

Regional Hydropower Potential Scoping Study

Prepared for the
Northwest Power & Conservation Council

November 2014

Submitted by the *Northwest Hydroelectric Association*



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Hydropower Potential - Studies Reviewed for Scoping Study

- Twenty-four studies reviewed
- Grouped by categories
- Organized by chapters in report

Studies

PROJECTS AT EXISTING UNPOWERED DAMS

- A-1 Hydropower Resource Assessment at Non-Powered USACE Sites
- A-2 An Assessment of Energy Potential at Non-Powered Dams in the United States
- A-3 Hydropower Resource Assessment at Existing Reclamation Facilities

CONDUIT AND KINETIC PROJECTS

- B-1 Technical & Economic Feasibility Assessment of Small Hydropower Development in Deschutes River Basin
- B-2 Integrated Basin-Scale Opportunity Assessment Initiative, FY 2011: Deschutes Basin
- B-3 Feasibility Study on Five Potential Hydroelectric Power Generation Locations, North Unit Irrigation District
- B-4 Power Extraction from Irrigation Laterals and Canals in the Columbia Basin Project
- B-5 Site Inventory and Hydropower Energy Assessment of Reclamation Owned Conduits
- B-6 Bureau of Reclamation Renewable Energy Update
- B-7 Scoping Study of Hydropower Potential in Wallowa County, Oregon

PUMPED STORAGE/ENERGY STORAGE PROJECTS

- C-1 Assessment of Opportunities for New US Pumped Storage Hydroelectric Plants Using Existing Water Features
- C-2 Appraisal Evaluation of Columbia River Mainstem Off-Channel Storage Options
- C-3 Hydroelectric Pumped Storage for Enabling Variable Energy Resources within the FCRPS
- C-4 Technical Analysis of Pumped Storage and Integration with Wind Power in the Pacific Northwest

TIDAL AND WAVE ENERGY PROJECTS

- D-1 Assessment of Energy Production Potential for Tidal Streams in the US
- D-2 Mapping and Assessment of the US Ocean Wave Energy Resources
- D-3 Assessment/Mapping of Riverine Hydrokinetic Resource in the Continental US

GENERAL GENERATION PROJECT ASSESSMENTS:

- E-1 New Stream-reach Development: Comprehensive Assessment of Hydropower Energy Potential in the US
- E-2 Assessment of Natural Stream Sites for Hydroelectric Dams in the PNW Region
- E-3 Irrigation Water Providers of Oregon: Hydropower Potential and Energy Savings Evaluation
- E-4 Small Hydropower Technology and Market Assessment
- E-5 Assessment of Waterpower Potential and Development Needs
- E-6 Feasibility Assessment of the Water Energy Resources for the US for New Low Power & Small Hydro Classes
- E-7 Estimation of Economic Parameters of US Hydropower Resources

MODELS/DATABASES/TOOLS

- F-1 Northwest Hydrosite Database
- F-2 National Inventory of Dams
- F-3 Hydropower Energy and Economic Analysis Tool
- F-4 Virtual Prospector Tool
- F-5 Tidal Stream Interactive Map
- F-6 National Hydropower Asset Assessment Program (database)

LEGISLATION AND RULEMAKING

- G-1 Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act
- G-2 Hydropower Regulatory Efficiency Act of 2013
- G-3 EPA Rulemaking - Existing Power Plant Emissions

Report Chapters

- Chapter 1: Non-powered dams
- Chapter 2: Conduit/kinetic
- Chapter 3: Pumped storage/energy storage
- Chapter 4: Tidal and wave energy
- Chapter 5: General hydropower assessments
- Chapter 6: Tools – models and databases

Study Parameters

- Objective of study
- Model used to develop study
- Approach – how review conducted; area and number of sites
- Cost
- Capacity and energy value
- Site specific restrictions or environmental attributes
 - Protected lands (national/state parks, etc.)
 - Fish and wildlife species
 - Wild and Scenic Rivers
 - Water quality and quantity
 - Greenhouse gas compensation
 - Green incentives
 - Transmission access
- Potential in the Pacific Northwest

Chapter 1 – Non-powered dams

- Study A-1 “Hydropower Resource Assessment at Non-Powered USACE Sites
 - U.S. Army Corps of Engineers, July 2013
- Study A-2 “An Assessment of Energy Potential at Non-powered Dams in the United States
 - U.S. Department of Energy, Wind and Water Power Program, April 2012
- Study A-3 “Hydropower Resource Assessment at Existing Reclamation Facilities
 - U.S. Bureau of Reclamation, March 2011

Studies A-1 thru A-3 Potential Hydropower Capacity

| Study | MWs | MWhs |
|------------|-----|---------|
| A-1, USACE | 116 | 168,778 |
| A-2, USDOE | 225 | 871,000 |
| A-3, USBR | 27 | 106,448 |

Note: Capacity at non-powered dams in Pacific Northwest. Values rounded.

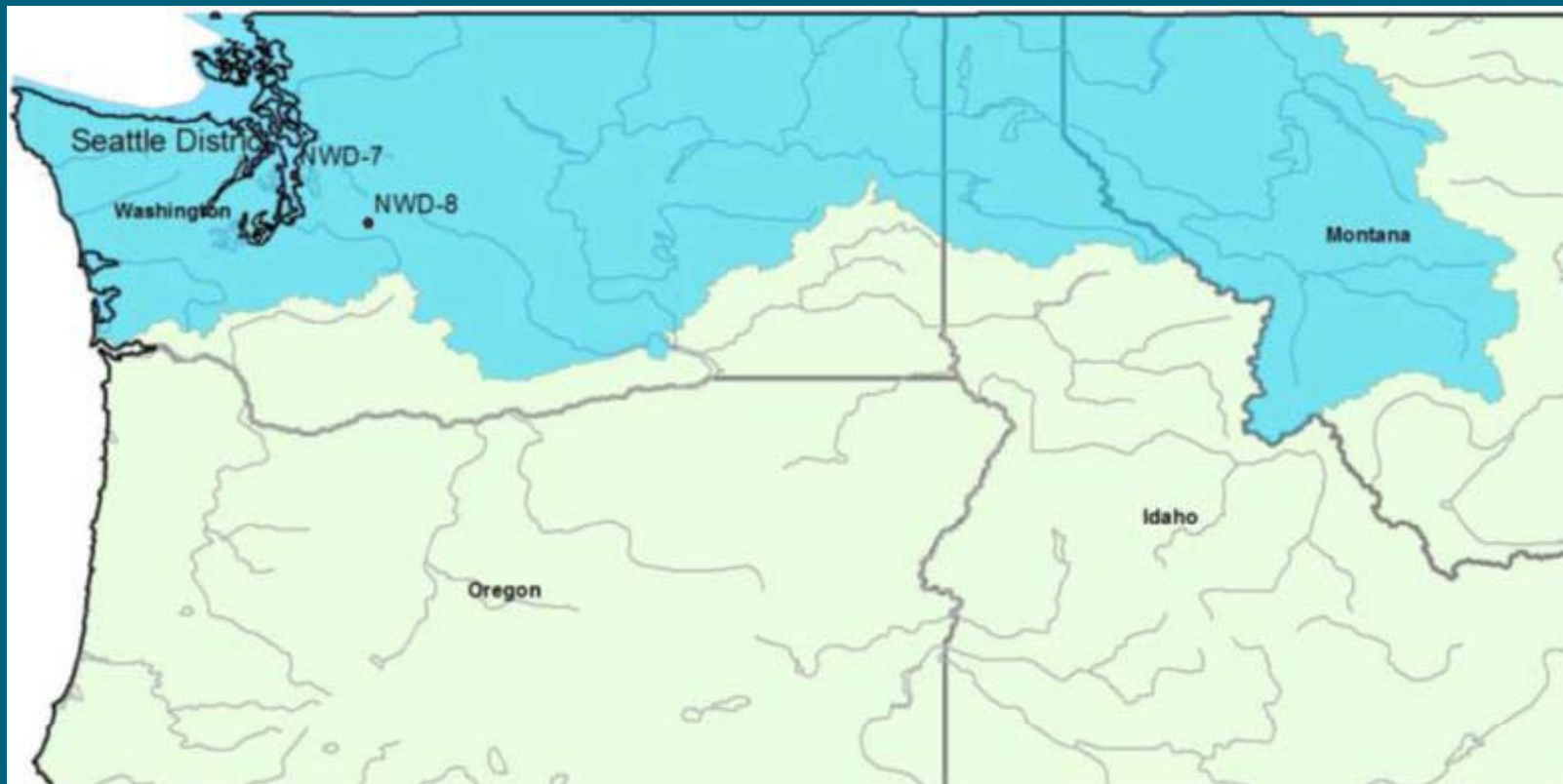
Specific Sites in A-1 thru A-3

| Study | Project Name | State | Capacity (MWs) | Generation (MWhs) |
|-------|---|-------|----------------|-------------------|
| A-1 | Blue River | OR | 20.63 | 32,565.26 |
| A-1 | Cottage Grove | OR | 8.41 | 12,048.79 |
| A-1 | Fern Ridge | OR | 10.08 | 11,832.67 |
| A-1 | Hiram M. Chittenden Locks & Dam | WA | 11.43 | 16,755.29 |
| A-1 | Howard A. Hanson Dam* | WA | 65.58 | 95,576.38 |
| A-2 | Howard A. Hanson Dam (not included in total)* | WA | [26.3] | [101.62] |
| A-3 | Arthur R. Bowman Dam | OR | 3.293 | 18,282.00 |
| A-3 | Easton Diversion Dam | OR | 1.057 | 7,400.00 |
| A-3 | Sunnyside Dam | WA | 1.362 | 10,182.00 |
| A-3 | Scootney Wasteway | WA | 2.276 | 11,238.00 |
| A-3 | Emigrant Dam | OR | .733 | 2,619.00 |
| A-3 | Wickiup Dam | OR | 3.950 | 15,650.00 |
| A-3 | Cle Elum Dam | WA | 7.249 | 14,911.00 |
| A-3 | Ririe Dam | ID | .993 | 3,778.00 |
| A-3 | Scoggins Dam | OR | .955 | 3,683.00 |
| A-3 | McKay Dam | OR | 1.362 | 4,344.00 |
| A-3 | Keechelus Dam | WA | 2.394 | 6,746.00 |
| A-3 | Haystack Dam | OR | .805 | 3,738.00 |
| A-3 | Kachess Dam | WA | 1.227 | 3,877.00 |
| A-3 | TOTAL | | 143.786 | 275,226.39 |

Top USACE Sites in Oregon



Top USACE Sites in Washington



The Non-Powered Dams with Potential Capacity Greater than 1 MW



Legend

Potential Capacity (MW)

- 1 - 30 MW
- 30 - 100 MW
- 100 - 250 MW
- 250 - 496 MW

- Major Rivers
- Major Lakes
- State Boundary

Map information was compiled from the best available sources.
No warranty is made for its accuracy and completeness.
Source: National Inventory of Dams, 2010

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



Chapter 2 – Conduit / Kinetic

- B-1 Technical & Economic Feasibility of Small Hydropower Development in the Deschutes River Basin”
 - June 2013, Department of Energy
- B-2 The Integration Basin-Scale Opportunity Assessment Initiative, FY 2011 Year-End Report
 - Sept. 2011, Pacific Northwest National Laboratory
- B-3 Feasibility Study on Five Potential Hydroelectric Power Generation Locations in the North Unit Irrigation District
 - August 2009, Energy Trust of Oregon

Chapter 2 – Conduit / Kinetic

- B-4 Power Extraction from Irrigation Laterals and Canals in the Columbia Basin Project
 - University of Washington, 2009
- B-5 Site Inventory and Hydropower Energy Assessment of Reclamation Owned Conduits
 - USBR, March 2012
- B-6 Bureau of Reclamation Renewable Energy Update, FY 2014 Q3
 - USBR, July 2014
- B-7 Scoping Study of Hydropower Potential in Wallowa County, OR
 - Energy Trust of Oregon, Nov 2010

