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Assessment of Opportunities for New United States Pumped Storage Hydroelectric Plants Using Existing Water Features as Auxiliary Reservoirs

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March 2014

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The term "candidate site" as used to refer to existing hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites, and paired waterbody sites in this report denotes only that these sites meet basic screening criteria for a pumped storage plant and are not located in a zone where hydropower development is unlikely. The term does not denote any knowledge of the feasibility of developing or of any resource owner or agency having jurisdiction over a site having an interest in developing or an intention to develop any site for the purpose of pumped storage hydroelectric generation. Actual feasibility of a site for development as a pumped storage hydroelectric plant must be determined by a site specific, comprehensive evaluation performed by the perspective developer.

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ABSTRACT

In this assessment of opportunities for new pumped storage hydroelectric plants performed in support of the U.S. Department of Energy Water Power Program, the characteristics of existing U.S. pumped storage hydroelectric plants (PSHs) are reviewed to define criteria for selecting candidate sites for new pumped storage plants. These characteristics are discussed and are presented in an appendix table. Candidate sites for new PSHs using existing U.S. hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites, and natural waterbodies as base plant locations and natural waterbodies as auxiliary reservoirs are identified using criteria based on existing PSHs. Characteristics of the candidate sites are discussed and their characteristic features are provided in the appendix tables and spreadsheets.

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SUMMARY

Hydroelectric pumped storage plants are valuable sources of electricity on demand in the U.S electric power industry. This technology provides the largest sources of stored energy. The benefits of pumped storage plants include: utilization of off-peak power to optimize generation from fossil and nuclear power plants, peak power delivery and load following, firming of variable source power, and black start capability.

The objective of the research reported in this document performed in support of the U.S. Department of Energy Water Power Program was to identify sites offering possible opportunities for new pumped storage plant development. The study was limited to the identification of sites in the conterminous U.S. at which an existing waterbody could serve as an auxiliary reservoir for a new plant. Sites where topography might offer development as an auxiliary reservoir or where a closed loop plant might be installed are subjects for future studies.

Four types of potential base plants were considered in the study: existing conventional hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites and paired waterbody sites. General characteristics of pumped storage hydroelectric (PSH) plants were obtained by examining the characteristics of existing U.S. pumped storage plants. These plants have two basic configurations – "pump-up" where the auxiliary storage reservoir is separate from and located above the base plant and "pump-back" where water is pumped back over the power plant dam into the main reservoir. The present assessment only considered the pump-up configuration.

With the exception of three existing pumped storage plants, all had reversible storage reservoirs (upper reservoirs) larger than 100 acres and most of these reservoirs were within two miles of the base plant. Use of these characteristics as screening criteria greatly reduced the populations of the viable waterbodies and potential base plant locations. The existing plants provided a full set of screening criteria including:

- Waterbody area
- Waterbody proximity
- Base plant capacity or capacity potential (except waterbody base plant sites)
- Elevation difference between the base plant and the waterbody.

An additional requirement for identifying candidate sites is that neither the base plant nor the potential auxiliary reservoir is in an exclusion zone defined by federal land use designations or environmentally sensitive zones.

Waterbodies of 100 acres or larger within the search radius of two miles were associated with the sites of each of the four types of potential base plants using geographic information systems (GIS) tools. Proximity and elevation difference attribute data were obtained for these associations. GIS tools were also used to identify excluded sites by virtue of the potential base plant or auxiliary reservoir being located in an exclusion zone. Additional screens for existing or potential base plant capacity and elevation difference were applied to identify candidate sites. In some cases, it was found that the potential auxiliary reservoir was located at a lower elevation than the potential base plant. These sites were retained as candidate sites, since reversible generation equipment might be located at the potential auxiliary reservoir using the potential base plant reservoir at the storage reservoir.

The study identified the following numbers of candidate sites for the four types of potential base plants:

- Hydroelectric plants – 31 sites
- Non-powered dams – 7 sites

- Greenfield hydroelectric plant sites – 97 sites
- Greenfield natural waterbody sites - 2,370 sites

The populations of existing hydroelectric plants, non-powered dams, and greenfield hydroelectric plant sites were limited by the criterion that the potential base plant should have a capacity or capacity potential of at least 10 MW. For this reason, data is provided for sites having potential base plant capacities or capacity potentials of 1 MW or greater in the appendices. Tables of characteristic data are provided for each set of sites. Distributions of the characteristics including capacity potential, proximity of the potential auxiliary reservoir to the potential base plant, and its elevation above or below the potential base plant are provided in the form of exceedance curves[2]. Satellite images of sample candidate sites are provided as are maps of the conterminous U.S. showing the locations of the candidate sites for each of the four types of potential base plants. Characteristic data for the existing PSH fleet are provided in Appendix A, potential PSH sites characteristic data for each of the four base plant types are provided in Appendices B through E, and a complete set of data for all the potential sites is provided in Appendix F.

The conclusion of this study is that there are a significant number of possible opportunities for new pumped storage plants that are worthy of further evaluation. At the same time, it is recognized that there may be use restrictions on the waterbodies that have been identified as potential auxiliary reservoirs that were not visible via the data used in the study that may make candidate sites unfeasible for development. The spatial distribution of the candidate sites is mostly limited to mountainous regions in the eastern and western regions of the country although some opportunities appear to be available in the mid-West and Southeast.

Recommendations are made for enhancing and expanding the present study including:

1. A feasibility study of the candidate sites identified in this study
2. Estimates of the reversible power capacity if the candidate sites are developed
3. An assessment of opportunities for pump-back pumped storage plants
4. An assessment of opportunities for new pumped storage at base plants where there isn't a nearby existing waterbody to serve as an auxiliary reservoir, but where local topography could possibly be developed to create an auxiliary reservoir
5. An assessment of sites for closed-loop pumped storage plants.
6. An assessment of shoreline sites for pumped storage plants using saltwater as the working medium.
7. Pumped storage assessments of Alaska and Hawaii
8. Feasibility assessments of the sites identified in the assessments described in Recommendations 3 through 7.
9. Providing site specific information from this assessment via the Virtual Hydropower Prospector GIS application on the Internet and other applications and databases

[2] In this report, site characteristics for a population of potential PSH sites (e.g., proximity and elevation difference between a base plant and an associated auxiliary waterbody) are presented in exceedance plots. The exceedance plots provide the percentage of the population as the abcissa value having a characteristic value equal to or greater than the corresponding ordinate value. The reader is cautioned that the sites corresponding to a percentage of the population in the exceedance curve for one characteristic are generally not exactly the same sites corresponding to the same percentage in the exceedance curve for another characteristic.

The report appendices provide:

A. A listing of the characteristics of the 43 existing U.S. pumped storage plants from which screening criteria for the study were derived

B. Characteristic data for the 75 opportunities for pumped storage plants at existing hydroelectric plants having installed capacities of 1 MW or greater organized by state, plant capacity, and reversible hydraulic head (elevation difference between waterbody and existing plant)

C. Characteristic data for the 27 opportunities for pumped storage plants at existing non-powered dams having capacity potentials of 1 MW or greater organized by state, non-powered dam capacity potential, and reversible hydraulic head

D. Characteristic data for the 97 opportunities for pumped storage plants at greenfield hydroelectric plant sites having capacity potentials of 10 MW or greater organized by state, conventional site capacity potential, and reversible hydraulic head

E. Characteristic data for the 127 opportunities for pumped storage plants at paired waterbody sites organized by state and reversible hydraulic head

F. Provides characteristic data for existing pumped storage plants and potential pumped storage sites associated with the four types of base plants including excluded sites in the form of an Excel workbook.

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FIGURES

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ACRONYMS

ACE	Army Corps of Engineers
USBR	Bureau of Reclamation
DOE	U.S. Department of Energy
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
	An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed.
INL	Idaho National Laboratory
NHD	National Hydrography Dataset
	A comprehensive set of digital spatial data that contains information about surface water features such as lakes, ponds, streams, rivers, springs, and wells. (http://nhd.usgs.gov)
NHD+	National Hydrography Dataset Plus
	An integrated suite of application-ready geospatial data products, incorporating many of the best features of the National Hydrography Dataset (NHD), the National Elevation Dataset (NED), and the National Watershed Boundary Dataset (WBD). NHDPlus includes a stream network based on the medium resolution NHD (1:100,000 scale), improved networking, feature naming, and "value-added attributes" (VAA). (http://www.horizon-systems.com/nhdplus/)
NID	National Inventory of Dams
	The National Inventory of Dams (NID) is a congressionally authorized database, containing characteristic data for approximately 84,000 dams in the U.S. and its territories. (http://www.agc.army.mil/fact_sheet/NID.pdf)
PSH	Pumped Storage Hydroelectric
USGS	U.S. Geological Survey

NOMENCLATURE

Annual mean flow rate	The statistical mean of the flow rates occurring at a particular location during the course of 1 year and may be the mean of annual mean flows for a number of years. The annual mean flow rates were provided by the National Hydrography Dataset Plus using unit runoff models based on gauged stream flow rates that occurred over a period of many years. The annual mean flow rate in any given year will usually differ from the predicted value .
Annual mean power	The statistical mean of the rate at which energy is produced over the course of 1 year. When based on the predicted annual mean flow rate, the predicted annual mean power is often the mean of the annual mean powers occurring over a period of many years. Such power values are denoted by units of "kWa" or "MWa". The actual annual mean power in a specific year will usually differ from the predicted value. A power rating of a hydroelectric plant based on electricity generation at this rate throughout the course of a year would produce the annual electricity generation of the plant; sometimes referred to as average megawatt power rating denoted in some usages by "MWa."
Attribute	Characteristic information about a feature such as name or owner, or data describing it such as length or voltage.
Auxiliary reservoir	A storage reservoir distinct from the principal reservoir behind a dam that provides a source of water for electricity generation at a pumped storage hydroelectric plant commonly referred to as the "upper reservoir". The usual configuration for an auxiliary reservoir is to be located at some distance from and at a higher elevation than the base plant. In some cases in this study, waterbodies at which a pumped storage powerhouse potentially could be installed that are located below what was considered to be the "base plant" thus using the "base plant" as the site of the upper reservoir.
Base plant	The installation at which the principal electro-mechanical equipment of a hydroelectric plant is or would be located. In this study, the starting point in the search for a natural waterbody meeting the pumped storage plant screening criteria being an existing hydroelectric plant, a non-powered dam at which power generation might be installed, or a greenfield site on a stream where a hydroelectric plant might be built. In the case of a paired waterbody site, it is the waterbody at the lower elevation.
Capacity	Typically refers to the design power rating of a hydroelectric plant and is denoted by units of "MW". Considering all U.S. hydroelectric plants, the average ratio of capacity to annual mean power is a factor of two.
Capacity factor	The ratio of the actual amount of electricity produced in a year to the ideal amount of electricity that would be produced in a year if a power plant operated throughout the year at its maximum power rating (nameplate capacity). Subsequently, the ratio of annual mean power to nameplate capacity having a typical value of 0.5 for U.S. hydroelectric plants.

Capacity potential	The estimated power rating (nameplate capacity) if a hydroelectric plant were to be installed at a given site based on estimates of flow rate and available hydraulic head at the site and assuming a typical hydroelectric plant factor of 0.5 to convert from estimated annual mean power potential to estimated capacity potential.
Exclusion zone	An area in which hydroelectric plant development is highly unlikely due to federal land use statutes or policies or environmental sensitivities.
Gross power potential	Ideal hydroelectric power based on an annual mean flow rate and an associated hydraulic head having units of MWa (average megawatts) in this report. The actual value in any given year will usually differ from the predicted value because of year to year variations in annual mean flow rate.
Hydraulic head	The elevation difference between the elevation of the headwater upstream of a dam and the elevation of the tailwater downstream of the dam. The elevation difference between the elevation of the water surface of an upper reservoir and the elevation of a base plant where electromechanical equipment including pump-turbines is housed.
Paired waterbodies	Two waterbodies meeting the proximity and elevation screening criteria used in this study that could provide pumped storage with pump-turbines installed at the lower elevation waterbody.
Pump-turbine	Hydraulic equipment capable of pumping water when driven by an electric motor and extracting kinetic energy from a water stream to generate electricity when water is passed through it in the opposite direction.
Reach	A stream segment often delineated by two successive confluences.
Reverse capacity or reversible capacity	The installed nameplate capacity power rating of a pumped storage plant for operation when the water supply is from the auxiliary reservoir and passed through pump-turbines operating as turbines.

