DEVELOPING HYDROPOWER

Developing a new hydropower facility on an existing dam is subject to technical and cost considerations that have the potential to derail the project. Recent feasibility studies commissioned by the Montana DNRCdetail several recurring issues that have made new hydropower development infeasible.

CHALLENGES

- Cost of Transmission Lines
- Costly improvements to dam facilities to meet FERC standards
- Securing Power Purchase Agreements through local utilities



COST OF TRANSMISSION LINES

- Dams must transmit the power they produce via transmission lines.
- Cost to construct transmission lines is highly dependent on existing infrastructure (i.e. adequate poles in good condition), terrain, right of way access/acquisition, length of the proposed line and capacity of the proposed line.

Power Purchase Agreements (PPAs)

A Power Purchase Agreement is a legal contract between an electricity producer and power purchaser, usually a local utility. Power purchase agreements set rates for a specific period of time.

Section 4

FUTURE PROJECTS - FEASIBILITY & ECONOMICS

STATE OF MONTANA OWNED DAMS HYDROPOWER DEVELOPMENT FEASIBILITY

Project Name	Feasibility Studied	Feasibility	Remarks
Ackley Lake Dam	N/A	N/A	Not Studied
Bair Reservoir Dam	N/A	N/A	Not Studied
Cooney Dam	2012	Not Feasible	Hindrances • Cost of Transmission Lines • FERC Dam Safety Compliance Requirements
Cottonwood Dam	N/A	N/A	Not Studied
Deadman's Basin Dam	1984	Not Feasible	Hindrances • Unfavorable benefit-cost analysis
East Fork of Rock Creek Dam	N/A	N/A	Not Studied
Fred Burr Dam	N/A	N/A	Not Studied
Frenchman Dam	N/A	N/A	Not Studied
Glacier Lake Dams	N/A	N/A	Not Studied
Martinsdale Dams	N/A	N/A	Not Studied
Middle Creek Dam (Hyalite)	1982	Not Feasible	Hindrances • Cost of Transmission Lines • Unfavorable benefit-cost analysis
Nevada Creek Dam	1982	Not Feasible	Hindrances • Power plant would not operate frequently enough to justify installation
Nilan Dams	N/A	N/A	Not Studied
North Fork of Smith River Dam	N/A	N/A	Not Studied
Painted Rocks Dam	Underway	Not Feasible	Hindrances • Cost of Transmission Lines • FERC Dam Safety Compliance Requirements
Ruby River Dam	2011	Feasible	Hindrances • Cost of Transmission Lines • FERC Dam Safety Compliance Requirements
Tongue River Dam	2018	Not Feasible	Unfavorable benefit-cost analysis
Willow Creek Dam	N/A	N/A	Hindrances • Unfavorable benefit-cost analysis
Yellow Water Dam	N/A	N/A	Not Studied

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FUTURE PROJECTS - FEASIBILITY & ECONOMICS

Ruby Dam

Dam Owner/Operator: Montana DNRC/SWPB
Ruby Water Users Association
Estimated Capacity: 3.48 MW
Annual Generated Power (Estimated): 10,433 MWh
Estimated Retail Value of Power: $719,911
Estimated Capital Costs: $6.44 Million
Annual Operating and Maintenance Costs (Estimated): $80,000
Potential Power Purchaser: NorthWestern Energy, Vigilante Electrical Cooperative

The Ruby Dam has been identified as a potential site for a new hydroelectric facility. A feasibility study performed in 2011 recommended that the Ruby Dam undergo further investigation citing “no identification of fatal flaws” and “attractive economic rates of return”. However, the State allowed its Preliminary Permit to expire in 2016 due to an unfavorable feasibility analysis. A private firm subsequently applied for and secured a new Preliminary Permit for the site which was also recently allowed to expire. To date, there has been no recorded progress in the hydropower development at Ruby Dam.

The biggest obstacle at Ruby Dam are the FERC spillway size requirements. The Ruby dam spillway was rebuilt to address deficiencies and to meet state spillway standards. To rebuild the spillway to meet FERC requirements, the cost would have escalated sufficiently to make the cost-benefit ratio unfavorable.