Conduit Projects



Photos of Swalley Irrigation District
Bend, OR

Kinetic Projects



**Photos of Kinetic Projects, courtesy of
Instream Energy and Hydrovolts**

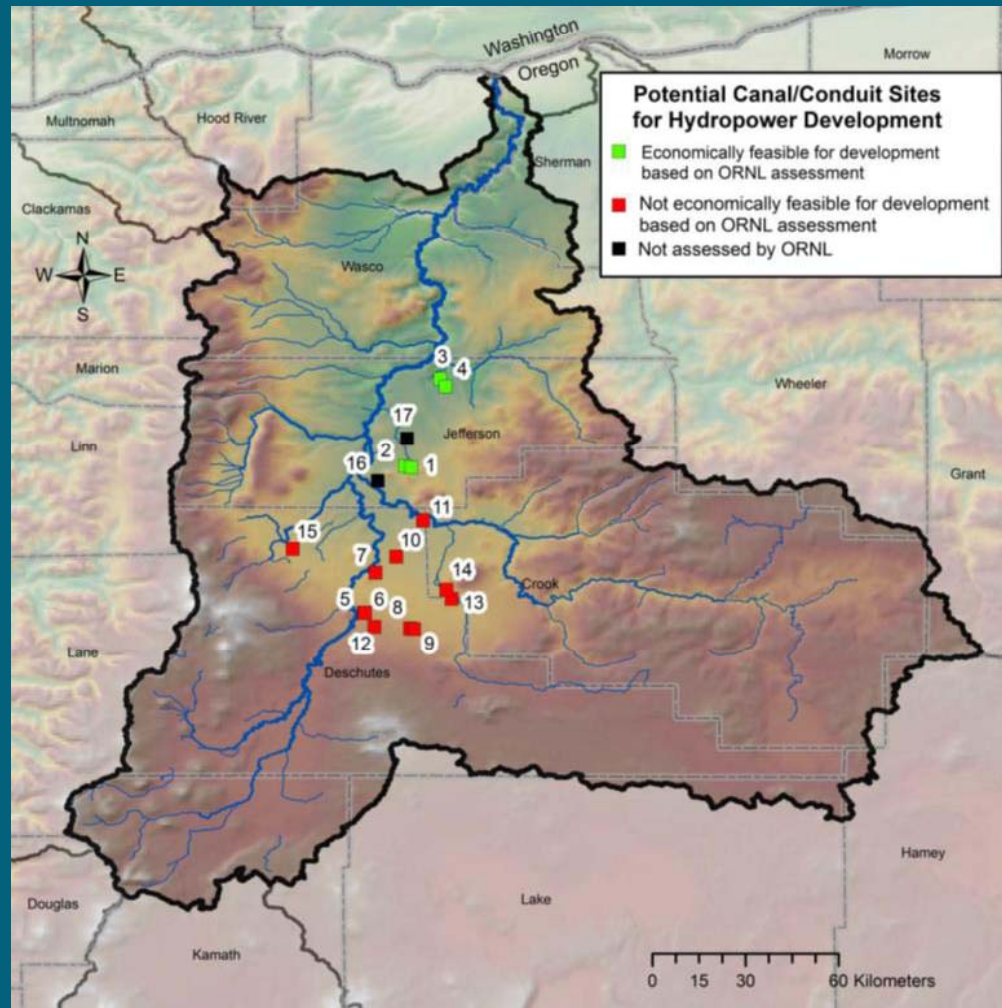
Specific Sites in B-1 thru B-7

| Study | Project Name | Capacity (MWs) | Generation (MWhs) |
|-------|---------------------------------|----------------|-------------------|
| B-1 | Wickiup Dam | 7.118 | 29,010 |
| B-1 | Bowman Dam | 5.959 | 19,587 |
| B-1 | North Canal Dam | 1.135 | 5,145 |
| B-1 | Ochoco Dam | .366 | 2,992 |
| B-1 | Mile 45 conduit site | 2.700 | 12,565 |
| B-1 | Haystack canal site | 1.730 | 8,078 |
| B-1 | Lateral 58-11 canal site | .137 | 560 |
| B-1 | Lateral 58-9 canal site | .750 | 305 |
| B-3 | Brinson Boulevard canal site | .969 | 4,214 |
| B-3 | Smith Rock Drop canal site | .610 | 1,958 |
| B-5 | Pacific NW Regional canal sites | 34.000 | 116,597 |
| B-6 | 18 Reclamation Facilities | 50.750 | 91,243 |
| B-7 | 22 conduit sites | 1.02 | 3,391 |
| | TOTAL | 92.616 | 295,645 |

B-1 Feasible Projects Oak Ridge Lab

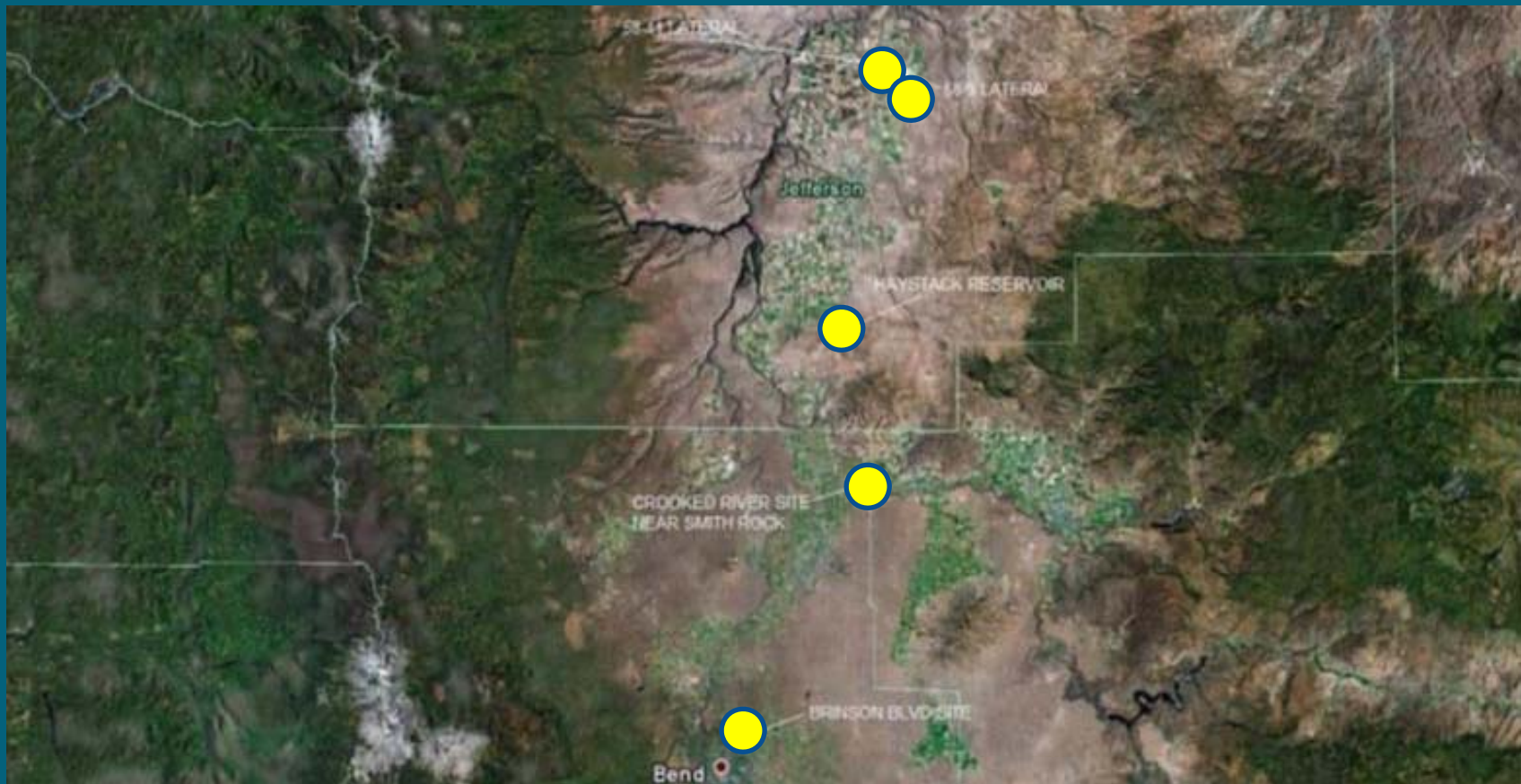
| Project Name | Project No. on Map | Capacity (MWs) | Generation (MWhs) |
|----------------------|--------------------|----------------|-------------------|
| Wickiup Dam | | 7.118 | 29,010 |
| Bowman Dam | | 5.959 | 19,587 |
| North Canal Dam | | 1.135 | 5,145 |
| Ochoco Dam | | .366 | 2,992 |
| Mile 45 conduit site | 1 | 2.700 | 12,556 |
| Haystack canal site | 2 | 1.730 | 8,078 |
| Lateral 58-11 site | 3 | .137 | 560 |
| Lateral 58-9 site | 4 | .075 | 305 |
| TOTAL | | 19.895 | 78,242 |

B-1 Canal and Conduit Sites, Central OR



Map of Potential Canal and Conduit Sites in the Deschutes and Crooked River Basins, Central Oregon

B-3 North Unit Irrigation Dist. Sites



B-5 Hydropower Resource Assessments at Existing Reclamation Facilities

| STATE | CANAL SITES | POTENTIAL INSTALLED CAPACITY MW | POTENTIAL ANNUAL ENERGY MWH |
|--------------|-------------|--|-----------------------------------|
| ID | 9 | 2.77 | 11,451.81 |
| MT | 32 | 9.88 | 26,316.56 |
| OR | 68 | 20.40 | 75,943.04 |
| WA | 2 | 1.05 | 2,885.36 |
| TOTAL | 111 | 34.00 | 116,596.77 |

B-6FERC & LOPP

Non-Federal Hydroelectric Projects

| State | Type | Facility Type | Status | Type | Project Name | FERC | Operating Entity | Capacity (kW) | Pump Generation Capacity (kW) | Estimated Annual Generation (kWh) | Project Initiation | Preliminary Permit/ Lease Date |
|-------|------|---------------|-------------|--------------|-----------------------------------|-------|---|---------------|-------------------------------|-----------------------------------|--------------------|--------------------------------|
| WA | FERC | Conduit | Preliminary | Conventional | 16.4 Wasteway | 14349 | Grand Coulee Project H. Authority | 1,750 | | | 7/29/2011 | 3/26/2013 |
| OR | FERC | Conduit | Exemption | Conventional | 45-Mile | 13817 | Earth by Design (Exemption: 12/17/2010) | 5,000 | | | 7/16/2010 | |
| WA | FERC | Conduit | Preliminary | Conventional | 46A Wasteway | 14351 | Grand Coulee Project H. Authority | 1,600 | | | 7/29/2011 | 3/26/2013 |
| WA | FERC | Dam | Preliminary | Pump Storage | Banks Lake Pumped Storage Project | 14329 | Grand Coulee Project H. Authority | | 1,000,000 | 2,263,000,000 | 11/30/2011 | 8/22/2013 |
| OR | FERC | Dam | Preliminary | Pump Storage | Bryant Mountain Pumped Storage | 13680 | Bryant Mountain LLC | - | 1,250,000 | 2,409,000,000 | 3/1/2010 | 9/24/2010 |
| MT | FERC | Conduit | Exemption | Conventional | Mary Taylor Drop | 14294 | Tumbull Hydro, LLC (Exemption: 6/28/2012) | 890 | | 1,840,000 | 9/23/2011 | |
| WA | FERC | Dam | Preliminary | Conventional | McKay Dam | 14546 | Houtama Hydropower, LLC | 2,300 | | | 8/13/2013 | 2/6/2014 |
| OR | FERC | Conduit | Preliminary | Conventional | Monroe Drop | 14430 | Natel | 300 | | 1,733,511 | 7/2/2012 | 3/28/2013 |
| WA | FERC | Conduit | Preliminary | Conventional | PEC 1973 Drop | 14316 | Grand Coulee Project H. Authority | 2,200 | | | 11/8/2011 | 3/26/2013 |
| WA | FERC | Dam | Preliminary | Conventional | Pinto Dam | 14380 | Grand Coulee Project H. Authority | 3,400 | | | 4/4/2012 | 10/10/2012 |
| WA | FERC | Conduit | Preliminary | Conventional | Rocky Coulee Wasteway | 14372 | Grand Coulee Project H. Authority | 12,000 | | | 3/13/2012 | 7/11/2012 |
| WA | FERC | Conduit | Preliminary | Conventional | Scootney Outlet Drop | 14317 | Grand Coulee Project H. Authority | 1,300 | | | 5/31/2011 | 3/26/2013 |
| WA | FERC | Conduit | Preliminary | Conventional | Scootney Wasteway | 14352 | Grand Coulee Project H. Authority | 1,110 | | | 7/28/2011 | 3/26/2013 |
| WA | FERC | Conduit | Preliminary | Conventional | Scootney Inlet Drop | 14318 | Grand Coulee Project H. Authority | 1,700 | | | 5/31/2011 | 3/26/2013 |
| OR | FERC | Dam | Preliminary | Conventional | Unity Dams/Warm Springs Hydro | 14576 | Warm Springs Hydro, LLC | 800 | | 3,400,000 | 1/13/2014 | 6/16/2014 |
| MT | LOPP | Conduit | Request | Conventional | A Drop | n/a | Tumbull Hydro, LLC | 1,000 | | 2,500,000 | 6/1/2014 | |
| MT | LOPP | Dam | Request | Conventional | Helena Valley Pumping Plant | n/a | Helena Valley Irrigation District | 4,800 | | 9,608,000 | 9/13/2013 | |
| MT | LOPP | Conduit | Request | Conventional | Johnson Drop | n/a | Tumbull Hydro, LLC | 700 | | 1,700,000 | 6/1/2014 | |
| MT | LOPP | Conduit | Request | Conventional | Woods Drop | n/a | Tumbull Hydro, LLC | 900 | | 2,200,000 | 6/1/2014 | |
| MT | LOPP | Dam | Request | Conventional | Yellowtail Afterbay | n/a | Crow Tribe | 9,000 | | 68,261,000 | 1/11/2012 | |