Assessment of Opportunities for New United States Pumped Storage Hydroelectric Plants Using Existing Water Features as Upper Reservoirs

1. INTRODUCTION

Utility scale electricity supply systems are composed of multiple generating facilities that collectively must produce electricity equal to demand at all times. Demand varies on a long time scale diurnally, may peak during the daylight hours exceeding base load generation, and can vary on a short time scale at any time. With the inclusion of significant amounts of variable generation sources such as wind and solar power plants, the electricity supply system must not only accommodate varying load, but also varying generation on a short time scale.

Base load generators such as fossil fuel and nuclear power plants do not have the response times to vary generation rates for load following or to rapidly respond to peak demands. These functions are typically provided by gas turbine and hydroelectric plants (particularly pumped storage hydroelectric plants) that are capable of providing electricity on demand. Pumped storage plants not only are capable of providing electricity on demand, but are also the only technology capable of storing large quantities of potential energy, which can be converted into electrical energy. They typically use low cost electricity generated at night particularly from fossil and nuclear plants to power the pumped storage plant pumps. Water pumped to an upper reservoir is stored for later use in generating electricity to meet peak demands and to respond to load and generation fluctuations thus increasing the efficiency of the electricity supply system.

In addition to their valuable functional attributes, pumped storage plants also have long service lives. Of the 43 existing pumped storage plants found in this study (EIA 2013), the oldest (Rocky River plant in Connecticut) dates from 1929. The median age of the pumped storage fleet is 40 years old. The most recent installation took place in 2012 according to the EIA listing. Beginning in 2004, there has been an increasing interest in pumped storage development. At present, there are 56 preliminary permits for pumped storage plants having a total potential installed capacity of 46.6 GW (FERC 2013a). There are also 10 pending preliminary permits adding another 8.5 GW of potential installed capacity (FERC 2013b). Compared to the current installed capacity of 21.6 GW, development of new plants could double or even triple the pumped storage capacity. A more realistic view to the state of progress toward new development is provided by the fact that there are currently only two pending FERC licenses for new pumped storage projects having a total capacity of 2.3 GW (FERC 2013c).

A major driver for interest in new pumped storage projects is the need to firm generation from variable sources such as wind and solar. An interesting aspect of the fleet of proposed pumped storage plants is that many are not the "pump-up" or "pump-back" configurations[2] on natural watercourses like existing plants. Many are "closed-loop configurations involving upper and lower reservoirs not on a natural watercourse. In these systems the working water is recycled by pumping it to the upper reservoir from the lower reservoir and then using it to generate electricity as it passes through one or more turbines on its way to the lower reservoir. The increased interest in closed-loop systems in particular is most likely the perception that it will be easier to obtain an operating license, since they are not located directly on a water course and are low environmental impact.

The purpose of the present study is to facilitate additional exploration of opportunities for new pumped storage plants by identifying

[2] The pump-up configuration refers to the combination of a base plant and separate upper reservoir located some distance from and at a higher elevation than the base plant. The pump-back configuration refers to a plant at which water is pumped from the tailwater back up to the headwater of the dam thus the main plant reservoir is the upper reservoir.

existing conventional hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites, and waterbodies having waterbodies in close proximity that could serve as a reservoir in an open-loop, pump-up, pumped storage plant configuration. Sites are chosen by meeting criteria based on the characteristics of existing pumped storage plants. Sites for closed–loop plants were not assessed in this study. Technical and economic feasibility were not assessed beyond ensuring that potential natural waterbody reservoirs were greater in surface area than a minimum size (100 acres), were within a typical distance of the candidate site (2 miles), there was an elevation difference between the water body and the candidate site of more than a minimum difference (20 ft). Assessment of technical feasibility was also supported by ensuring that neither the candidate base plant site nor the potential auxiliary reservoir was in an exclusion zone based on federal land use designations or environmental sensitivities.

The report is organized by describing the characteristics of existing pumped storage plants as a basis for selecting screening criteria used to identify candidates for new pumped storage plant sites. The methodology by which potential sites were identified and were then screened to identify candidate sites is described. Assessment results are presented for each of the four base plant types. Based on this information, conclusions are drawn about opportunities for new pumped storage plants. Recommendations to upgrade and extend the assessment are made. Appendix A presents characteristic data for the 43 existing U.S. pumped storage plants. Appendices B through E present characteristic data for potential pumped storage plant sites where the base plant is an existing hydroelectric plant, non-powered dam, greenfield hydroelectric plant site, or a natural waterbody site, respectively. Appendix F is on a CD on the back cover of the report and contains databases that provide the data listed in Appendices A through E expanded to include sites for which either the base plant or the potential auxiliary reservoir is in an exclusion zone.

2. CHARACTERISTICS OF EXISTING PUMPED STORAGE PLANTS

The current U.S. fleet of operating pumped storage plants is comprised of 43 plants ranging in reverse generating capacity from 6 to 2,772 MW providing a total capacity of 21.6 GW (EIA 2013). These plants are located in 18 states. Considering the most recent dates of installation, these plants have dates of operation ranging from 1929 (Rocky River Plant in Connecticut) to 2012 (Lake Hodges Plant in California).

Hydroelectric plants offering reverse generation are of two basic types:

- Combination plants providing both conventional generation and reverse generation (e.g. Robert Moses Niagara – 2,515 MW – 13 conventional turbines, 240 MW – 12 reversible pump-turbines)
- Dedicated pumped storage plants providing only reverse generation (e.g. Bath County – 2,772 MW – 6 reversible pump-turbines)

Pumped storage plants have reversible pump-turbines installed that are powered to pump water to the upper reservoir, but are also turbines that drive generators for power production when supplied with water from the upper reservoir. Most pumped storage plants are configured as a base plant at or near which the generating equipment is housed and an upper reservoir some distance from and above the base plant (pump-up configuration). However, some pumped storage plants simply pump water from the tailwater to the headwater of the dam (pump-back configuration).

The capacity distribution of the existing pumped storage plants is shown in Figure 1. The distribution shows that a 30% of the population (12 plants) constitutes 70% of the total reversible capacity while 70% of the plant population (30 plants) has reverse generating capacities less than 500 MW. About a quarter of the plants (12 plants) have reverse capacities equal to or less than 100 MW.

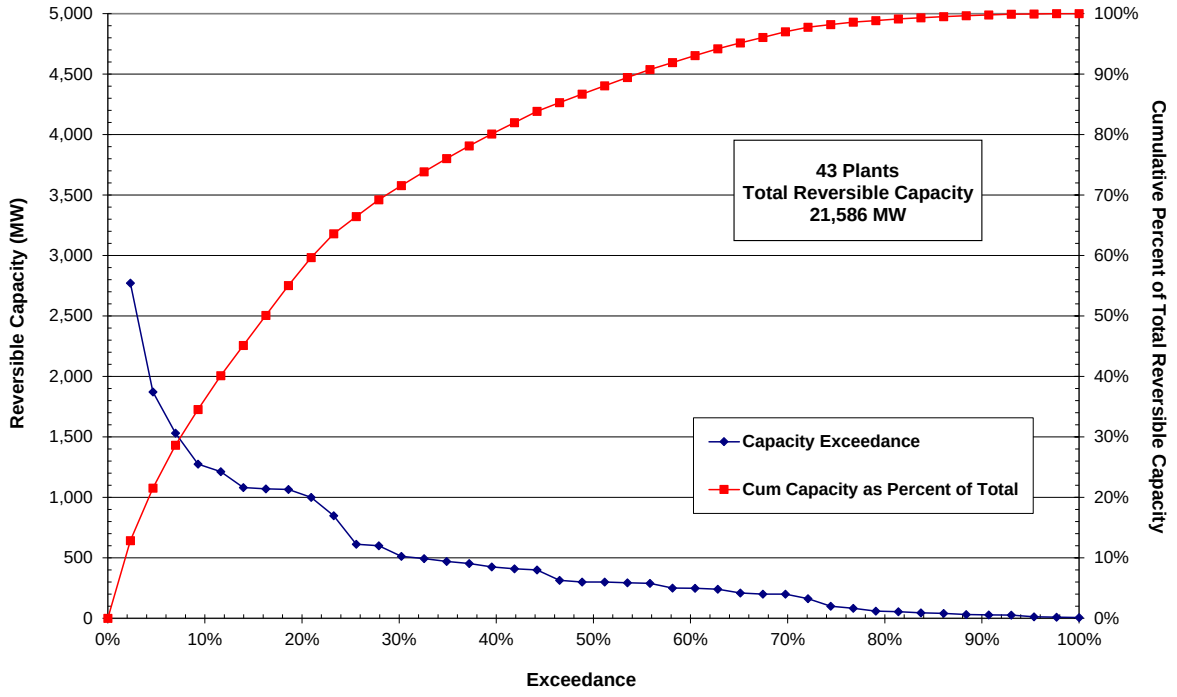

Figure 1. Reverse generating capacity distribution of existing U.S. pumped storage hydroelectric plants.

Plant characteristics of particular interest in identifying opportunity sites for new pumped storage plants are:

- Area of the upper reservoir
- Distance of the upper reservoir from the base plant
- Elevation difference between the base plant and upper reservoir.

These characteristics of the existing plants were determined using geographic information system (GIS) tools. Base plant location and reference elevation [provided by a 10 m digital elevation model (DEM)] were taken to be at plant headwater immediately upstream of the dam in most cases. The upper reservoir was identified as a waterbody in the National Hydrography Dataset (NHD 2011), which provided the surface area of the reservoir. The distance from the base plant to the near edge of the upper reservoir was provided by GIS software. The elevation of this near point was also provided by the DEM thus allowing the elevation difference to be calculated.

The area of the upper reservoirs as a function of reverse generating capacity is shown in Figure 2. With the exception of three plants (Richard B. Russell – Georgia – 26,653 acres, Big Bend Plant – South Dakota – 58,425 acres and Grand Coulee – Washington – 71,395 acres) the other 40 plants have upper reservoirs of less than 25,000 acres ranging from 24 to 24,000 acres. Twenty-five plants have upper reservoirs of less than 3,000 acres with only three plants having upper reservoirs of less than 100 acres.

The proximity of the near point of the upper reservoir to the base plant reference location versus reverse generating capacity is shown in Figure 3. With the exception of six plants, the upper reservoirs are within two miles of the base plant. Thirty-two plants have upper reservoirs that are less than a mile from the base plant including 17 pump-back plants where the base plant reservoir is the upper reservoir (proximity distance 0 ft to the chosen reference location).

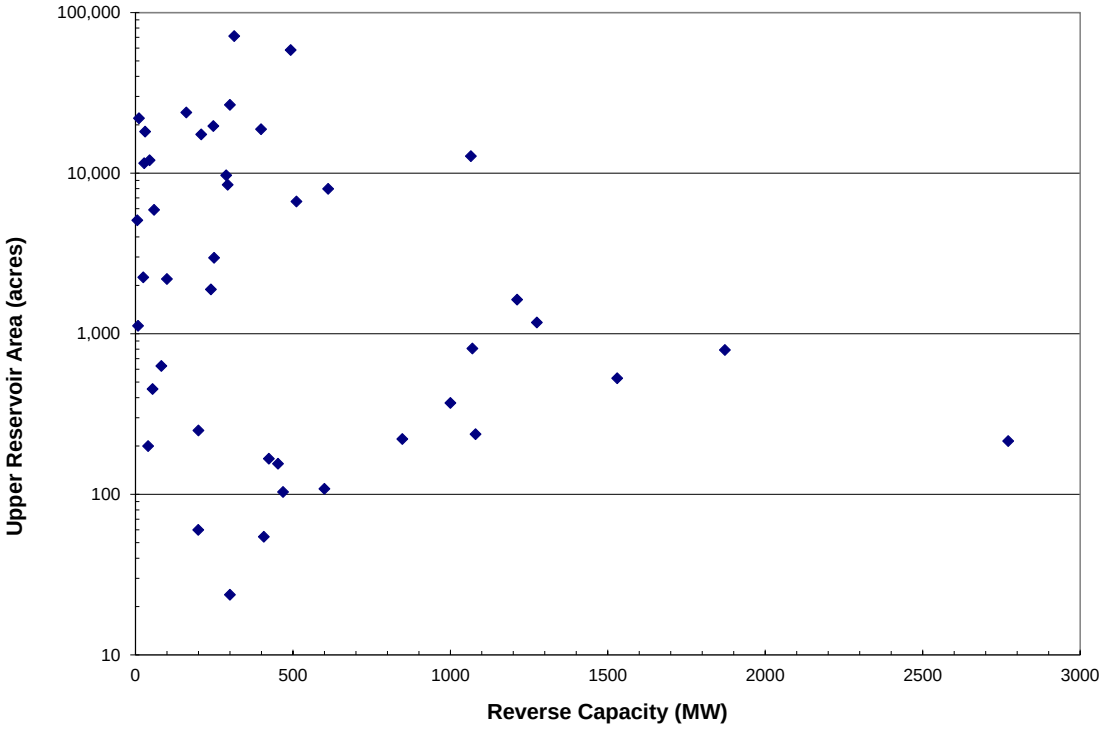

Figure 2. Area of U.S. pumped storage plant upper reservoir versus plant reverse capacity.