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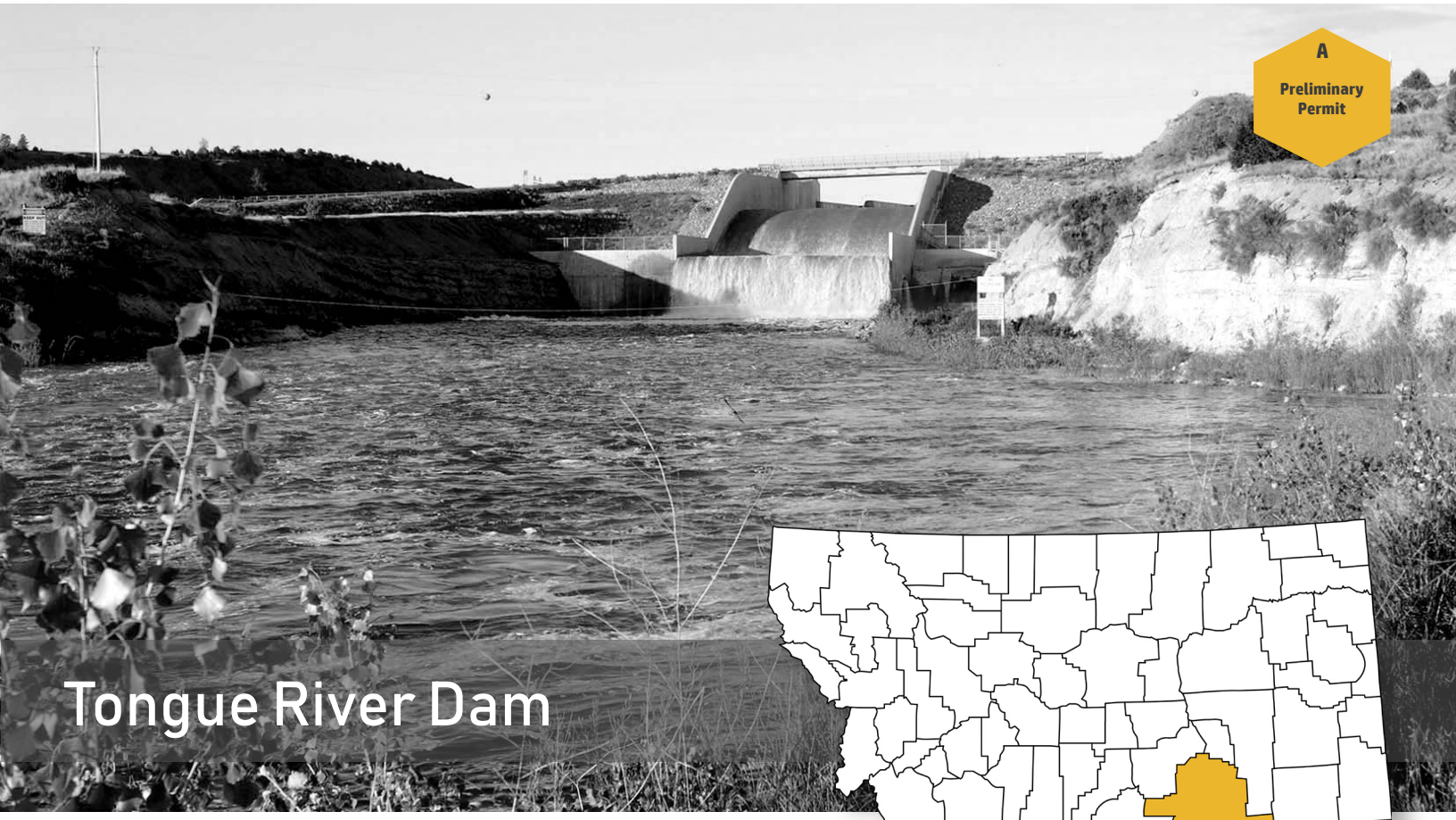
FUTURE PROJECTS - FEASIBILITY & ECONOMICS



Tongue River Dam

Dam Owner/Operator: Montana DNRC/SWPB
Estimated Capacity: 2.2 MW
Annual Generated Power (Estimated): 6,000-7300 MWh
Estimated Retail Value of Power: $350,570-$428,820 (2015 Dollars)
Estimated Construction Cost: $10.1-10.8 Million (2015 Dollars)
Annual Operating and Maintenance Costs (Estimated): $100,000

The Tongue River Dam was identified as marginally feasible in a 2012 feasibility study. FERC awarded a Preliminary Permit to Montana DNRC on July 30, 2014 so the dam could be further evaluated. The Preliminary Permit was subsequently extended for an additional two years so that a more detailed feasibility study could be completed. The results of the detailed feasibility study concluded that the payback timeline for hydropower development on the Tongue River Project was excessive and adding a hydropower unit was not feasible.