Chapter 3 -Hydroelectric Pumped Storage



1095-MW Rocky Mountain Pumped Storage Project

Pumped Storage is Proven and Prolific

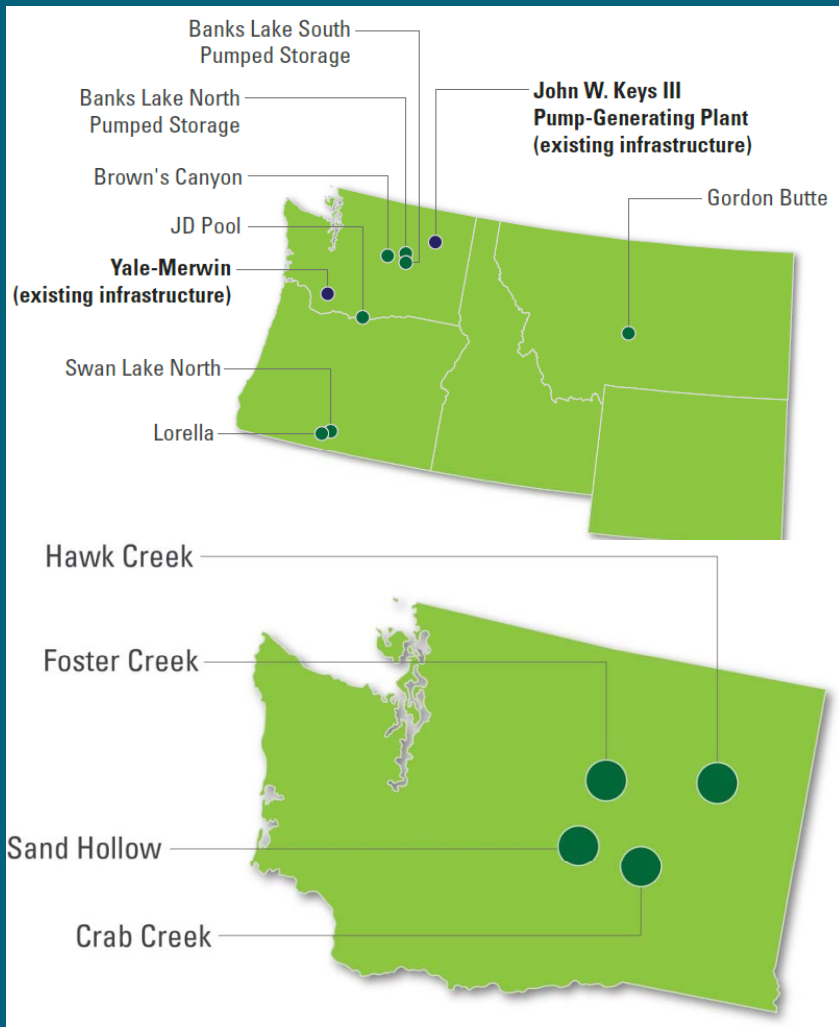


Today, there are 40 pumped storage projects operating in the U.S. that provide more than 20 GW, or nearly 2 percent, of the capacity for our nation's energy supply system (Energy Information Admin, 2007).

Pumped Storage Studies Reviewed

- **C-1: “Assessment of Opportunities for New US Pumped Storage Hydroelectric Plants Using Existing Water Features as Auxiliary Reservoirs”**
 - Department of Energy, Idaho National Lab, March 2014
- **C-2: “Technical Analysis of Pumped Storage and Integration with Wind Power in the Pacific Northwest”**
 - MWH for US Army Corps of Engineers, August 2009
- **C-3: “Appraisal Evaluation of Columbia River Mainstem Off-Channel Storage Options**
 - CH2MHill for US Bureau of Reclamation, May 2007
- **C-4: “Hydroelectric Pumped Storage for Enabling Variable Energy Resources within Federal Columbia Power System**
 - *HDR for Bonneville Power Administration, September 2010*

Summary of Capacity Identified in Studies C-1 through C-4



| Study | Project Name | State | Capacity (MW) |
|-------|--|-------|---------------|
| C-1 | See Report, Large Number of Studies Nationwide | N/A | ----- |
| C-2 | John Day Pool | WA | 1300 |
| C-2 | Swan Lake | OR | 600 |
| C-3 | Crab Creek (varies by size) | WA | 69-392 |
| C-3 | Sand Hollow Creek | WA | 285 |
| C-3 | Hawk Creek (varies by size) | WA | 237-1136 |
| C-3 | Foster Creek | WA | 300-1100 |
| C-4 | John Day Pool (duplicate, also cited in C-2) | WA | ----- |
| C-4 | Swan Lake North | OR | 600 |
| C-4 | Brown's Canyon | WA | 1000 |
| C-4 | Banks Lake Pumped Storage – North Banks Lake | WA | 1000 |
| C-4 | Banks Lake Pumped Storage – South Banks Lake | WA | 1040 |
| C-4 | Lorella (Klamath County) | OR | 1000 |
| C-4 | Gordon Butte | MT | 400 |
| C-4 | Yale-Merwin | WA | 255 |

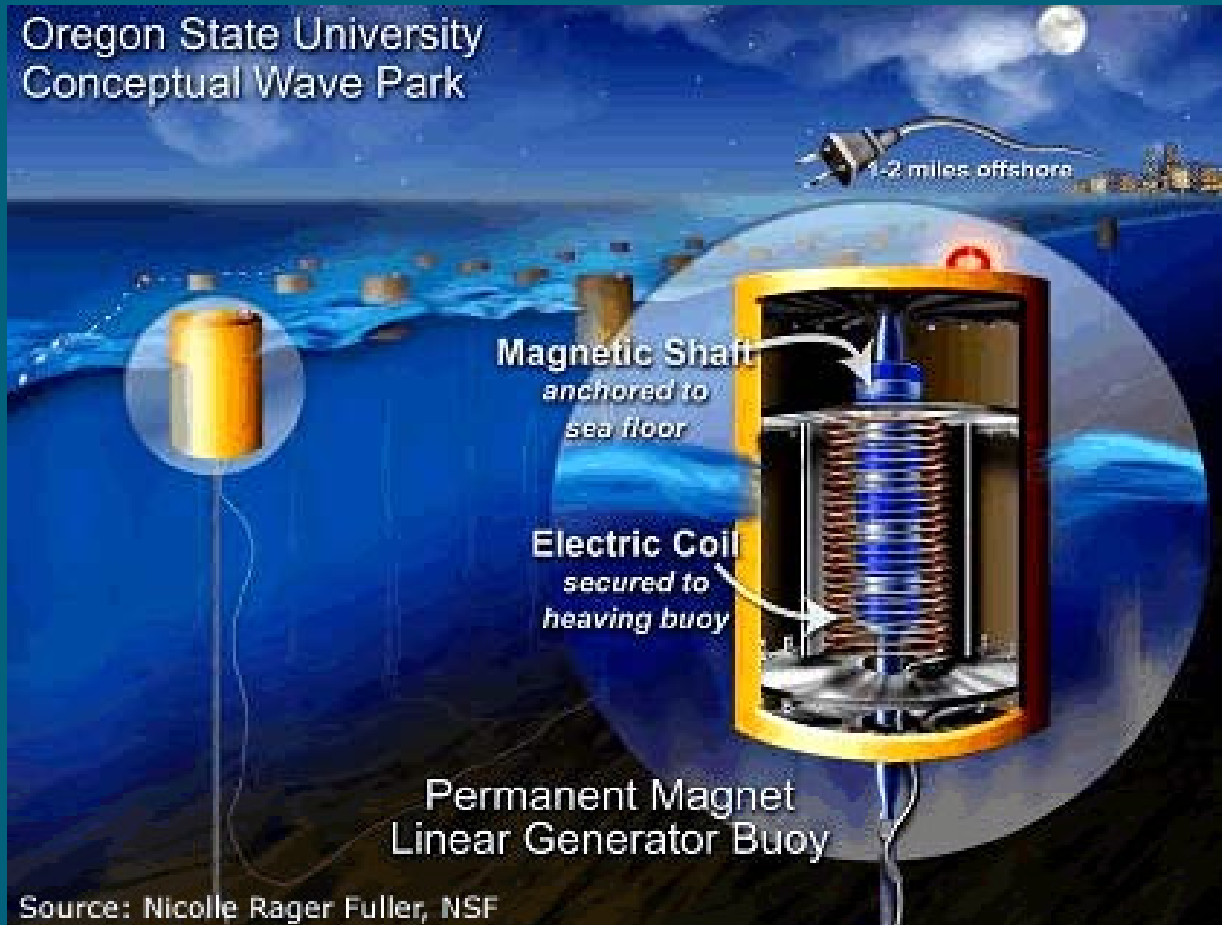
Pumped Storage Projects with FERC Preliminary Permits

| FERC Docket Number | Project Name | Licensee/Permit Holder/Applicant | State | Capacity (MW) | Closed Loop? | L/H Ratio | Estimated Energy Storage (MWh) |
|--------------------|--|----------------------------------|-------|---------------|--------------|-----------|--------------------------------|
| 13333 | John Day Pool | PUD No.1 of Klickitat County | WA | 1000 | Yes | 4.58 | 15000 |
| 13318 | Swan Lake North | Swan Lake North Hydro, LLC | OR | 600 | Yes | 4.98 | 10000 |
| 14329 | Banks Lake Pumped Storage (Alternative 1 – North Banks Lake) | Grand Coulee Hydro Authority | WA | 1000 | No | 28.29 | 8000 |
| 14329 | Banks Lake Pumped Storage (Alternative 2 – South Banks Lake) | Grand Coulee Hydro Authority | WA | 1040 | No | 3.18 | 8084 |
| 14416 | Lorella (Klamath County) | FFP Project 111, LLC | OR | 1000 | Yes | 4.81 | 15625 |
| 13642 | Gordon Butte | GB Energy Park, LLC | MT | 400 | Yes | 3.88 | 3422 |

Project Storage Projects Under Significant Development

- Klickitat PUD's JD Pool Project – Notice of Intent, Traditional Licensing Process request and Pre-Application Document filed with FERC on 3 NOV 14; expect to file a Draft License Application October 2015.
- EDF Renewable Energy's Swan Lake Project – ongoing geo-tech investigation with deep borehole drilling of the escarpment where the main shaft and powerhouse location; expect to file a Final License Application in October 2015.