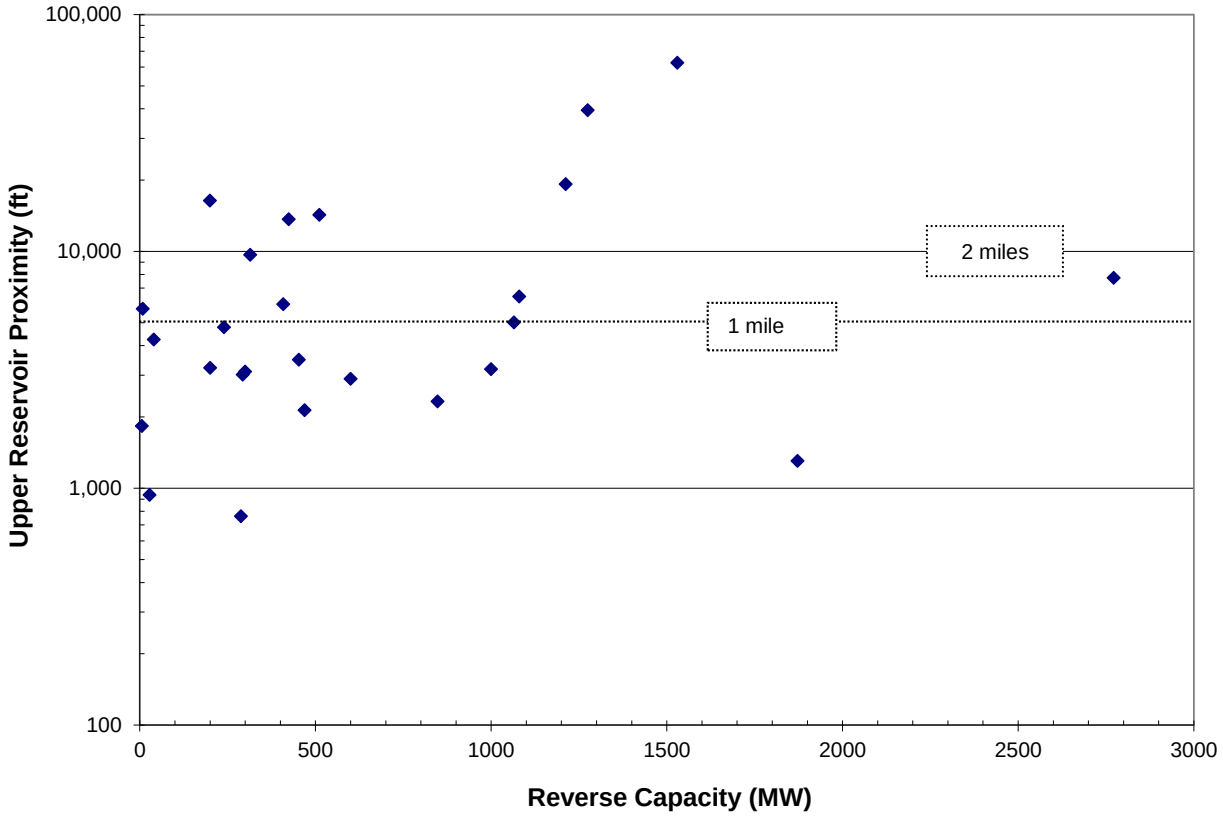

Figure 3. Distance of upper reservoir from U.S. pumped storage base plant versus plant reverse capacity.

The elevation difference between the reference elevation of the headwater and the mean elevation of the water surface of the upper reservoir for pump-up configured plants or the elevation difference between the tailwater and the headwater for pump-back configured plants versus reverse capacity is shown in Figure 4. The elevation differences range from 22 to 1,645 ft. With the exception of seven plants, the elevation difference is less than 1,000 ft for the other 36 plants as shown in Figure 4. A majority of the lower elevation difference plants are the 17 pump-back plants having elevation differences ranging from 22 to 402 ft. with all but four pump-back plants having elevation differences less than 200 ft. The elevation differences for the 26 pump-up plants range from 115 to 1645 ft with the median elevation difference being 746 ft.

Characteristic information about the 43 existing pumped storage plants is presented in Appendix A.

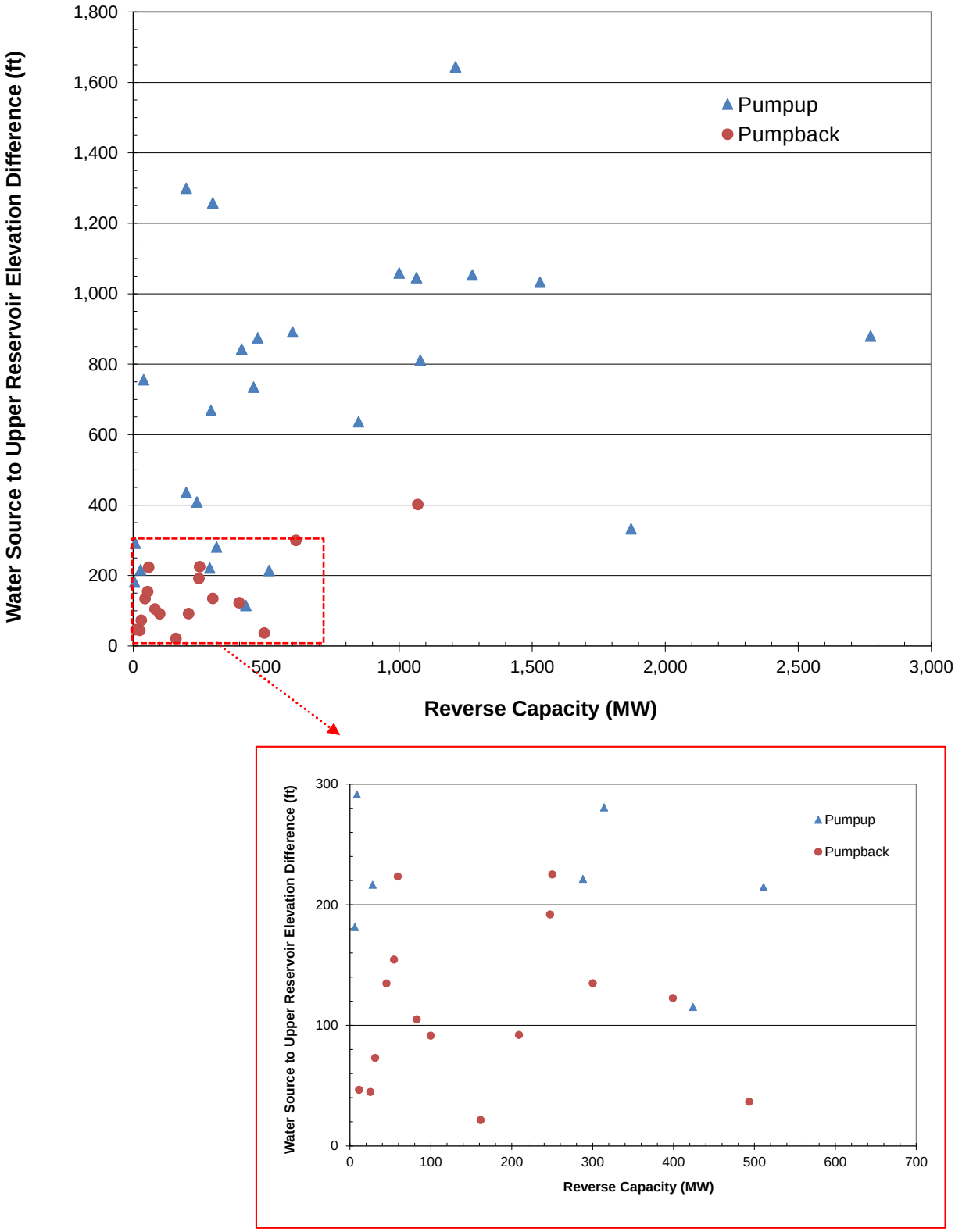

Figure 4. Elevation difference between water source for pumping and upper reservoir water surface versus reverse capacity of U.S. pumped storage hydroelectric plants.

3. TECHNICAL APPROACH

The technical approach for identifying existing hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites, and paired natural waterbodies that are candidate sites for a new pumped storage plant was to identify which of these sites include an existing waterbody near them that could serve as an auxiliary reservoir based on screening criteria. Derivation of the screening criteria and the application of the screening criteria to identify candidate sites of each type of site is described.

3.1 Derivation of Screening Criteria

Based on the characteristic data in the previous section, four basic screening criteria were defined for use in identifying potential new pumped storage sites:

- Existing or potential conventional capacity of the base plant
- Area of the potential upper reservoir
- Proximity of the upper reservoir to the base plant
- Elevation difference between the base plant and the near point of the upper reservoir boundary.

The base plant capacity criterion was chosen to be a minimum of 10 MW of capacity based on the characteristics of existing combination pumped storage plants (plants having both conventional and reversible turbines) and the rationale that existing conventional hydroelectric plants or potential sites should have at least this much capacity or capacity potential indicative of sufficient water supply and local topographic relief. Selection of this lower limit criterion is based on Figure 5, which shows combination plants' reverse capacity plotted against their conventional capacity. This figure shows that only one of the 13 plants had a conventional capacity less that 20 MW.

The limiting criterion for the area of a potential upper reservoir is a surface area of 100 acres or greater. This criterion is based on the data in Figure 2, which shows that only three of the 43 existing pumped storage plants have

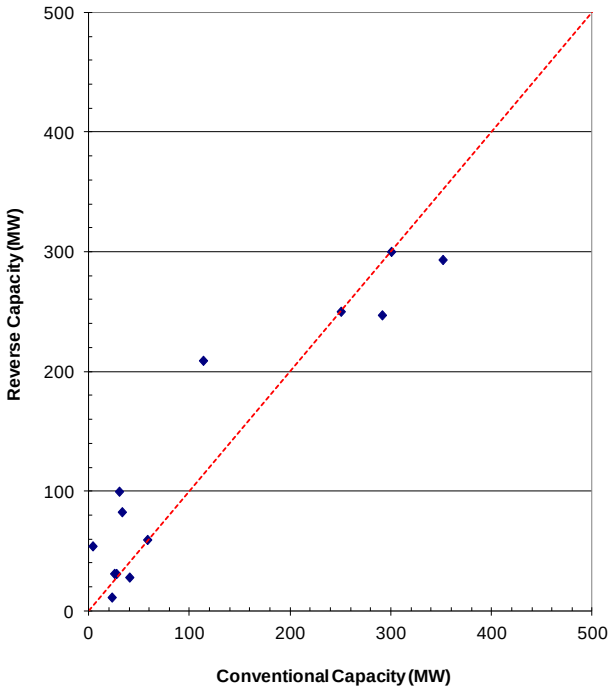

Figure 5. Combination pumped storage plant reverse capacity versus conventional capacity.

upper reservoirs with surface areas less than 100 acres. This limitation reduced the number of waterbodies that might be upper reservoirs from 5.7 million in the National Hydrography Dataset (USGSa 2011) that provided the waterbody dataset for the assessment to 28,581 waterbodies that could potentially be auxiliary reservoirs. This reduction greatly reduced the processing time needed to search for candidate upper reservoirs.

The proximity criterion of the maximum distance between the base plant reference location and the near point of the shoreline of a potential upper reservoir is two miles. This criterion is based on data in Figure 3, which shows that only six of the 43 existing plants had reservoirs more than two miles from the base plant[4].

The elevation criterion of the minimum elevation difference between the base plant reference location and the surface of the potential upper reservoir is 20 ft. This criterion is based on the data in Figure 4, which shows that one of the 43 existing plants had an elevation difference of 22 ft. The choice of this very low limit may be viewed as ultra conservative in view of the fact that the lowest elevation difference for an existing pump-up pumped storage plant is 115 ft. However, this low limit was chosen considering the possibility of a future interest in small pumped storage plants particularly for firming variable energy sources with relatively low capacities.