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FUTURE PROJECTS - FEASIBILITY & ECONOMICS

A
Preliminary Permit

Cooney Dam

Dam Owner/Operator: Montana DNRC/SWPB
Estimated Capacity: 1.3 MW
Annual Generated Power (Estimated): 3,300 MWh
Estimated Retail Value of Power: $172,540-192,510 *(2015 Dollars)*
Estimated Construction Cost: $5.3-6.6 Million (2015 Dollars)
Annual Operating and Maintenance Costs (Estimated): $100,000

The Cooney Dam's primary purpose is to provide water storage for downstream irrigation users. Water is only released during the (approximate) 6-month crop growing season and is therefore not conducive to year-round hydropower generation. Furthermore, costs to improve the existing dam infrastructure to meet FERC standards, construct the power house, and construct a new transmission line are substantial. In a recent feasibility study, it was estimated to take approximately 70 years to realize any real benefit from the project.

Developing hydropower on an existing dam requires compliance to FERC design criteria. Meeting these FERC requirements can result in costly infrastructure improvements, including spillway modifications and dam raises, which may ultimately negate the cost benefits of the proposed hydropower installation.

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FUTURE PROJECTS - FEASIBILITY & ECONOMICS

Painted Rocks Dam

Dam Owner/Operator: Montana DNRC/FWP, Painted Rocks Water Users Association
Estimated Capacity: 2.6-4.3 kW
Annual Generated Power (Estimated): 6,513-8,207 MWh
Estimated Retail Value of Power: $581,000-732,000[13]
Estimated Construction Cost: $18.9-20.2 Million (2012 Dollars)
Annual Operating and Maintenance Costs (Estimated): $100,000

The Painted Rocks Dam is located on the West Fork of the Bitterroot River about thirty miles upstream of Darby. The dam is owned by Montana DNRC and water is marketed to the Montana Department of Fish, Wildlife, and Parks (FWP) and the Painted Rocks Water Users Association. Hydropower potential was examined in a feasibility study in 2012 and deemed not economically viable.

[13]Based on $0.0892/KWh (average power rate in Montana)

OTHER INFORMATION

Clean

Reliable

Domestically Produced

MONTANA RENEWABLE PORTFOLIO STANDARD

- Montana Legislature passed the Montana Renewable Power Production and Rural Economic Development Act in 2005
- Established Renewable Portfolio Standard (RPS) in Montana
- Established that utilities must obtain 15% of their energy portfolio from renewable energy sources
- Hydropower is an eligible Renewable Energy Credit (REC)

HYDROPOWER AND IRRIGATION STRUCTURES

Hydropower can be produced anywhere site conditions provide adequate hydraulic head and flow volumes. There are small hydropower generating facilities on Montana irrigation ditches throughout the state that are operated by private entities.

It is important to note that agricultural projects are seasonal (large summer releases, low winter releases). This has a significant impact on the viability of the project, as it is often not cost-effective to put in a "summer flow" turbine and have it sit idle for 9-months. Conversely a "winter flow" turbine often does not generate enough power to make the project cost-effective. Also, it is common (typical) that no single turbine can operate for both scenarios, so it is often necessary to use a dual turbine solution (which adds cost).

I AM INTERESTED IN DEVELOPING A NEW HYDROPOWER PROJECT, WHAT IS THE FIRST STEP?

Visit the Federal Energy Regulatory Commission (FERC) website for additional information on the licensing process. www.ferc.gov/industries/hydropower.asp There is merit to contracting with a qualified engineering firm to help guide you. No doubt, it is a complicated process. Engaging a firm or individual that understands the complexities involved will ultimately save you time and money in the long run.

Disclaimer:

This document was intended to provide a high level overview of hydropower in Montana, using current available information. We welcome any suggestions for improvement or corrections. Please send your comments to dnrdamsafety@mt.gov and we will do our best to address in a future version of this document.

MONTANA DNRC
MT. DEPARTMENT OF NATURAL RESOURCES & CONSERVATION

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