Chapter 4 – Tidal & Wave Energy



Chapter 4 – Tidal & Wave Energy

- There are three types of wave energy technologies:
 - Floats, buoys or other pitching devices to generate electricity, driving hydraulic pumps by using the rise and fall of swells
 - Oscillating water column (OWC) devices to generate near the shore using the rise and fall of water in a cylindrical shaft
 - Overtopping device or tapered channel, which may be used either near the shore or offshore

Chapter 4 – Tidal & Wave Energy

- D-1 Assessment of Energy Production Potential from Tidal Streams in the US
 - Funded by Wind and Water Program, U.S. Dep't of Commerce
 - Prepared by Georgia Tech Research Corporation
 - June 29, 2011
- D-2 Mapping and Assessment of the United States Ocean Wave Energy Resource
 - Electric Power Research Institute (EPRI), 2011
- D-3 Assessment and Mapping of the Riverine Hydrokinetic Resource in the Continental United States
 - Electric Power Research Institute (EPRI), 2012

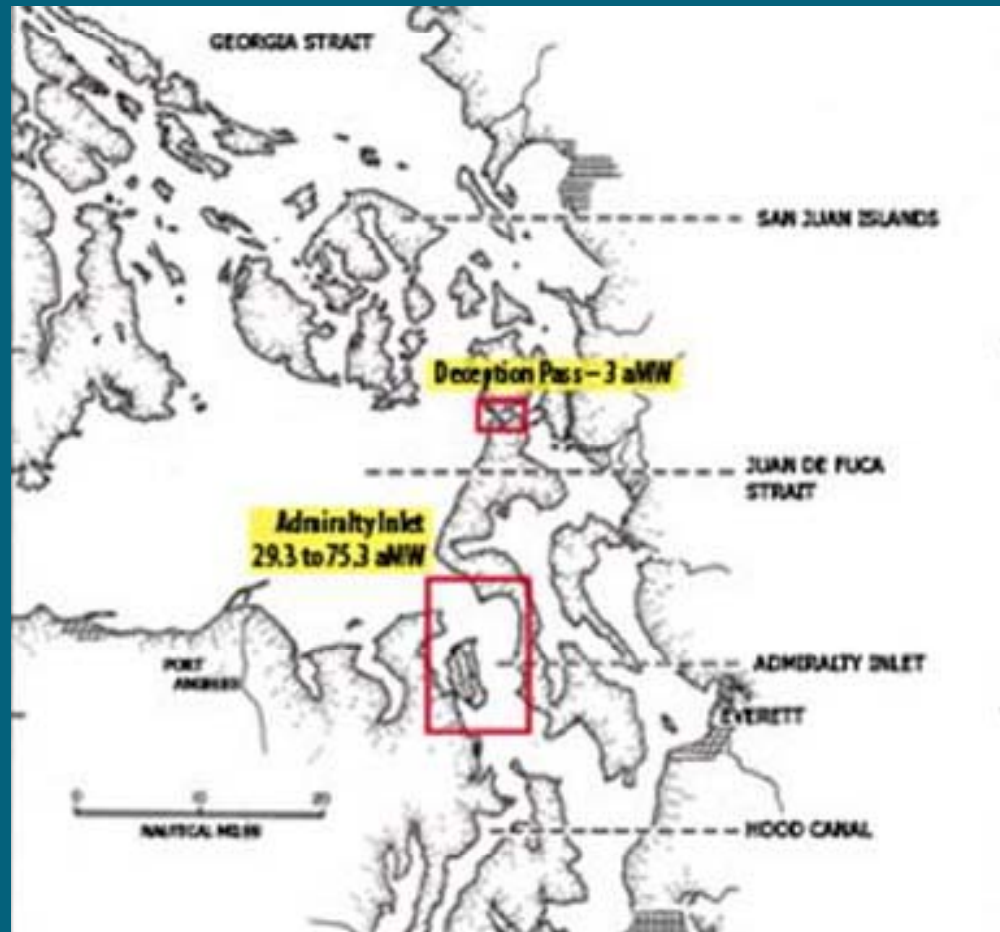
Chapter 4 – EPRI Estimates

| | Inner Shelf TWh/yr | Outer Shelf TWh/yr |
|-------------------------|-----------------------|-----------------------|
| West Coast (CA, OR, WA) | 440 | 590 |
| Washington | 72 | 116 |
| Oregon | 143 | 179 |

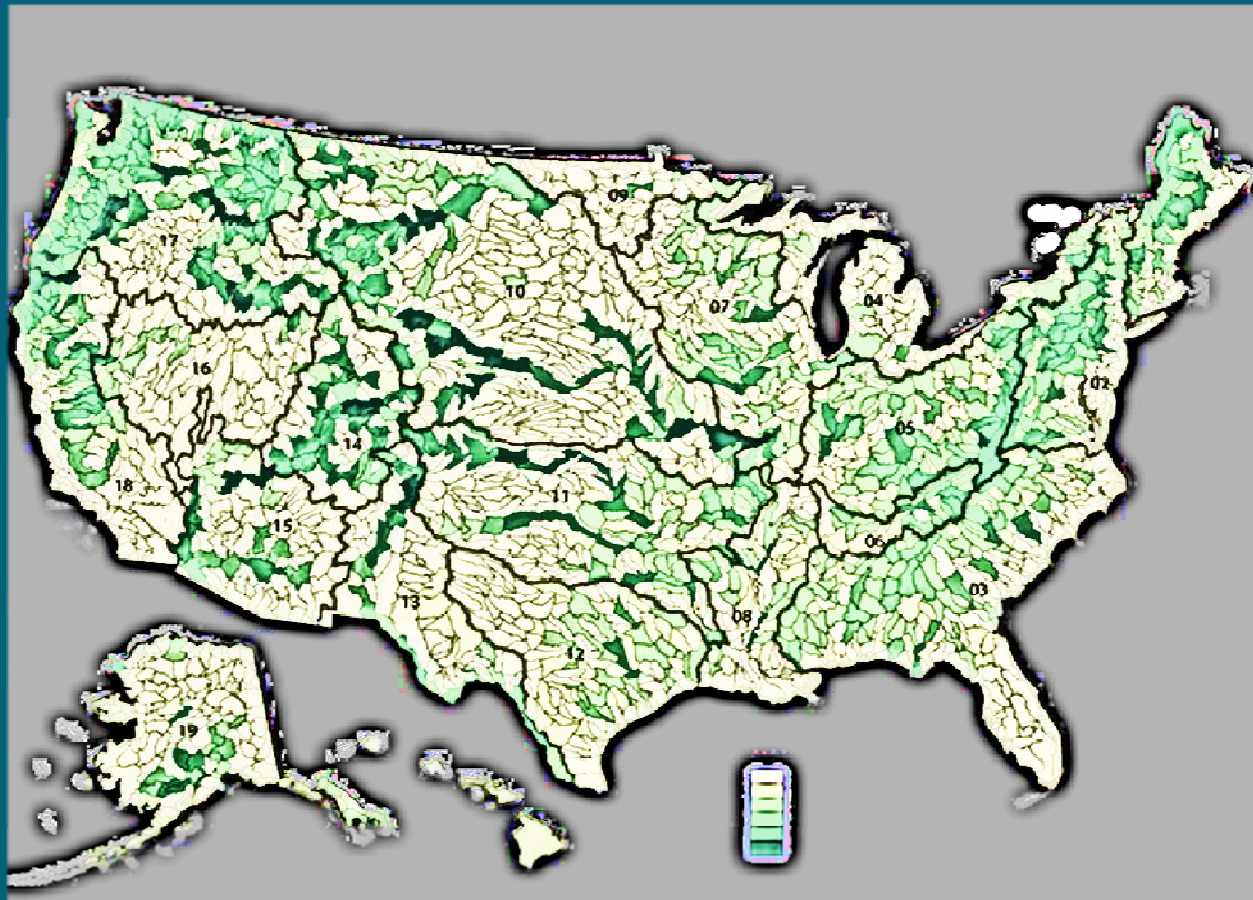
*Terawatt hours per year

*A terawatt hour is one million megawatt hours or one trillion kilowatt hours.

Chapter 4 – Tidal & Wave Energy



Chapter 5 – General Hydropower Project Assessments



Chapter 5 – General Hydropower Project Assessments

- E-1 New Stream-reach Development: A Comprehensive Assessment of Hydropower Energy Potential in the US
 - U.S. Department of Energy, Wind and Water Power Technologies Office, April 2014
- E-2 Assessment of Natural Stream Sites for Hydroelectric Dams in the PNW Region
 - Idaho National Lab, March 2012
- E-3 Hydropower Potential & Energy Savings Evaluation – Irrigation Water Provides of Oregon
 - Energy Trust of Oregon, 2011, Black Rock Consulting

Chapter 5 – General Hydropower Project Assessments

- E-4 Small Hydropower Technology and Market Assessment
 - Energy Trust of Oregon, January 2009, Summit Blue Consulting
- E-5 Assessment of Waterpower Potential & Development Needs
 - Electric Power Research Institute, March 2007
- E-6 Feasibility Assessment of the Water Energy Resources of the US for New Lower Power and Small Hydro Classes of Hydroelectric Plants
 - U.S. Department of Energy, Wind and Water Power Technologies Office, January 2006, Idaho National Lab

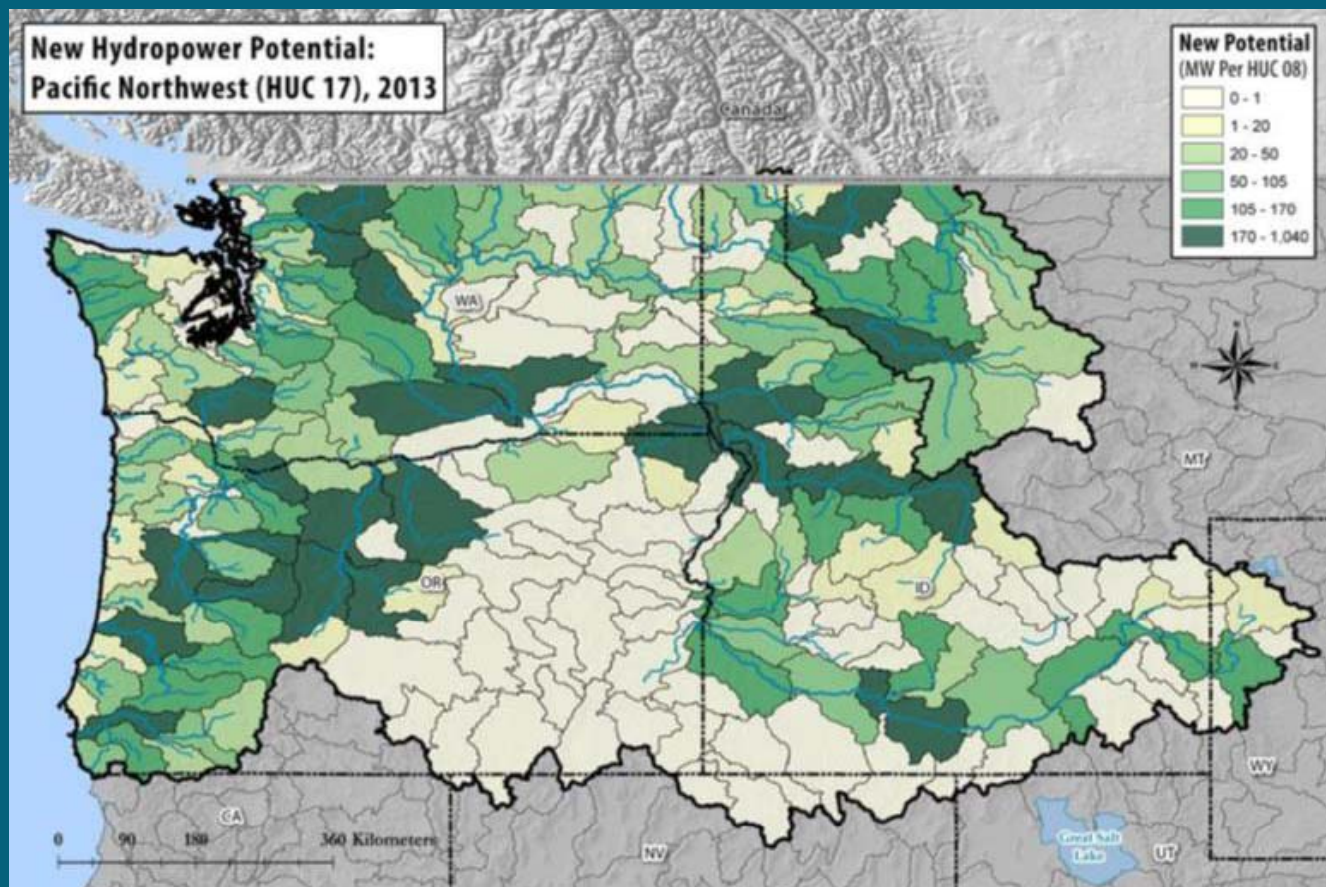
Chapter 5 – General Hydropower Project Assessments

| Study | Project Name | Capacity (MWs) | Generation |
|-------|----------------------------------|----------------|----------------|
| E-1 | Northwest Projects < 1 MW | 15,997.00 | 96,756,000 MWh |
| E-1 | Northwest Projects > 1 MW | 9,228.00 | 52,244,000 MWh |
| E-2 | Northwest Projects (5,439 sites) | 15,021.00 | n/a |
| E-3 | Irrigation Projects (30 sites) | 20.61 | 5,823 MWh |
| E-6 | Northwest Projects | n/a | 9,969 MWa |