In summary, the basic criteria used to identify sites for new pumped storage plants based on the characteristics of existing pumped storage plants are:

- Base plant capacity ≥ 10 MW
- Upper reservoir area ≥ 100 acres
- Base plant to upper reservoir proximity ≤ 2 mi
- Base plant to upper reservoir elevation difference ≥ 20 ft.

[4] The plant with the maximum distance between the supply and receiving waterbodies is Castaic Pumped Storage Plant which pumps water from Castaic Lake to Pyramid Lake seven and a half miles away.

3.2 General Approach to Identifying New Pumped Storage Sites

Candidate locations for new pumped storage sites were identified by first using geographic information system (GIS) tools to identify waterbodies having surface areas of 100 acres or greater within a two mile search radius of an existing hydroelectric plant, non-powered dam, greenfield hydroelectric plant site, or natural waterbody having a surface area of 100 acres or greater. The proximity of waterbodies within the search radius and their elevation above the potential base plant were then obtained using GIS tools. Subsequent application of the base plant capacity or capacity potential (except in the case of a natural waterbody base plant) and elevation difference criteria described above led to the identification of possible sites for new pumped storage plants.[5] It should be noted that it was possible for a base plant to have more than one waterbody meet the criteria for a viable potential auxiliary reservoir.

It was found that many of the potential base plants had associated waterbodies meeting all the screening criteria with the exception that the waterbody was below instead of above them. It was reasoned that these potential auxiliary reservoirs should not be discounted, since they might serve as a water source and location of a pump-turbine power house. The elevation criterion was thus modified to be:

- Absolute value of the base plant to auxiliary reservoir elevation difference ≥ 20 ft

A final step in the process of identifying candidate sites was to intersect potential base plant locations and waterbodies identified as potential auxiliary reservoirs with data layers containing exclusion zones based on federally designated land and water use and environmentally sensitive areas (Hall et al 2006). Potential base plant locations or associated waterbodies located within these zones were considered to be excluded from consideration as candidate sites for a new pumped storage plant. Land use restrictions and environmental sensitivities beyond those visible

[5] The potential capacity criterion was not applicable for paired waterbodies sites.

to the project may make additional sites unfeasible for development.

3.3 Existing Conventional Hydroelectric Plants

The locations of 1,500 conventional hydroelectric plants were visually verified using GIS tools and satellite imagery. These plants included all of the higher capacity plants. The general approach described in the previous subsection was applied to identify plants having potential auxiliary reservoirs meeting the screening criteria.

In some cases, the automated search techniques resulted in the identification of the reservoir associated with an existing hydroelectric plant being identified as a potential auxiliary reservoir. They were detectible by the proximity distance being comparatively small. To eliminate these cases, an additional criterion was applied requiring that the proximity of the potential auxiliary reservoir to the base plant be at least 1,000 ft. This reduced the number of candidate plants to a reasonable number for visual verification, which was done to ensure that the potential auxiliary reservoir was not already associated with the base plant.

The final version of the screening criteria was thus:

- Base plant capacity $\geq$ 10 MW
- Potential auxiliary reservoir area $\geq$ 100 acres
- Base plant to potential auxiliary reservoir proximity >1000 ft and $\leq$ 2 mi
- Absolute value of the base plant to potential auxiliary reservoir elevation difference $\geq$ 20 ft

3.4 Non-powered Dams

INL performed a gross power potential of over 50,000 non-powered dams (Hall and Lee 2011). Of these 50,000, 653 dams were found to offer potential capacities of 1 MW or greater. These dams were investigated to identify candidate sites for new pumped storage plants using the process described above in Subsection 3.2 and the screening criteria listed in Subsection 3.3

3.5 Greenfield Hydroelectric Plant Sites

The stream reaches in the National Hydrography Dataset Plus (NHD+) (USGSb 2011) were used as a population of possible sites for new pumped storage sites in the conterminous U.S. (48 states). Reaches containing an existing hydroelectric plant or non-powered dam were eliminated from the reach population. The power potential of each stream reach was estimated using the elevation change from the upstream to the downstream end of the reach as the hydraulic head and reach average flow rate listed in the NHD+ dataset (unit runoff value) as inputs to the equation:

$$P = Q * H / 11.8$$

where

P = annual average power in kWa

Q = annual average flow rate in cfs

H = hydraulic head (elevation difference) in ft.

The resulting annual average power values were converted to potential capacity values by assuming a typical hydropower capacity factor of 0.5. (Hall, Hunt, Reeves, Carroll 2003)

Reaches having capacity potentials of 1 MW and greater were investigated to identify potential sites for new pumped storage plants using the process described above in Subsection 3.2 and the screening criteria listed in Subsection 3.3. The reference location for a reach was the downstream end of the reach where a base plant might be installed.

An additional issue encountered in the greenfield hydroelectric plant site assessment was the fact that in some instances, the base plant stream reach was actually within the boundary of the associated waterbody. This is an artifact of the NHD+ dataset. Such reaches were eliminated from consideration by intersecting the reach dataset with the waterbody dataset.

3.6 Paired Waterbodies

Unlike the previous three categories of sites that were originally identified as the site of an existing or potential conventional hydroelectric plant, it was recognized that a natural waterbody could be a candidate site of a pumped storage plant if there was another natural waterbody meeting the screening criteria near it. The 28,581 waterbodies having surface areas of 100 acres or greater (thus meeting the surface area assessment criterion) were therefore assessed using GIS analysis to determine pairs of waterbodies meeting the 2 mi proximity criterion. Pairs of waterbodies meeting this criterion were further screened to determine whether they met the minimum elevation criterion. For paired waterbodies meeting the screening criteria, the waterbody at the lower elevation was considered to be the potential base plant location where the electro-mechanical equipment would be located. The base plant capacity criterion was not applicable in the paired waterbody assessement. Waterbody pairs meeting the screening criteria were examined to determine whether one or both of the waterbodies is located in an exclusion zone as discussed in Subsection 3.2. Location of one of the waterbodies in an exclusion zone, disqualified the waterbody pair as a candidate site for a new pumped storage plant.

4. RESULTS

Sites for new pumped storage plants using existing hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites, and greenfield paired waterbodies sites identified as candidate sites in the assessment process are discussed in following subsections. The potential new plants have been assessed only for the pump-up configuration (storage reservoir spatially separated from the base plant location), but not for the pump-back configuration (water pumped back from the tailwater to the headwater of a dam).

Candidate sites have been included for which the waterbody that might become a second reservoir is at an elevation lower than the assessed base plant. Sites with this configuration have been included as candidate sites, since it is possible that the pump-turbine powerhouse might be located at the waterbody below the base plant with the upper reservoir being located behind the base plant dam. These sites were included only for further consideration, since questions like whether the base plant dam has sufficient freeboard or would have to be modified, unacceptable additional inundation would occur, and water level fluctuations due to pumped storage operations would be acceptable were not researched.

4.1 Existing Hydroelectric Plants

Of the 1,500 existing hydroelectric plants that were assessed, 31 were found to meet the screening criteria described in the prior section with the additional criterion that neither the dam nor potential auxiliary reservoir is located in an exclusion zone defined by federal land use designations or environmentally sensitive areas. These sites were visually inspected to ensure that the identified potential auxiliary reservoir for the pumped storage plant was not the reservoir associated with the existing plant. They are located in 14 states: Alabama, Arkansas, California, Massachusetts, Michigan, North Carolina, New York, Oregon, Pennsylvania, South Carolina, Texas, Vermont, Virginia, and Washington. Characteristic data for these potential projects are provided in Table 1. Most of the sites are configured with the potential auxiliary reservoir for the pumped storage plant located at a higher elevation than the base plant; however, nine of the sites are configured with the potential auxiliary reservoir below the existing plant.

Relaxation of the base plant capacity criterion to 1 MW or greater results in a total of 75 candidate sites. All of these sites were visually verified as being configured for pump-up. The characteristics of these all 75 sites are provided in Appendix B where they are presented sorted by state, nameplate capacity, and the elevation difference between the dam site and the potential auxiliary reservoir. For 26 of these plants, the potential auxiliary reservoir for the pumped storage plant is located at an elevation below the plant as detailed in Table B-3.

There may be as many as 48 additional potential sites: 31 of which meet all the screening criteria and 17 of which meet all the screening criteria with the exception of the 10 MW base plant capacity criterion. However, at these sites either the existing plant or in most cases, the potential auxiliary reservoir is located in an exclusion zone. These sites were not validated by visual inspection, but are included in addition to the 75 candidate sites in Appendix F.

Distributions of characteristic data for the 31 hydroelectric plants having nameplate capacities of 10 MW or greater identified as potential sites for new pumped storage plants are presented in Figures 6 through 8. The distribution of the nameplate capacity of these plants (Figure 6) shows that 25% of the plants have capacities greater than the 50 MW and 60% of the plants have capacities greater than 20 MW. The distribution of elevation difference between the existing hydroelectric plant and the associated potential reservoir (Figure 7) shows that 65% of the plants have potential reservoirs located above the plant and 35% plants have potential auxiliary reservoirs located at elevation below the plant. Elevation differences range from 1,269 ft above the plant to 377 ft below the plant. About 55% of the plants have elevation

Table 1. Candidate existing hydroelectric plants as potential sites for pump-up configuration pumped storage plants.

	Hydroelectric Plant Characteristics							Potential Reservoir Characteristics				
	State	Project Name	Owner Name	River	Nameplate Rating (MW)	Base Plant Elevation (MSL) (ft)	Reservoir	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Plant to Waterbody (ft)
1	CA	PARKER	BUREAU OF RECLAMATION	COLORADO R	120	417	LAKE HAVASU	Gene Wash Reservoir	200	739	7,180	321
2	OR	LOOKOUT POINT	CORPS OF ENGINEERS	M FK WILLAMETTE R	120	724	LOOKOUT POINT LAKE	Fall Creek Lake	1,716	841	8,744	117
3	AR	ARKANSAS L&D 2	ARKANSAS ELEC COOP CORP	ARKANSAS R	120	193	POOL 2		619	152	9,271	-42
4	PA	HOLTWOOD	PPL Holtwood, LLC	SUSQUEHANNA R	108	154	LAKE ALDRED		811	501	6,004	347
5	CA	EXCHEQUER	MERCED IRRIG DIST	MERCED R	80	476	EXCHEQUER RES		296	402	6,490	-74
6	TX	DENISON	CORPS OF ENGINEERS	RED R	70	546	LAKE TEXOMA	Randell Lake	242	616	6,576	70
7	CA	DONNELLS	OAKDALE & SAN JOAQUIN IRR DIST	M FK STANISLAUS R	54	3,460	DONNELLS RES	Beardsley Lake	704	3,408	1,000	-52
8	MA	CABOT	NORTHEAST GENERATION CO	CONNECTICUT R	51	132	TURNERS FALLS POND		229	180	9,279	48
9	SC	DEARBORN	DUKE POWER CO	CATAWBA R	45	330	DEARBORN-GT FALLS RE	Wateree Lake	11,756	257	7,574	-72
10	AL	HOLT L&D	ALABAMA POWER CO	BLACK WARRIOR R	40	168	HOLT LAKE	Lake Harris	139	203	6,726	35
11	PA	WALLENPAUPACK	PPL Holtwood, LLC	WALLENPAUPACK CR	40	850	LAKE WALLENPAUPACK	Tinkwig Lake	117	1,101	8,919	251
12	CA	CHICAGO PARK	NEVADA IRRIG DIST	CHICAGO PARK FLM(BEAR	40	2,289	CHICAGO PARK FOREBAY	Rollins Reservoir	777	2,193	5,562	-95
13	VT	HARRIMAN	USGEN NEW ENGLAND, INC	DEERFIELD R	34	1,320	HARRIMAN RES	Sadawga Lake	160	1,669	8,908	348
14	MA	COBBLE MOUNTAIN	WESTERN MASS ELECTRIC CO	LITTLE R	33	565		Cobble Mountain Reservoir	1,034	954	6,788	390
15	NY	BENNETTS BRIDGE	ERIE BOULEVARD HYDROPOWER LP	SALMON R	29	937	Salmon River Reservoir		159	660	9,596	-276
16	WA	ELECTRON	PUGET SOUND PWR AND LT CO	PUYALLUP R	26	709	ELECTRON RES	Lake Kapowsin	497	585	6,790	-125
17	NY	NEVERSINK	CENT HUDSON G & EL CORP	NEVERSINK DIV	25	913		Rondout Reservoir	2,046	839	4,544	-74
18	SC	GREAT FALLS	DUKE POWER CO	CATAWBA R	24	297	DEARBORN-GT FALLS RE	Wateree Lake	11,756	257	7,836	-40
19	NC	THORPE	Duke Energy Corporation	W FK TUCKASEGEE R	22	2,295	THORPE RES	Cedar Cliff Lake	108	2,327	10,424	32
20	CA	DE SABLA	PACIFIC GAS & ELECTRIC CO	BUTTE CR	18	1,287	DE SABLA FB	Paradise Lake	149	2,556	9,491	1,269
21	NY	SCHAGHTICOKE	ERIE BOULEVARD HYDROPOWER, LP	HOOSIC R	16	248	SCHAGHTICOKE RES		1,709	391	8,927	143
22	NY	BROWNS FALLS	ERIE BOULEVARD HYDROPOWER LP	E BR OSWEGATCHIE R	15	1,096	BROWNS FALLS RES		144	1,346	5,081	251
23	NY	BLAKE FALLS	ERIE BOULEVARD HYDROPOWER, LP	RAQUETTE R	14	1,195	BLAKE FALLS RES	Joe Indian Pond	357	1,299	9,041	104
24	CA	FORKS OF BUTTE	Hypower, Inc	BUTTE CR	13	1,299	Butte Creek Diversion	Paradise Lake	149	2,556	9,662	1,257
25	OR	STONE CREEK	EUGENE WATER & ELECTRIC BOARD	OAK GROVE FK	12	3,077		Timothy Lake	1,400	3,231	3,398	154
26	WA	KOMA KULSHAN	KOMA KULSHAN ASSOC	SANDY CR	12	1,105		Baker Lake	4,745	729	8,506	-377
27	NY	VISCHER FERRY	NEW YORK POWER AUTHORITY	MOHAWK R	12	203	Vischer Ferry		359	271	6,075	68
28	MA	FIFE BROOK (BEAR SWAMP LWR)	USGEN NEW ENGLAND, INC. & BEAR SWAMP GENERATING	DEERFIELD R	11	886	FIFE BROOK RES	Bear Swamp Upper Reservoir	108	1,600	2,414	713
29	VA	PINNACLES(TOWNES DAM)	DANVILLE, CITY OF	DAN R	11	2,120	PINNACLES	Talbott Reservoir	140	2,531	7,971	410
30	NY	GRANBY (NEW)	ERIE BOULEVARD HYDROPOWER, L.P.	OSWEGO R	10	307	FULTON LWR DAM 4 RES	Lake Neatahwanta	776	368	4,433	61
31	MI	MC CLURE	UPPER PENISULA POWER CO (UPPCO)	DEAD R	10	795			110	657	8,522	-138

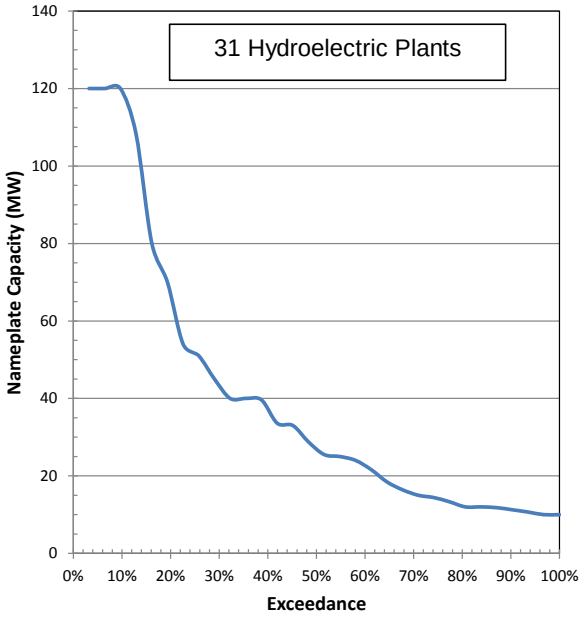

Figure 6. Distribution of the nameplate capacity of exiting 10 MW or greater hydroelectric plants that are potential pumped storage plants.

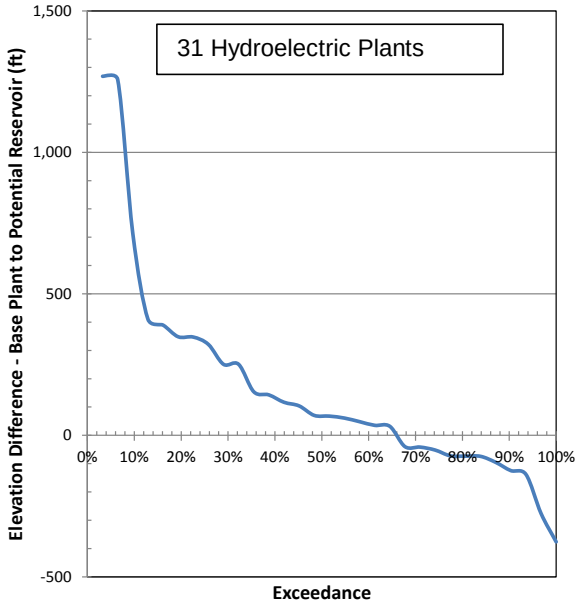

Figure 7. Distribution of the elevation difference between exiting 10 MW or greater hydroelectric plants that are potential pumped storage plants and their associated potential reservoir.

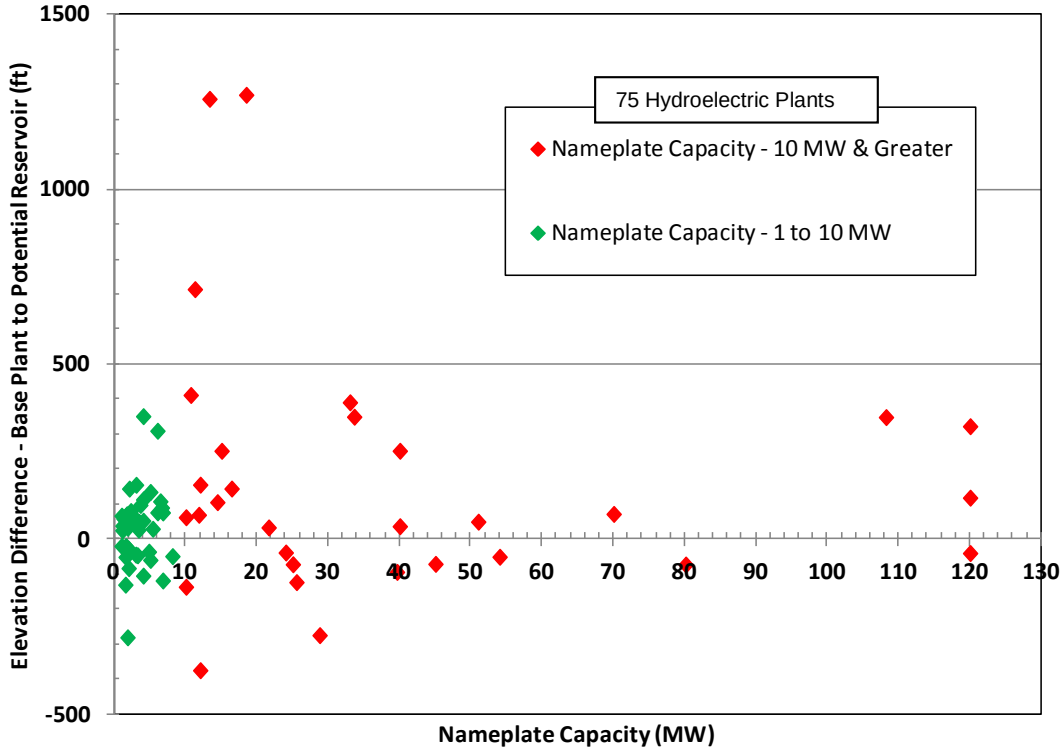

Figure 8. Elevation differences between 1 MW or greater hydroelectric plants that are potential pumped storage plants and their associated potential reservoir versus existing hydroelectric plant nameplate capacity.

differences to the associated potential auxiliary reservoir greater than 100 ft – 45% having the potential auxiliary reservoir above them and 10 % having the potential auxiliary reservoir below them. Elevation difference versus nameplate capacity (Figure 8) shows that the great majority of plants having nameplate capacities of 10 MW or greater have elevation differences in the range of -150 to +400 ft. For the most part, the plants with the higher elevation differences have capacities of 35 MW or less. The great majority of the plants having capacities less than 10 MW have elevation differences in the range from -150 to +150 ft., which by itself does not disqualify at least some of the plants considering that some existing pumped storage plants have a little as 22 ft of reversible hydraulic head at pump-back plants.

Satellite images of two of the 31 sites meeting the screening criteria are shown in Figures 9 and 10 – both with a nameplate capacity of 120 MW. The plant shown in Figure 9 owned by the Bureau of Reclamation is in California and the plant shown in Figure 10 owned by the Army Corps of Engineers is in Oregon. While these plants and their associated potential upper reservoirs meet the criteria to be candidates for new pumped storage plants used in this assessment, there may be factors that make such development unfeasible, which is also true of the other identified candidate sites.

A map showing the locations of the 75 sites associated with plants ranging in nameplate capacity from 1 to 120 MW is presented in Figure 11. Characteristic data for all 123 sites (75 non-excluded sites and 48 having an exclusion) are provided in Appendix F.

Figure 9. Potential pumped storage configuration at Parker Dam Hydroelectric Plant in California.

Figure 10. Potential pumped storage configuration at Lookout Point Hydroelectric Plant in Oregon.

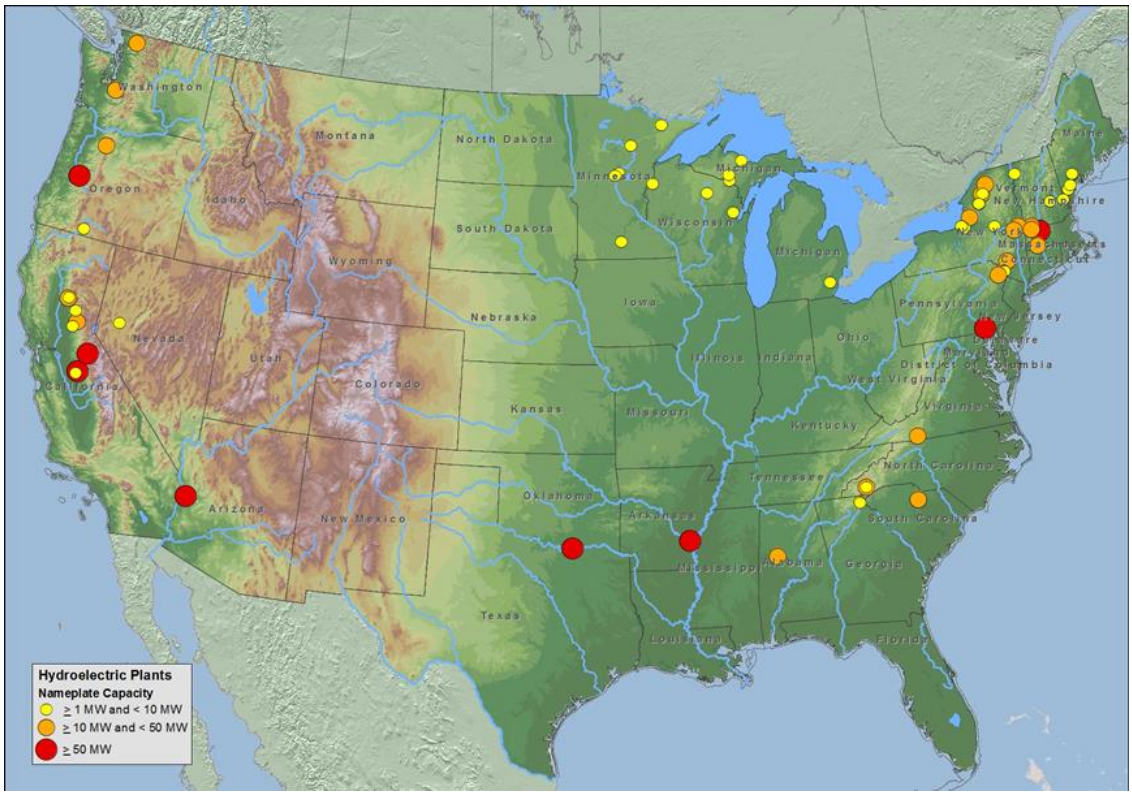

Figure 11. Potential new pumped storage plant sites using existing hydroelectric plants.