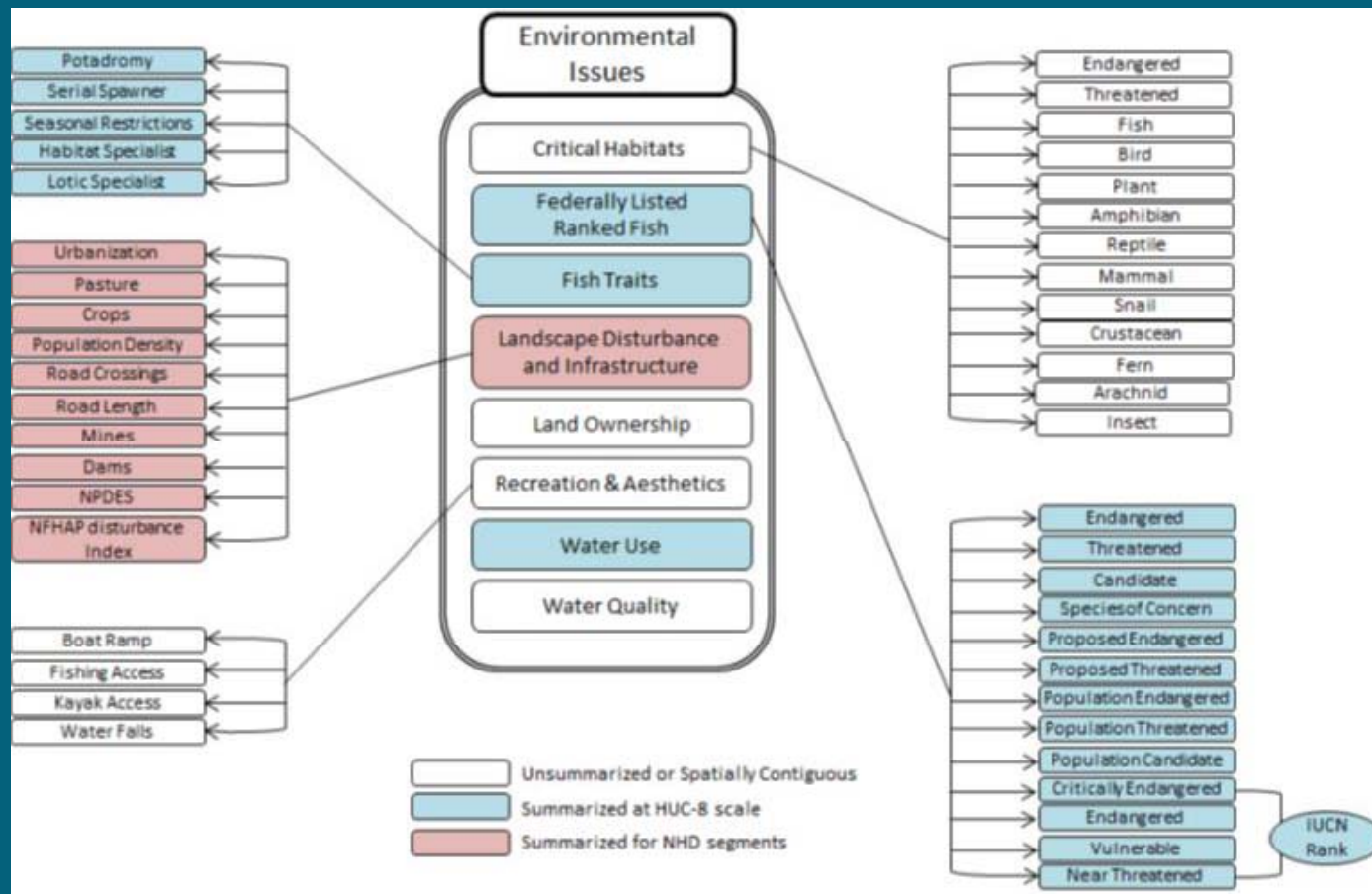
E-1 – PNW New Hydropower Potential

| State | Capacity (MW) | Energy (MWhs/year) |
|--------------|---------------|--------------------|
| Idaho | 7,018 | 41,015,000 |
| Montana | 4,763 | 28,201,000 |
| Oregon | 8,920 | 53,353,000 |
| Washington | 7,381 | 43,788,000 |
| TOTAL | 28,082 | 166,357,000 |

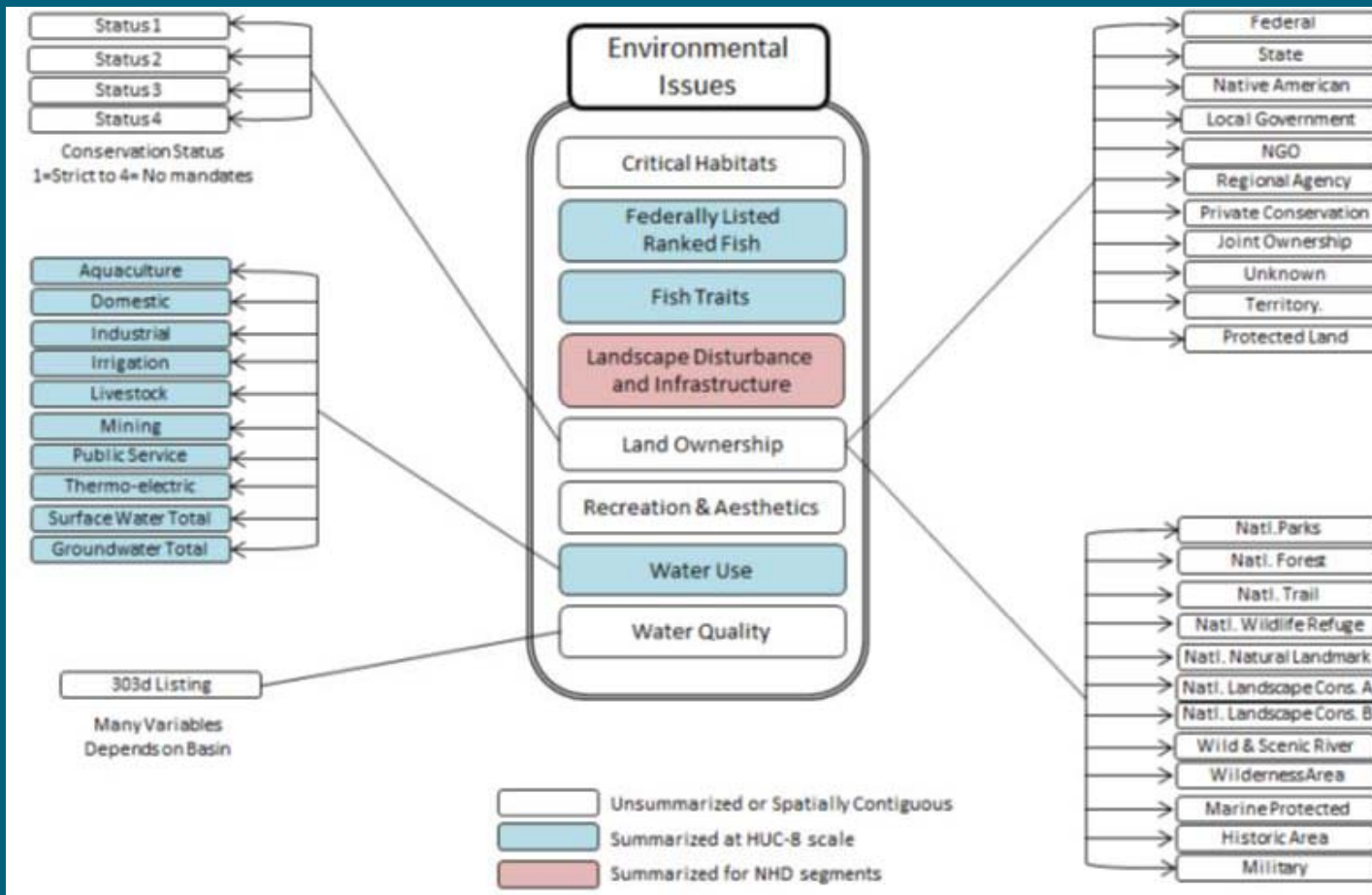
E-1 PNW New Hydropower Potential



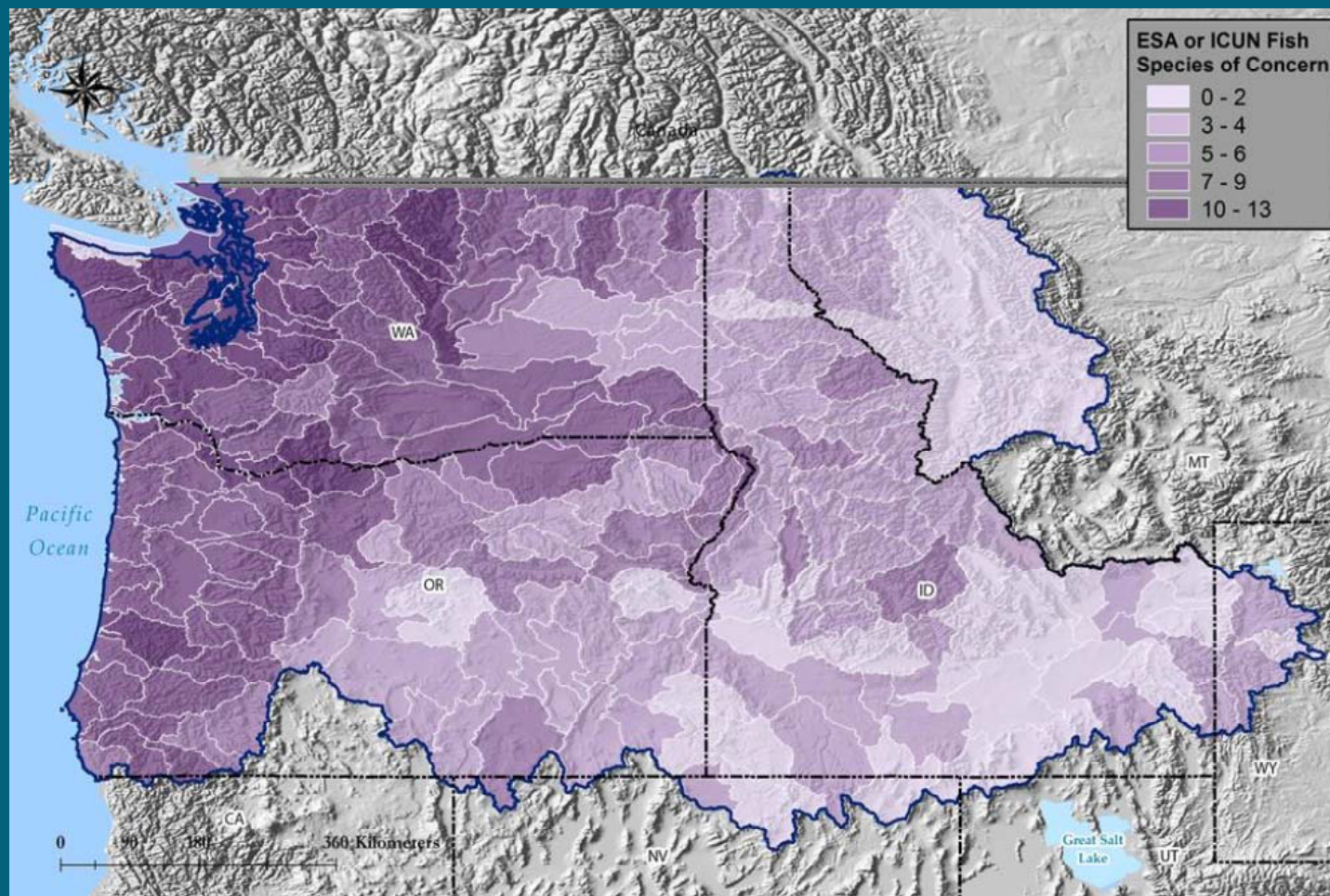
E-1 Environmental Constraints (Chart 1, DOE)