4.2 Non-powered Dams

Seven out of 653 non-powered dams having capacity potentials of 10 MW or greater met the screening criteria for a potential new pumped storage plant with neither the dam nor potential auxiliary reservoir being located in an exclusion zone. They are located in four states: California, Kentucky, New Hampshire, and Texas. The characteristic data for these dams is listed in Table 2. Five of the sites are configured with the potential auxiliary reservoir for the pumped storage plant located at a higher elevation than the base plant, and two of the sites are configured with the potential auxiliary reservoir below the existing dam.

Relaxation of the base plant capacity criterion to 1 MW or greater results in a total of 27 candidate sites. These sites were visually verified as being configured for a pump-up pumped storage plant. The characteristics of these 27 sites are provided in Appendix C where they are presented sorted by state, non-powered dam capacity potential, and the elevation difference between the dam and the potential auxiliary reservoir. The potential reservoir for the pumped storage plant is located at a lower elevation for 11 of the dams as detailed in Table C-3.

There are an additional 10 non-powered dams that meet the screening criteria with the exception of the 10 MW base plant capacity criterion, but have either the non-powered dam or the potential auxiliary reservoir in an exclusion zone. These sites were validated by visual inspection. Characteristic data for all 37 sites is provided in Appendix F.

Distributions of characteristic data for the 7 non-powered dams having capacity potentials of 10 MW or greater identified as being potential sites for new pumped storage plants are presented in Figures 12 through 15. The distribution of the potential capacity of these non-powered dams (Figure 12) shows that all have potential capacities of 20 MW or greater and three have capacity potentials greater than 35 MW. The distribution of the flow rate at the non-powered dams (Figure 13) shows that the dams are not located on the largest U.S. rivers with the seven candidate dams having annual average flow rates ranging from 1,441 to 4,418 cfs. The distribution of elevation difference between the non-powered dam and the associated potential auxiliary reservoir (Figure 14) shows the five have potential auxiliary reservoirs located above the dam with elevation differences ranging from 29 to 183 ft. and two have potential auxiliary reservoirs located at elevation below the dam with elevation differences ranging from 21 to 29 ft. Elevation difference versus potential capacity (Figure 15) shows that four non-powered dams having potential capacities of 10 MW or greater have elevation differences of about 80 ft and greater. The dams having capacity potentials less than 10 MW have elevation differences from their associated potential auxiliary reservoir in the range from - 155 to +224 ft with none of them being below the lowest value of existing pumped storage plants of 22 ft.

Satellite images of two of the seven non-powered dam sites meeting the screening criteria are shown in Figures 16 and 17 – one in New Hampshire with a conventional capacity potential of 42 MW and the other in Kentucky with a conventional capacity potential of 24 MW, respectively. A map showing the locations of the 27 sites associated with non-powered dams ranging in capacity potential from 1 to 42 MW is presented in Figure 18.

Table 2. Candidate non-powered dams as potential sites for pump-up configuration pumped storage plants.

	Non-Powered Dam Characteristics									Potential Reservoir Characteristics			
	NIDID	Dam Name	Owner	State	River	NID Height (ft)	Hydraulic Hgt (ft)	MAFLOWU (cfs)	Potential Capacity Based on Hydraulic Hgt or 70% NID HGT (MW)	Name	Area (acres)	Proximity Dam to Waterbody (ft)	Elevation Difference Dam to Waterbody (ft)
1	NH00003	FRANKLIN FALLS DAM	CENAE	NH	PEMIGEWASSET RIVER	112	116	2,215	42	Webster Lake	606	3,550	80
2	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Forebay	563	9,662	82
3	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Diversion Pool	298	3,167	76
4	KY03005	GREEN RIVER LOCK & DAM 5	CELRL	KY	GREEN RIVER	32	32	4,418	24	Shanty Hollow Lake	109	5,942	29
5	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		254	9,762	-21
6	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		408	5,795	-29
7	CA00260	Goodwin	Tri-Dam Project	CA	Stanislaus Rv	81	101	1,441	20	Tulloch Reservoir	938	8,460	183

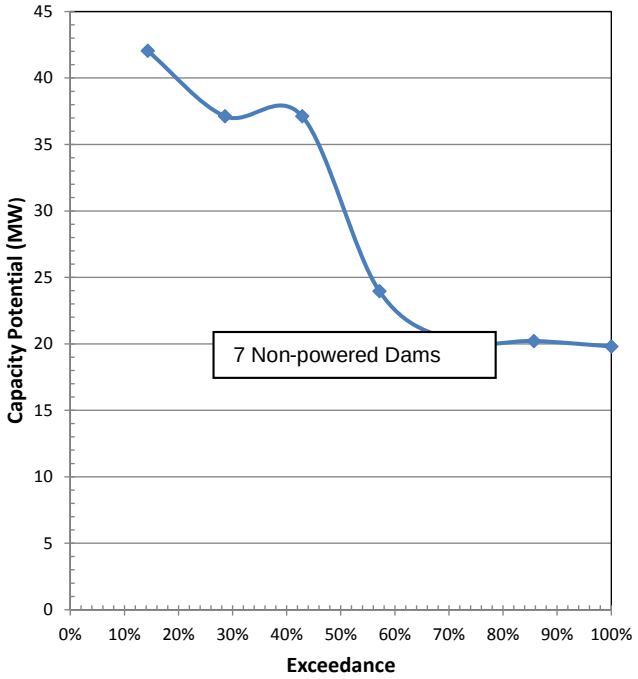

Figure 12. Distribution of conventional capacity potential of non-powered dams that are candidate pumped storage plants.

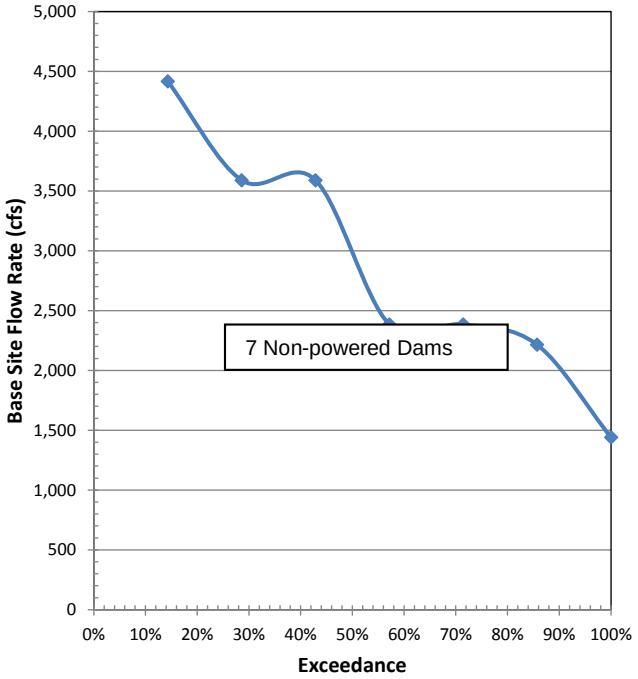

Figure 13. Distribution of flow rates at non-powered dams that are candidate pumped storage plants.

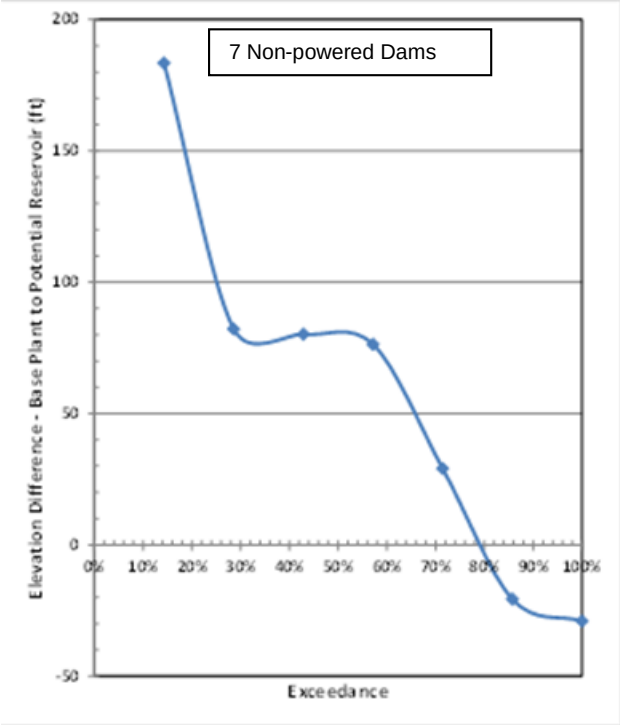

Figure 14. Distribution of the elevation difference between non-powered dams that are candidate pumped storage plants and their associated potential auxiliary reservoir.

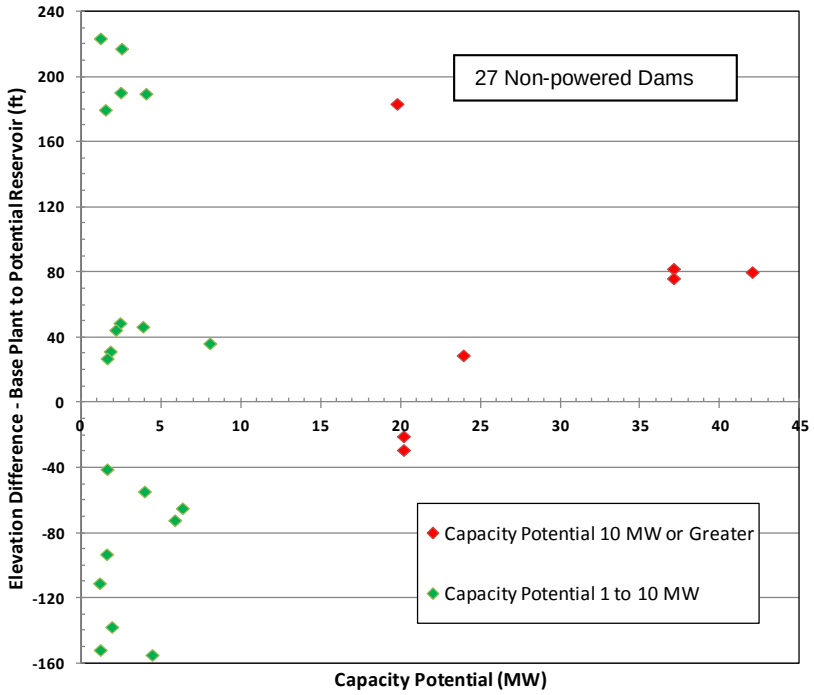

Figure 15. Elevation differences between non-powered dams that are potential pumped storage plants and their associated potential auxiliary reservoir versus non-powered dam conventional capacity potential.

Figure 16. Potential pumped storage configuration at Franklin Falls Dam in New Hampshire.

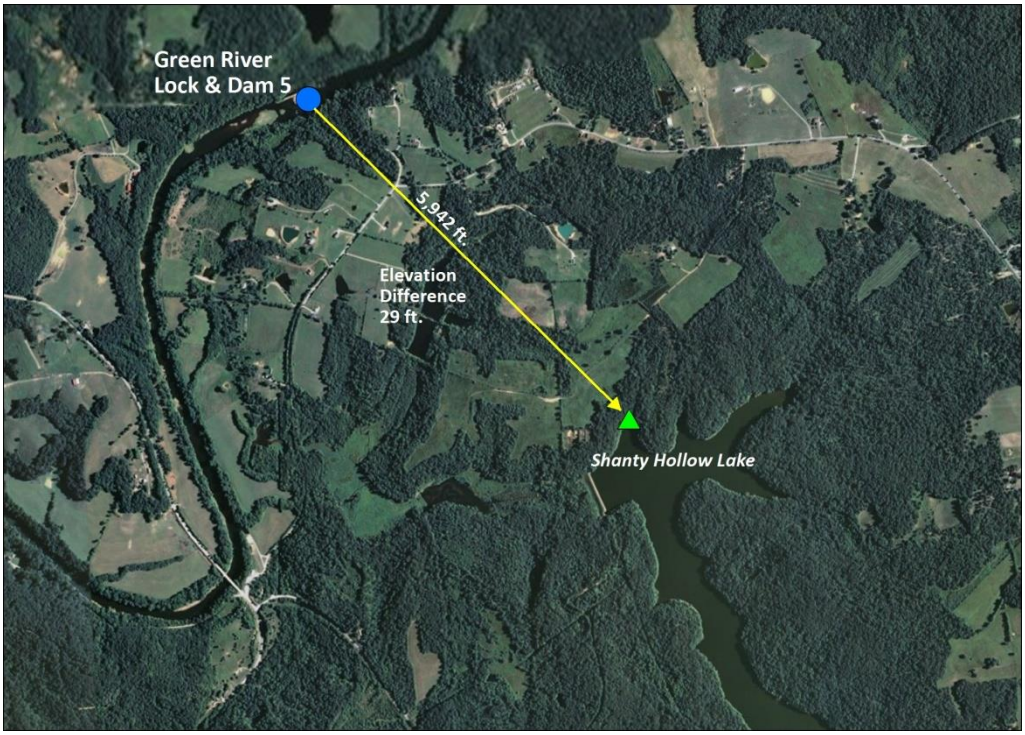

Figure 17. Potential pumped storage configuration at Green River Lock & Dam 5 in Kentucky

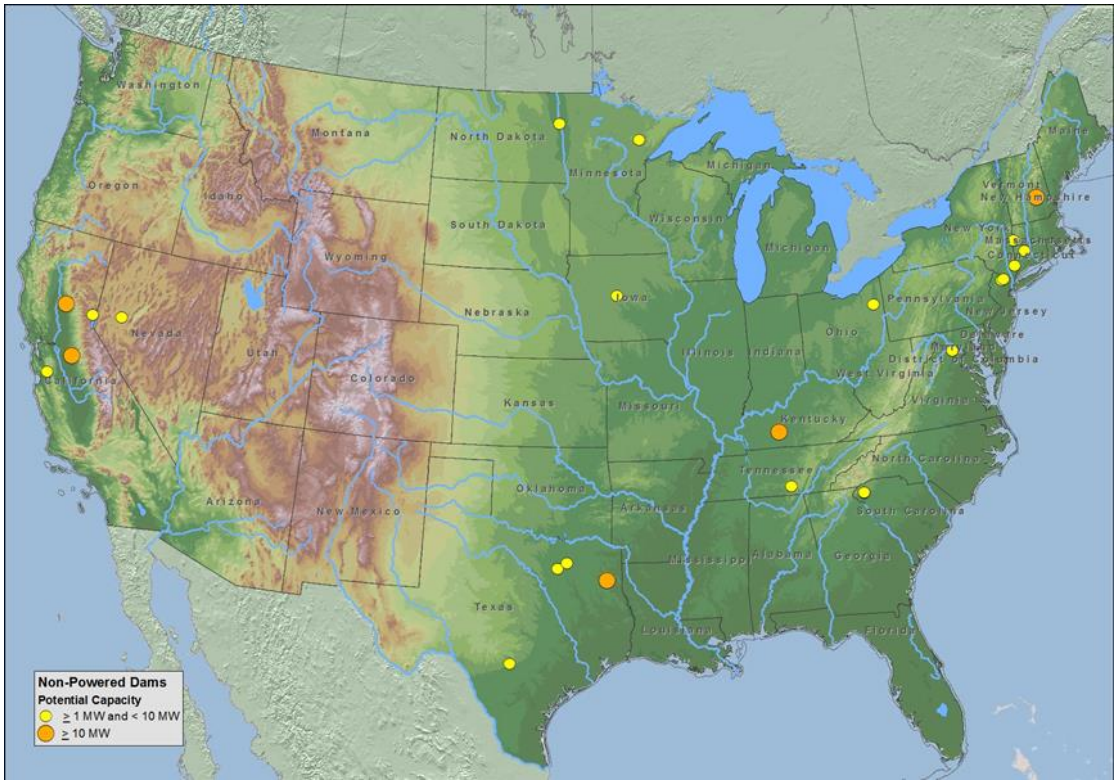

Figure 18. Potential new pumped storage plant sites at existing non-powered dams.

4.3 Greenfield Hydroelectric Plant Sites

Out of a total of 4,015 greenfield hydroelectric plant sites having capacity potentials of 1 MW or greater, 218 met the screening criteria with neither the potential dam site (downstream end of the stream reach), nor the potential auxiliary reservoir being located in an exclusion zone. However, visual inspection of these sites revealed that over half were located on the watercourse coming from the waterbody that was the potential auxiliary reservoir for the site. Sites having this configuration were disqualified as candidate sites leaving 97 candidate sites. The characteristic data for these sites is listed in Table 3. They are located in 23 states throughout the conterminous U.S. The characteristics of these sites are provided in Appendix D where they are presented sorted by state, greenfield site capacity potential, and the elevation difference between the potential dam site and the potential auxiliary reservoir. A majority of the sites (64) are configured with the potential auxiliary reservoir for the pumped storage plant located at a higher elevation than the potential base plant, while the other 33 sites are configured with the potential auxiliary reservoir below the potential base plant site as detailed in Table D-3.

Relaxation of the base plant capacity criterion to 1 MW or greater results in a total of 1,926 non-excluded potential sites; however, of this total, only the 97 referred to above were visually inspected. There are an additional 198 sites having capacity potentials between 10 and 2,091 MW that meet the screening criteria, but have either the greenfield dam site or the potential auxiliary reservoir in an exclusion zone. These sites were not validated by visual inspection. The characteristics of 3,894 sites which includes excluded sites divided by capacity range and exclusion status are provided in Appendix F.

Distributions of characteristic data for the 97 greenfield sites identified as potential sites for new pumped storage plants are presented in Figures 19 through 22. The distribution of the nameplate capacity of these sites (Figure 19)

Table 3. Candidate greenfield hydroelectric plant sites as potential sites for pump-up configuration pumped storage plants.

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
1	KY	Mississippi River	08010100000827	6,880	572,319	5	487	294		106	321	1,727	28
2	AR	Mississippi River	08020100000230	22,270	588,466	4	360	167	Porter Lake	476	192	10,395	25
3	AZ	Colorado River	15030104003180	3,261	33,785	62	354	366	Gene Wash Reservoir	200	738	8,661	372
4	AR	Mississippi River	08020100000212	19,534	588,448	2	209	172	Horseshoe Lake	2,364	192	9,322	20
5	NY	Oswego River	04140203000003	27,638	11,162	45	85	307	Lake Neatahwanta	776	368	8,936	61
6	CA	San Joaquin River	18040006001544	6,936	2,096	223	79	1,641		453	1,404	8,449	-237
7	WA	Puyallup River	17110014000071	38,235	632	740	79	693	Lake Kapowsin	497	585	8,471	-109
8	ME	Androscoggin River	01040002000748	8,855	5,875	78	77	167	Gulf Island Pond	908	261	8,006	94
9	AR	Arkansas River	08020401000006	11,398	49,893	5	43	130		619	155	6,740	25
10	LA	Red River	11140202000015	7,287	22,490	11	43	159	Dutch Johns Lake	322	188	5,405	29
11	CA	North Fork Feather River	18020121000003	13,704	1,450	152	37	934	Lake Oroville	8,468	914	6,168	-21
12	OR	McKenzie River	17090004000246	17,890	1,910	95	31	1,081	Blue River Lake	797	1,357	5,398	276
13	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Hess Lake	764	763	9,916	125
14	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Brooks Lake	285	764	6,837	126
15	WA	Deer Creek	17110008000204	19,862	412	391	27	714	Lake Cavanaugh	833	1,016	5,696	302
16	CA	Stevenson Creek	18040006000527	14,692	55	2,849	26	1,641		453	1,404	8,449	-237
17	OR	McKenzie River	17090004000243	10,863	1,881	80	26	1,187	Blue River Lake	797	1,366	9,139	179
18	CA	Butte Creek	18020120000186	20,886	158	898	24	1,155	Paradise Lake	149	2,556	9,932	1,401
19	CA	Pit River	18020003000078	16,608	1,049	134	24	3,375		256	4,059	8,498	684
20	CA	South Fork American River	18020129000081	12,877	774	173	23	1,883	Slab Creek Reservoir	242	1,859	3,899	-24
21	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622	Kerckhoff Lake	161	986	10,234	-635
22	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622		453	1,403	9,238	-218
23	CA	South Fork American River	18020129000075	7,336	879	149	22	1,400	Slab Creek Reservoir	242	1,827	10,325	427
24	CA	San Joaquin River	18040006000009	5,646	2,472	50	21	731	Kerckhoff Lake	161	957	9,344	226
25	CA	Slate Creek	18020125000339	22,503	156	795	21	1,978	New Bullards Bar Reservoir	4,021	1,910	9,102	-68
26	CA	Pit River	18020003000036	6,627	3,068	40	21	1,502	Pit Six Reservoir	292	1,428	9,453	-74
27	CA	North Yuba River	18020125000407	4,275	1,247	97	21	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792
28	CA	Tuolumne River	18040002002243	9,931	1,575	74	20	176	Dawson Lake	118	262	5,668	86
29	MS	Yazoo River	08030206002332	15,315	12,959	9	20	65	Dump Lake	440	87	9,205	23
30	OR	Middle Fork Willamette River	17090001000087	11,621	3,040	38	20	980	Lookout Point Lake	4,088	945	8,579	-35
31	CA	San Joaquin River	18040006000010	11,152	2,470	45	19	786	Kerckhoff Lake	161	957	7,666	171
32	CO	South Platte River	10190003000030	13,356	5,667	19	19	4,469	Riverside Reservoir	3,633	4,512	5,601	43
33	WA	Elk Creek	17110009000423	27,257	65	1,642	18	1,625	Spada Lake	1,687	1,455	7,615	-169
34	OR	McKenzie River	17090004000157	8,898	2,817	38	18	1,043	Blue River Lake	797	1,392	7,187	349
35	MN	Mississippi River	07010104000118	23,907	3,872	27	18	1,151	Perch Lake	266	1,186	9,192	35
36	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Blake Falls Reservoir	631	1,251	1,568	71
37	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Joe Indian Pond	357	1,299	8,871	119
38	ME	Saco River	01060002001655	3,648	3,825	27	18	174	Bonny Eagle Pond	211	272	5,294	98
39	WA	Sultan River	17110009000406	8,750	570	175	17	441	Lake Chaplain	423	649	8,778	208
40	WY	Bull Lake Creek	10080001000510	22,241	270	362	17	5,878	Bull Lake	2,942	5,822	6,020	-56
41	OR	South Fork McKenzie River	17090004000161	18,970	884	110	16	1,083	Blue River Lake	797	1,357	5,757	274
42	CO	South Platte River	10190002000213	9,301	684	142	16	6,960	Cheesman Lake	885	6,846	7,979	-114
43	OK	Arkansas River	11060006001569	2,290	11,082	9	16	830	Sooner Lake	5,162	855	5,266	25
44	CO	South Platte River	10190002000192	14,554	754	120	15	6,462	Cheesman Lake	885	6,850	10,163	388
45	CA	North Yuba River	18020125000218	10,633	989	91	15	2,001	New Bullards Bar Reservoir	4,021	1,908	9,814	-93
46	WA	Canyon Creek	17080002000123	13,451	323	274	15	237	Yale Lake	3,613	493	5,686	256
47	WA		17110005000959	17,375	29	2,951	15	943	Lake Shannon	2,047	439	5,191	-504
48	NC	Pee Dee River	03040201000154	4,560	8,230	10	14	79	Everetts Lake	110	178	7,095	99
49	WA	Bear Creek	17110005000960	16,299	35	2,322	14	943	Lake Shannon	2,047	439	5,191	-504
50	WY	Shoshone River	10080014001956	9,820	2,081	38	13	4,009		322	4,052	9,087	43

Table 3. Candidate greenfield hydroelectric plant sites as potential sites for pump-up configuration pumped storage plants. (continued)