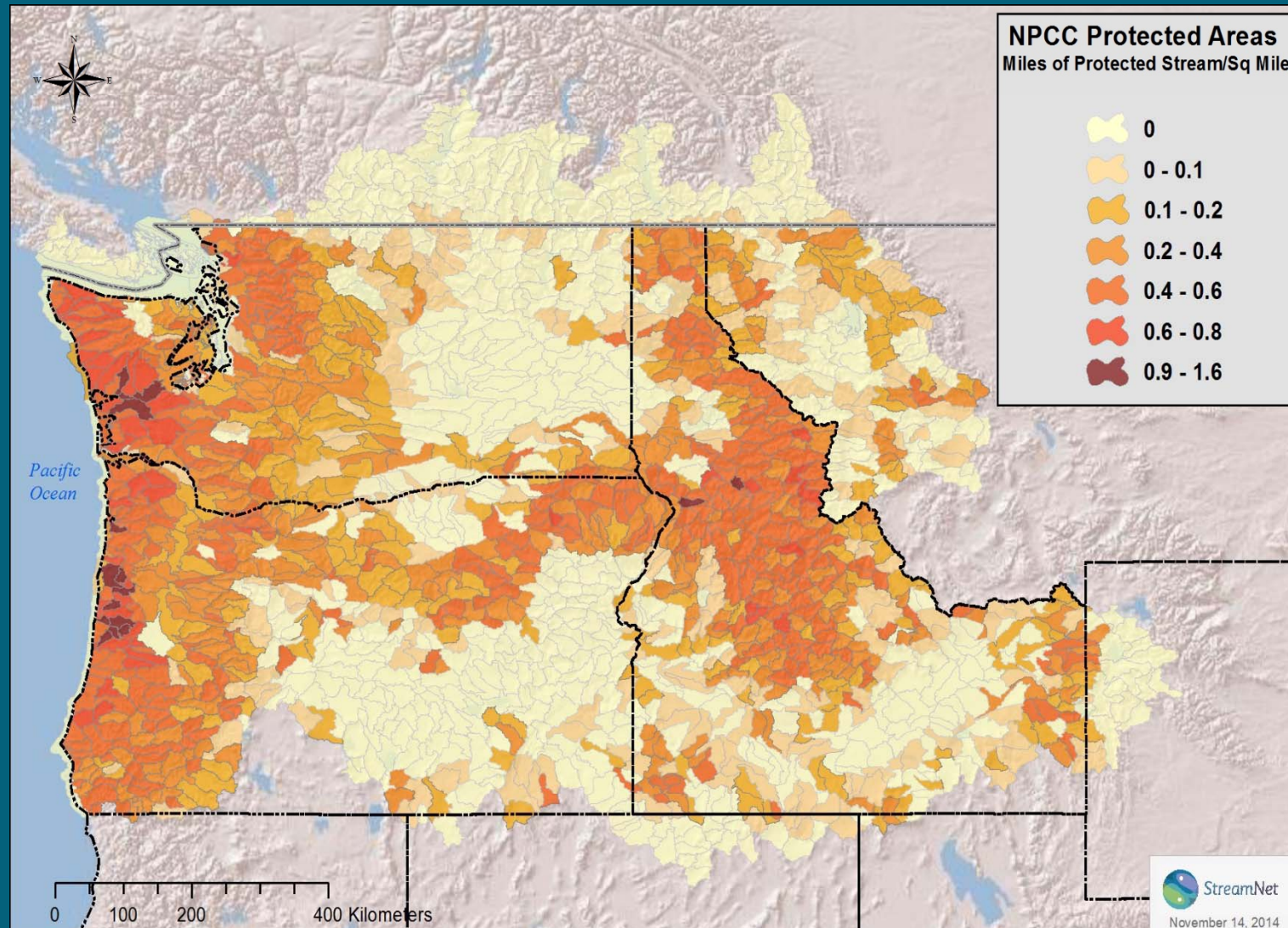
E-1 Environmental Constraints (Chart 2, DOE)



E-1 Fish Species of Concern, DOE

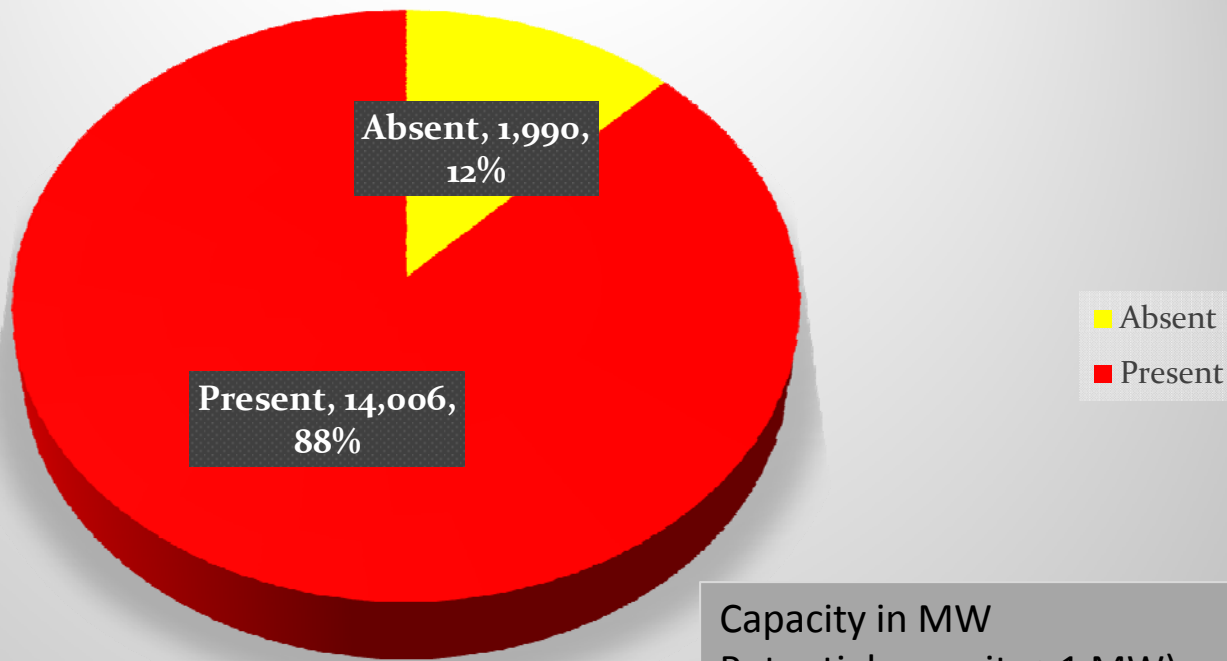


Northwest Power and Conservation Council's Protected Areas dataset designating stream reaches protected from hydropower development. map illustrates relative density of protected stream segments in the Pacific Northwest by normalizing the miles of NPCC protected streams by watershed area (miles/square mile).



Potential Capacity Associated with NPCC Protected Areas in Region 17

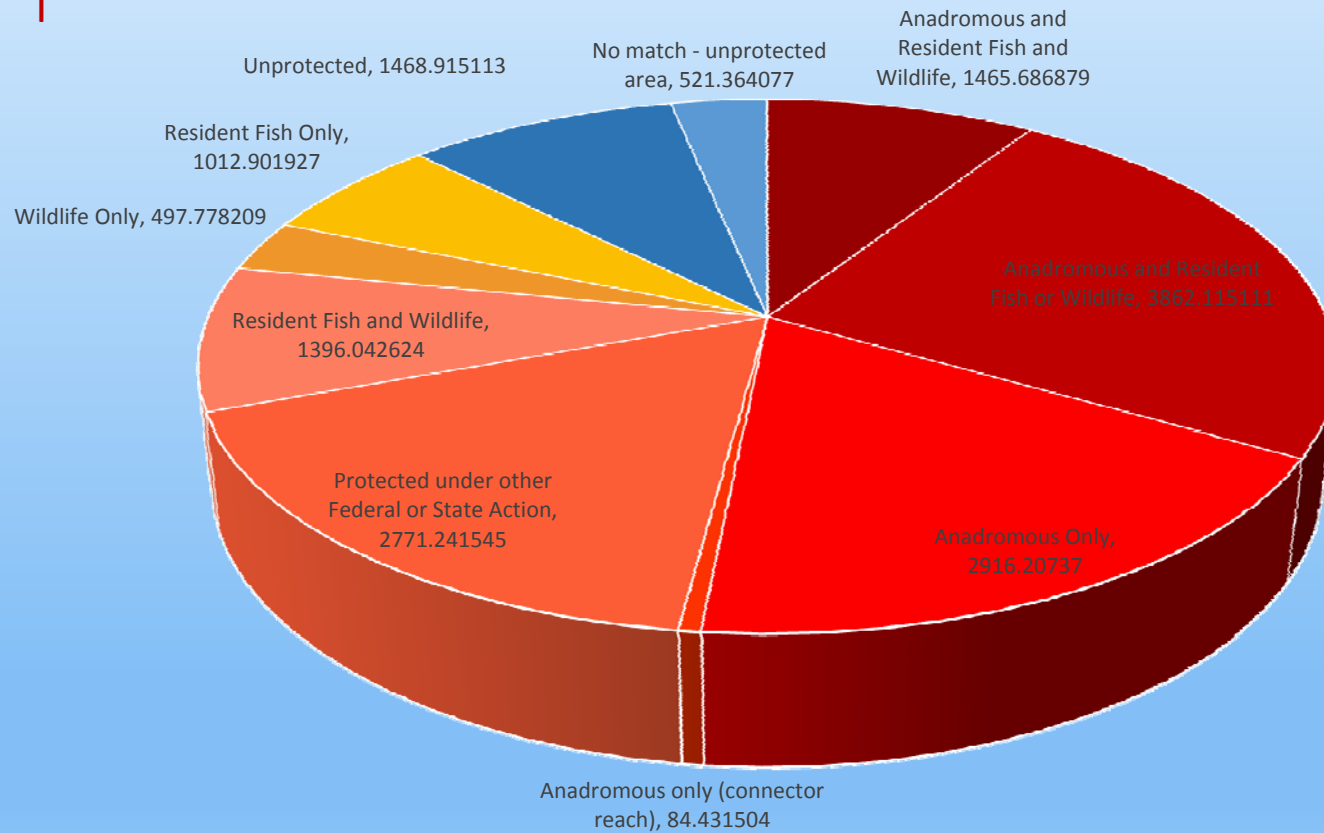
NPCC PROTECTED AREAS



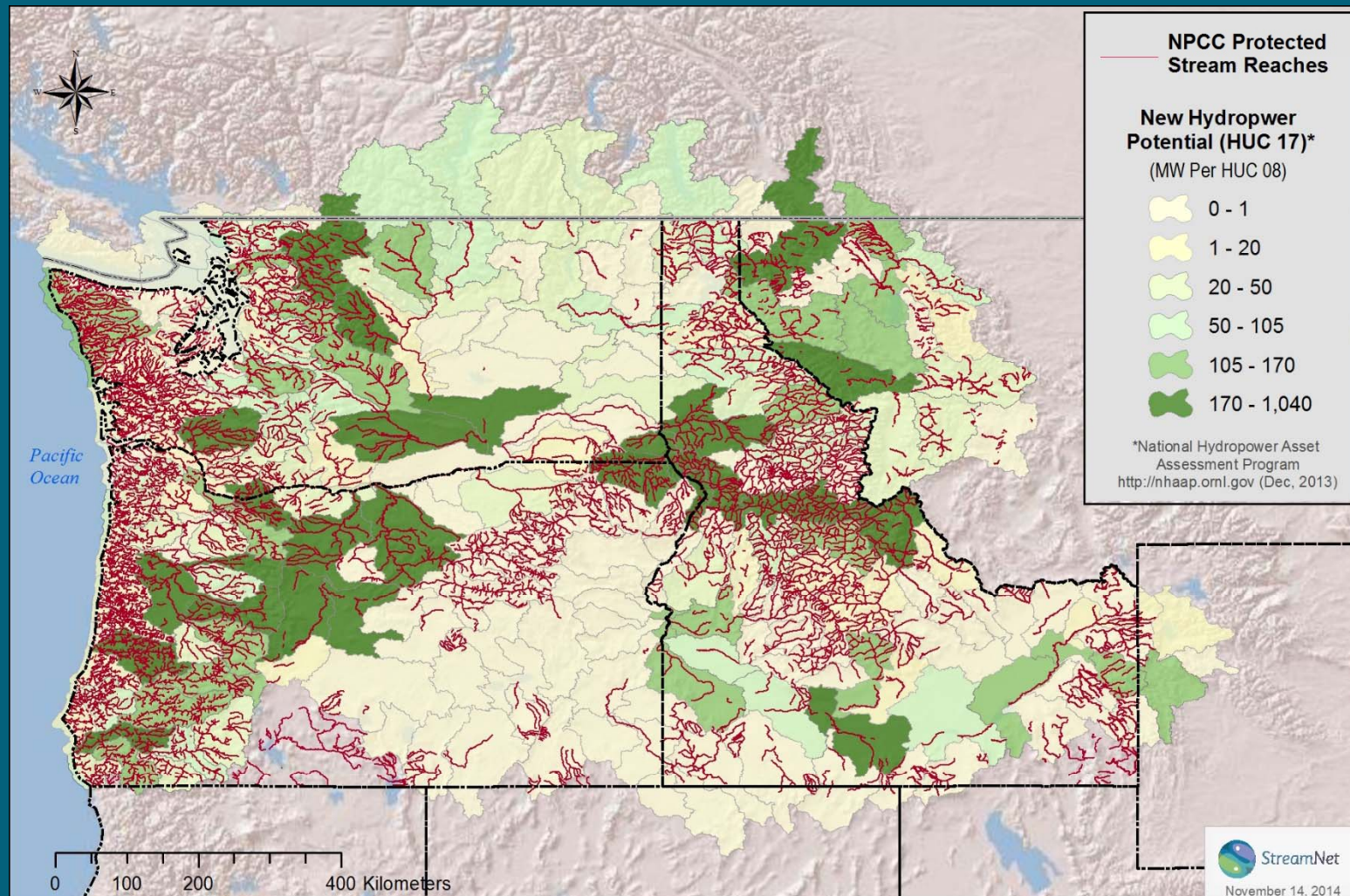
Capacity in MW
Potential capacity >1 MW)

Potential Capacity Associated with NPCC Protected Areas in Region 17

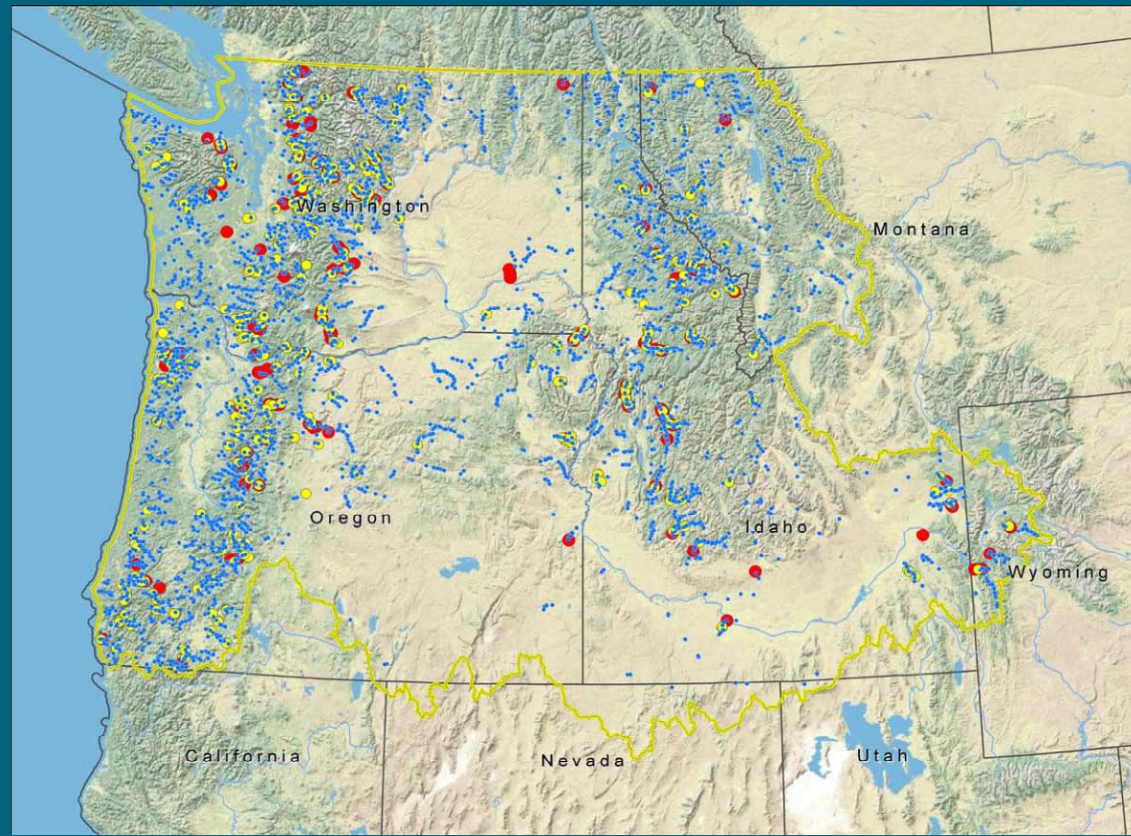
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Protected Areas stream reaches overlaid on map layer of new hydropower potential (MW) existing in Pacific Northwest (Hydrologic Region 17) at the HUC08 level (4th level HUC) based on study conducted by the National Hydropower Asset Assessment Program (Kao, S. et. al, 2014), US DOE.



E-2 Locations of Small Hydropower Sites, Idaho National Lab

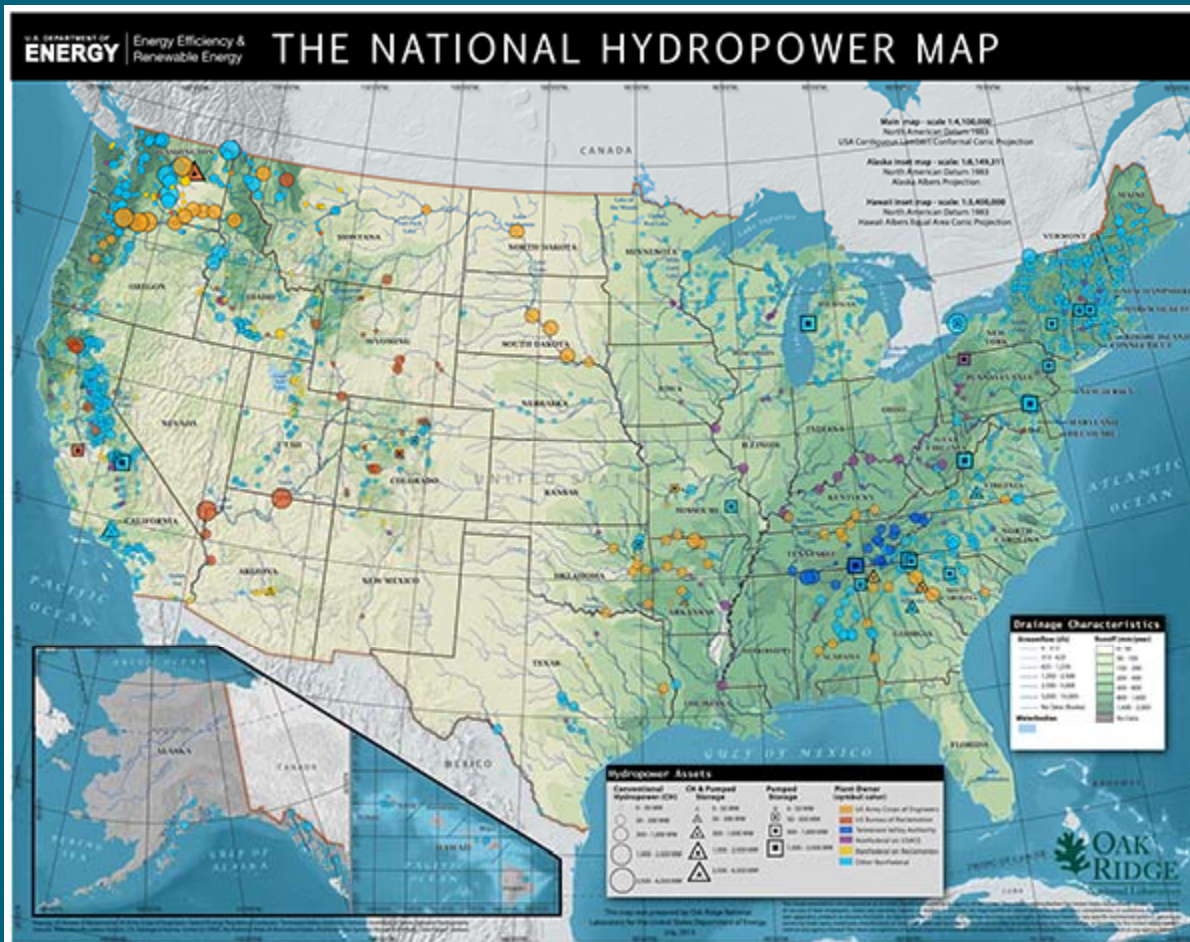


E-2 Stream Reaches Identified with Potential Hydropower Projects

| Reaches | Number of Reaches | Capacity (MWs) |
|--|-------------------|----------------|
| All reaches | 231,747 | 211,666 |
| Capacity potential less than 1 MW | 29,580 | 185,485 |
| Small hydropower reaches: 2 MW – 60 MW | 24,489 | 73,934 |
| Available small hydropower reaches | 15,676 | 42,835 |
| Candidate reach sites for further assessment | 5,439 | 15,021 |

Chapter 6

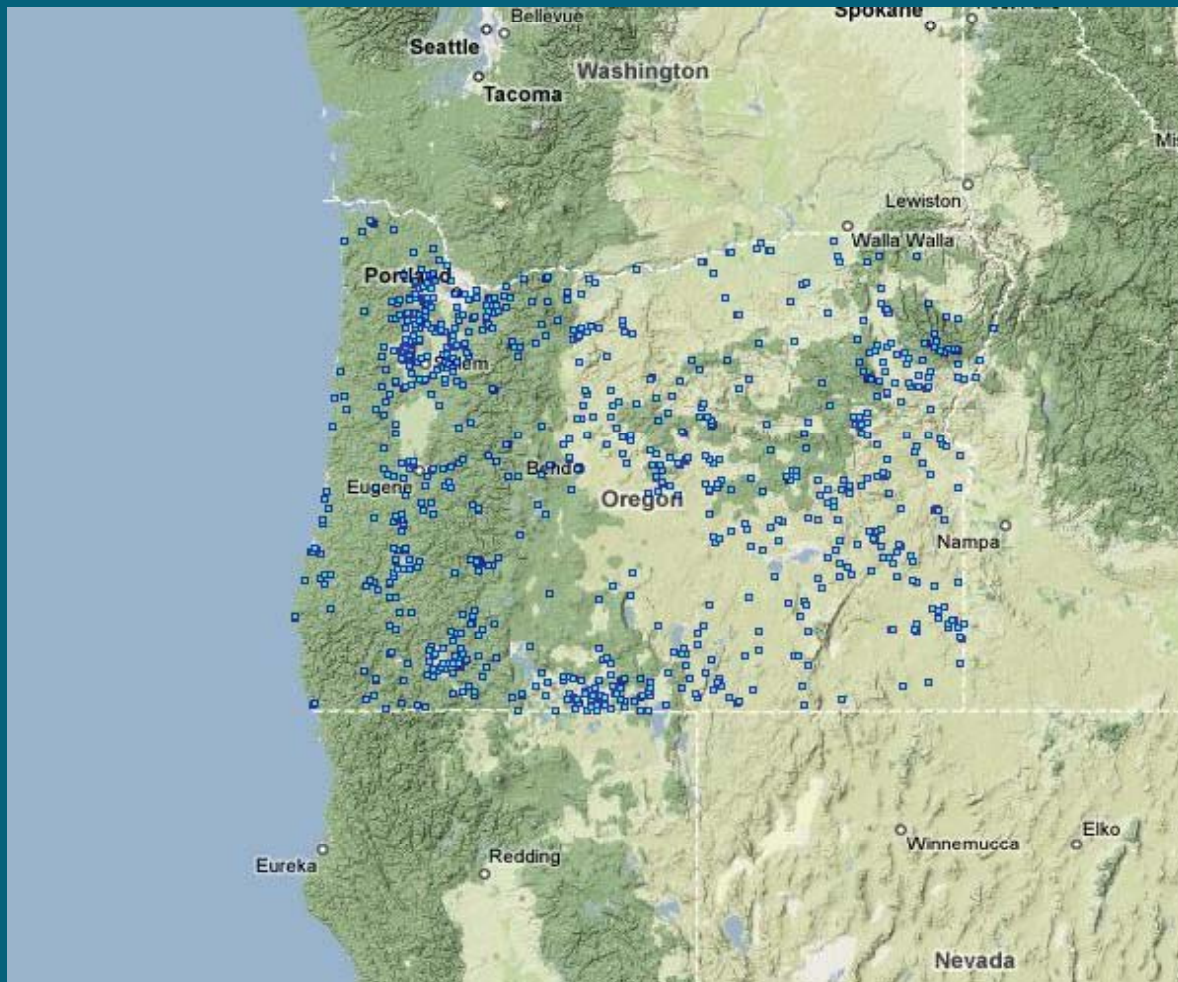
Tools for Assessing Hydropower Potential



Chapter 6 – Tool F-6

- F-1 Northwest Subbasin Databrowser
 - Developed by GIS Support Division and Environment, Fish and Wildlife Group, BPA, 2014
- F-2 National Inventory of Dams
 - Maintained by the USACE, May 2013 Update
- F-3 Hydropower Energy & Economic Analysis Tool
 - USBR, 2014
- F-4 Virtual Hydropower Prospector
 - Idaho National Laboratory, 2011
- F-5 Tidal Stream Interactive Map
 - Georgia Institute, June 2011
- F-6 National Hydropower Asset Assessment Program
 - Oakridge National Lab

F-2 National Inventory of Dams



Chapter 6 – Tool F-6

- NHAAP GIS Team at Oak Ridge National Laboratory (ORNL) Interactive Mapping Site
- Navigation system access to data and map products for:
 - Existing hydropower assets
 - Non-powered dams
 - New stream-reach development
 - Environmental attribution
 - Ecological research
 - Stream classification

Chapter 7 – Legislative/Rulemaking

- Hydropower Regulatory Efficiency Act of 2013
Public Law 113-23 (H.R. 267) Enacted August 9, 2013
 - Capacity Exemption increased to 10 MW
 - Streamlining of Conduit Exemption, raise capacity threshold
 - Extensions allowable for preliminary permits
 - Pilot 2 year licensing process
- Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act , Public Law 113-24
 - Authorizes Lease of Power Privilege
 - Categorical Exclusion from NEPA
 - BOR processes “small conduit hydropower” up to 5 MW

Rulemaking

- EPA 111d Rule - June 24, 2014
under “President’s Climate Action Plan”
 - Lower carbon emissions by 30% below 2005 levels by 2030
 - Each state defines its own plan
 - Or addresses a regional solution
 - Plans due by June 2016
 - Pacific NW Goal – 60% Reduction Average
 - Idaho – 33%
 - Montana – 21%
 - Oregon 48%
 - Washington 72%

Summary of Findings

Pacific NW Potential for 2015-2035

- 3,200 MW Capacity
- 23,000,000 MWhs

Potential Cost

- Non-powered dams \$1,889 to \$5,075 per kW - \$3,518 average
- Conduit projects \$2,140 to \$11,867 per kW - \$4,391 average*
- Pumped storage \$5,000 to \$7,000 per kW - \$6,000 average
- Run-of-river \$2,487 to \$21,062 per kW - \$8,464 average

- *includes development of pipeline infrastructure for non-power purposes

Potential Hydropower 2015-2035

| Non-Powered Dams | | | | | | | | Capacity |
|---|----------|---------|-----------|--|-------|--------------------------------|----------------------|------------------|
| | FERC No. | Study # | Date Opr. | Developer | State | Project Information | River | MW |
| Identified in Survey and FERC Applications | | | | | | | | |
| Tongue River Dam | P-14602 | | N/A | State of Montana, DNR | MT | Add capacity | Ruby | 2.200 |
| Gibson Dam | P-12478 | | 2016 | Tollhouse Energy/Greenfield I.D. | MT | New project at existing dam | Sun | 15.000 |
| Mason Dam | P-12686 | | N/A | Baker County | OR | New project at existing dam | Powder | 3.400 |
| Pinto Dam | P-14380 | | 2019 | GCHPA* | WA | New project at existing dam | Columbia | 2.929 |
| Warm Springs Dam Hydro | P-13570 | | N/A | Warm Springs Irrigation District | OR | New project at existing dam | Malheur | 2.700 |
| Studies A-1, A-2, A-3 & FERC Applications | | | | | | | | |
| McKay Dam | P-14205 | A-3 | N/A | McKay Dam Hydropower | OR | New project at existing dam | Umatilla | 3.000 |
| Howard A. Hanson Dam | P-14594 | A-1, 2 | N/A | Howard A. Hanson Power, LLC | WA | New project at existing dam | Green | 5.000 |
| Scooteney Wasteway | P-14352 | A-3 | 2019 | GCHPA | WA | New project at existing dam | Columbia | 1.100 |
| Easton Diversion Dam | P-13850 | A-3 | N/A | Qualified Hydro 15 LLC | WA | New project at existing dam | Yakima | 1.200 |
| Blue River Dam | P-14381 | A-1 | N/A | Qualified Hydro 15 LLC | OR | New project at existing dam | Blue | 20.630 |
| NON-POWERED DAMS POTENTIAL | | | | | | | 10 Projects: | 57.159 |
| Conduit Exemptions & Hydrokinetic Projects | | | | | | | | |
| Studies B-1 and B-2 | | B-2 | N/A | Various irrigation districts | OR | 4 Conduit projects | Deschutes | 5.317 |
| Study B-3 | | B-3 | N/A | Various irrigation districts | OR | 2 Conduit projects | Deschutes | 1.579 |
| Study B-5 | | B-5 | N/A | Various canal sites | NW | 111 Conduit projects | NW Rivers | 34.000 |
| Survey Responses | | SR | N/A | Various canal/pipeline sites | NW | 15 Conduit projects | NW Rivers | 14.627 |
| Hydrokinetic Demo Project | | SR | 2015 | Hydrokinetic unit in canal | WA | 1 Hydrokinetic conduit project | Yakima | 0.01 |
| FERC apps. Issued | | FERC | N/A | Approved projects/canals | NW | 7 Conduit projects | NW Rivers | 2.099 |
| FERC approved NOIs | | FERC | N/A | Approved projects/canals | NW | 3 Conduit projects | NW Rivers | 6.065 |
| CONDUIT EXEMPTIONS AND HYDROKINETIC PROJECTS | | | | | | | 143 Projects: | 63.697 |
| Pumped Storage Projects | | | | | | | | |
| John Day Pool | | C-2 | N/A | Klickitat PUD | WA | Pumped storage | Columbia | 1,000.000 |
| Swan Lake | | C-2 | N/A | EDF Renewable Energy | OR | Pumped storage | Klamath | 600.000 |
| Banks Lake | | SR | 2019 | *Grand Coulee Hydroelectric Power Agency (GCHPA) | WA | Pumped storage | Columbia | 1,040.000 |
| PUMPED STORAGE PROJECTS | | | | | | | | 2,640.000 |

Potential Hydropower 2015-2035

| General Assessments | | | | | | | | Capacity |
|---|----------|---------|-----------|------------------------------|-------|----------------------------------|---------------------|-----------------|
| | FERC No. | Study # | Date Opr. | Developer | State | Project Information | River | MW |
| Identified in Survey and FERC Applications | | | | | | | | |
| Various canal or small reservoir | | E-3 | N/A | Various irrigation districts | OR | 30 Conduit exemptions | Oregon Rivers | 20.630 |
| Oak Springs | | SR | N/A | Oregon Dept. Fish/Wildlife | OR | Exemption at existing diversion | Deschutes | 0.085 |
| Unidentified Location | | SR | N/A | Portland General Electric | OR | New traditional project | Clackamas | 2.800 |
| Identified in FERC Applications only | | | | | | | | |
| Go with the Flow | P-14538 | FERC | N/A | Go with the Flow Hydropower | OR | Traditional hydro exemption | Umatilla | 1.200 |
| Weiser-Galloway | P14608 | FERC | N/A | Idaho Water Resources Board | ID | Traditional hydro project | Weiser | 60.000 |
| Two Girls Creek | P-14626 | FERC | N/A | Green Volt Hydro Inc. | OR | Traditional hydro | Two Girls Creek | 5.000 |
| GENERAL ASSESSMENTS | | | | | | | 35 Projects: | 89.7 |
| Upgrades | | | | | | | | |
| These projects were identified in the survey: | | | | | | | | |
| Blind report as requested | | SR | 2020 | Unidentified utility | WA | Add equipment | NW | 7.000 |
| Box Canyon Dam | P-2042 | SR | 2017 | Pend Oreille PUD | WA | Add equipment | Pend Oreille | 30.000 |
| North Wasco PUD Plant | P-7076 | OR | 2018 | North Wasco PUD | OR | Add capacity at Dalles Dam | Columbia | 5.000 |
| Shoshone Falls | P-2778 | ID | 2022 | Idaho Power Company | ID | Add capacity | Snake | 52.000 |
| Blind report as requested | | SR | 2015 | Unidentified utility | WA | Add energy | NW | 0.000 |
| Grand Coulee Dam | | SR | 2018+ | Bureau of Reclamation | WA | Add units 19-21 | Columbia | 200.000 |
| Boundary Dam | | SR | 2015-2035 | Seattle City Light | WA | Add equipment | Pend Oreille | 40.000 |
| Packwood Lake Hydro | | SR | 2015 | Energy Northwest | WA | Add energy | Cowlitz | 0.000 |
| Black Canyon Dam | | SR | 2018 | Bureau of Reclamation | ID | Add third unit | Payette | 12.000 |
| Hungry Horse Dam | | SR | 2019+ | Bureau of Reclamation | MT | Replace turbines/efficiency | Flathead | 0.000 |
| Lower Baker | | SR | N/A | Puget Sound Energy | WA | New powerhouse | | 30.000 |
| Little Falls | | SR | 2015-2018 | Avista Corporation | WA | 4 new units | Spokane | 4.000 |
| Nine Mile | | SR | 2015 | Avista Corporation | WA | Upgrade | Spokane | 8.000 |
| Palisades Dam | | SR | 2016 | Bureau of Reclamation | ID | Replace turbines +7.5 efficiency | Snake | 0.000 |
| | | | | | | | 14 Projects: | 388.000 |
| TOTAL OF ALL PROJECTS OF EACH TECHNOLOGY: | | | | | | | | 3,238.56 |

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