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
49	WA	Bear Creek	17110005000960	16,299	35	2,322	14	943	Lake Shannon	2,047	439	5,191	-504
50	WY	Shoshone River	10080014001956	9,820	2,081	38	13	4,009		322	4,052	9,087	43
51	CA	Pit River	18020003000034	2,589	3,071	25	13	1,477	Pit Six Reservoir	292	1,428	8,330	-49
52	CA	Rubicon River	18020128000085	5,328	535	144	13	2,569	Stumpy Meadows Lake	343	4,276	6,611	1,706
53	WA	Sol Duc River	17100101000243	13,652	1,623	47	13	321	Lake Pleasant	492	399	6,257	78
54	CA	McCloud River	18020004000026	11,673	593	129	13	2,709	Lake McCloud	481	2,686	4,747	-23
55	WY	Shoshone River	10080014000202	8,261	1,768	43	13	4,861	Beck Lake	100	5,087	8,041	225
56	CA	North Fork Feather River	18020121000068	4,039	547	139	13	3,033	Butt Valley Reservoir	1,538	4,147	10,423	1,114
57	WY	Shoshone River	10080014000143	10,102	1,919	39	13	4,400	Ralston Reservoir	110	4,603	7,427	204
58	OK	Red River	11140101000007	16,837	7,477	10	13	384	Roebuck Lake	147	414	8,668	31
59	WY	Shoshone River	10080014000201	7,507	1,787	41	12	4,827	Beck Lake	100	5,086	7,897	258
60	WY	Laramie River	10180011000122	14,843	1,808	41	12	4,554	Reservoir Number 3	165	4,650	10,478	96
61	CO	South Platte River	10190012002216	4,373	6,474	11	12	4,042	Prewitt Reservoir	1,888	4,090	9,737	48
62	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Lake Merwin	3,837	242	9,839	-274
63	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Yale Lake	3,613	491	7,994	-26
64	NH	Merrimack River	01070006001803	4,583	4,456	16	12	219	Penacook Lake	362	401	3,887	182
65	MS	Pascagoula River	03170006000902	8,274	11,766	6	12	0	Black Creek Cooling Pond	1,129	25	9,319	25
66	TX	Grande, Rio	13080002000796	4,150	9,540	8	12	312		143	365	2,576	53
67	MT	Logan Creek	17010210000214	10,338	229	312	12	3,541	Tally Lake	1,212	3,355	8,143	-185
68	CO	Animas River	14080104000110	11,470	367	194	12	7,745	Electra Lake	800	8,353	9,269	608
69	WA	Williamson Creek	17110009000426	18,609	49	1,430	12	1,606	Spada Lake	1,687	1,455	8,402	-151
70	MA	Merrimack River	01070006000363	10,781	8,481	8	12	6	Chadwick Pond	173	102	10,454	95
71	WA		17110014000845	26,237	71	946	11	694	Lake Kapowsin	497	586	5,748	-108
72	WA		17110014000845	26,237	71	946	11	694	Tanwax Lake	174	613	7,475	-81
73	WA		17110014000845	26,237	71	946	11	694	Clear Lake	156	782	9,418	88
74	WA	Tolt River	17110010000426	11,850	644	104	11	200	Lake Joy	103	532	9,415	333
75	WA	Nisqually River	17110015000054	11,168	1,953	34	11	376	Clear Lake	181	520	10,360	144
76	GA	Flint River	03130008000419	17,831	6,917	10	11	118		264	149	6,888	32
77	WA	Thunder Creek	17110005000485	14,065	94	698	11	1,047	Lake Shannon	2,047	443	6,276	-604
78	WA	North Fork South Fork Sultan Riv	17110009000421	21,342	45	1,391	11	1,725	Spada Lake	1,687	1,459	7,339	-265
79	ME	Saco River	01060002000026	20,689	3,236	19	11	242	Horne Pond	139	279	5,610	37
80	LA	Red River	11140202000015	24,318	22,540	3	11	147	Bossier City Reservoir	101	184	9,902	37
81	CA	Rubicon River	18020128000084	6,106	540	115	11	2,471	Stumpy Meadows Lake	343	4,280	7,302	1,809
82	NY	Hudson River	02020001000092	7,375	1,586	39	11	779	Friends Lake	448	916	7,458	137
83	TX	Brazos River	12070101000990	6,686	3,242	19	10	268	Robertson Lake	266	294	9,441	25
84	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Dexter Reservoir	884	712	10,339	-93
85	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Lookout Point Lake	4,088	935	9,787	131
86	CA	Pit River	18020003000033	2,234	3,072	20	10	1,459	Pit Six Reservoir	292	1,428	6,364	-31
87	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Lake Shannon	2,047	475	9,018	-935
88	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Baker Lake	4,745	727	2,425	-683
89	MT	Yellowstone River	10070002002418	2,680	3,337	18	10	4,947	Dailey Lake	207	5,248	7,376	301
90	ID	South Fork Boise River	17050113000172	6,644	745	81	10	4,253	Anderson Ranch Reservoir	4,639	4,201	7,651	-52
91	GA	Etowah River	03150104002130	19,075	2,598	23	10	639		224	717	3,376	78
92	CA	Klamath River	18010206000972	2,674	3,987	15	10	2,645	Copco Lake	977	2,624	9,583	-21
93	WA	White River	17110014000467	3,825	2,268	26	10	398	Lake Tapps	2,434	547	7,667	149
94	NY	Hudson River	02020001000093	13,757	1,484	39	10	900	Loon Lake	525	868	10,148	-32
95	LA	Red River	11140202000015	34,147	22,535	3	10	149	Bossier City Reservoir	101	184	5,462	35
96	WA	Sultan River	17110009000407	8,179	545	105	10	621	Lake Chaplain	423	652	6,970	31
97	CA	Middle Yuba River	18020125000152	3,510	485	116	10	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792

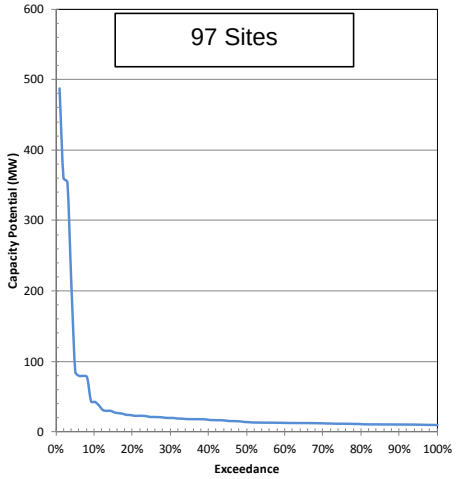

Figure 19. Distribution of capacity potential of greenfield hydroelectric plant sites that are potential pumped storage sites.

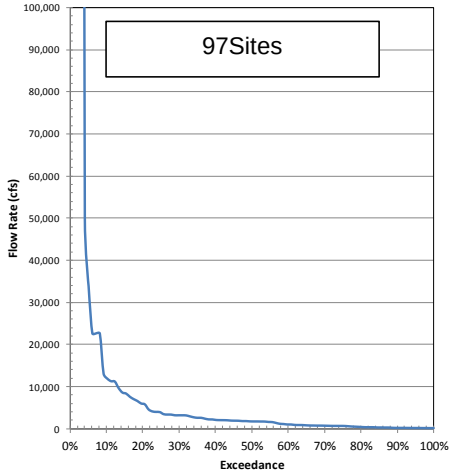

Figure 20. Distribution of annual average flow rate at greenfield hydroelectric plant sites that are potential pumped storage sites.

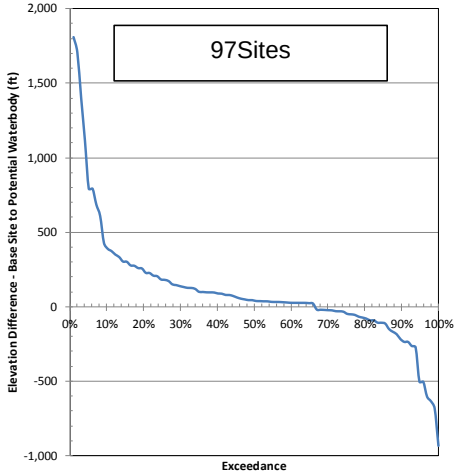

Figure 21. Distribution of elevation difference from greenfield hydroelectric plant site to potential auxiliary reservoir.

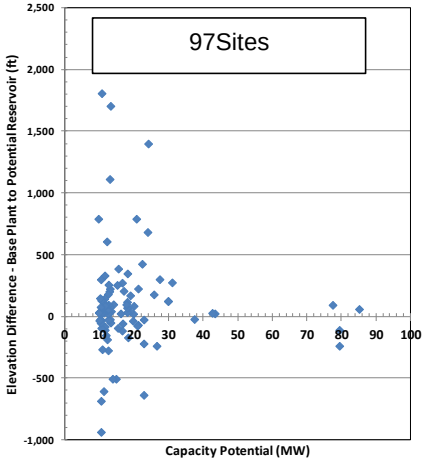

Figure 22. Distribution of elevation difference from greenfield hydroelectric plant site to potential auxiliary reservoir versus greenfield site conventional capacity potential.

shows that about 90% of the sites have capacity potentials less than 50 MW. The distribution of flow rates at the sites (Figure 20) shows that about 80% of the sites have annual average flow rates less than 5,000 cfs. Some of the high capacity sites are on large rivers and therefore are not realistic sites for construction of a stream obstructing dam. However, they may be viable sites for a pumped storage plant given the proximity of an existing waterbody that is a potential auxiliary reservoir. The distribution of elevation difference between the site and the associated potential auxiliary reservoir (Figure 21) shows that 65% of the sites have potential auxiliary reservoirs located above the plant and 35% plants have potential auxiliary reservoirs located at elevation below the plant. Elevation differences range from 1,809 ft above the site to 935 ft below the site. About 50% of the sites have elevation differences to the associated potential auxiliary reservoir greater than 100 ft – 34% having the potential auxiliary reservoir above them and 16 % having the potential auxiliary reservoir below them. Elevation difference versus conventional capacity potential (Figure 22) shows that significant elevation differences occur at sites having capacity potentials less than 30 MW.

Satellite images of two of the 97 sites meeting the screening criteria are shown in Figures 23 and 24 – one in Oregon with a capacity potential of 31 MW and the other in California with a capacity potential of 11 MW, respectively. In the case of the 31 MW site on the McKenzie River, the potential upper reservoir, Blue River Lake is produced by the presence of the Blue River Dam. This non-powered dam is one of the candidate sites for the addition of power generation. In addition to a pump-up configuration, it may also offer an opportunity for a pump-back pumped storage plant at which water downstream of the dam would be pumped back into the lake for release to meet electricity demand.

A map showing the locations of the 97 greenfield sites that are candidate pumped storage sites is presented in Figure 25. The sites are distributed around the country except in the plain states with the greatest concentrations being in the West coast states – California, Washington, and Oregon.

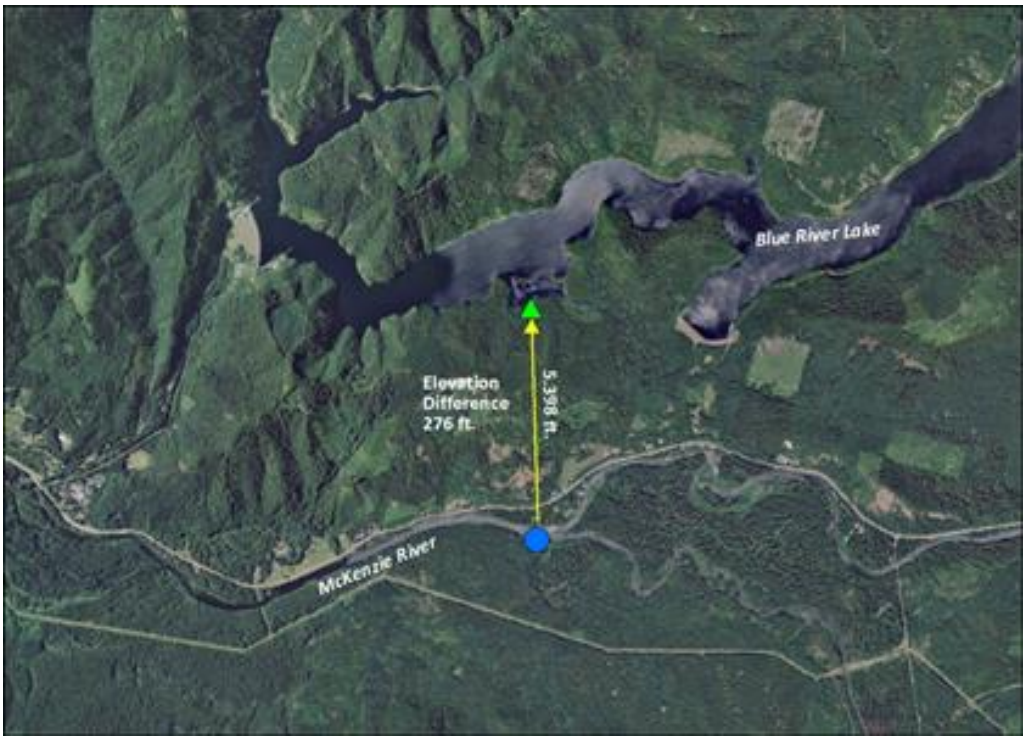

Figure 23. Potential pumped storage configuration on the McKenzie River in Oregon.

Figure 24. Potential pumped storage configuration on the Rubicon River in California.

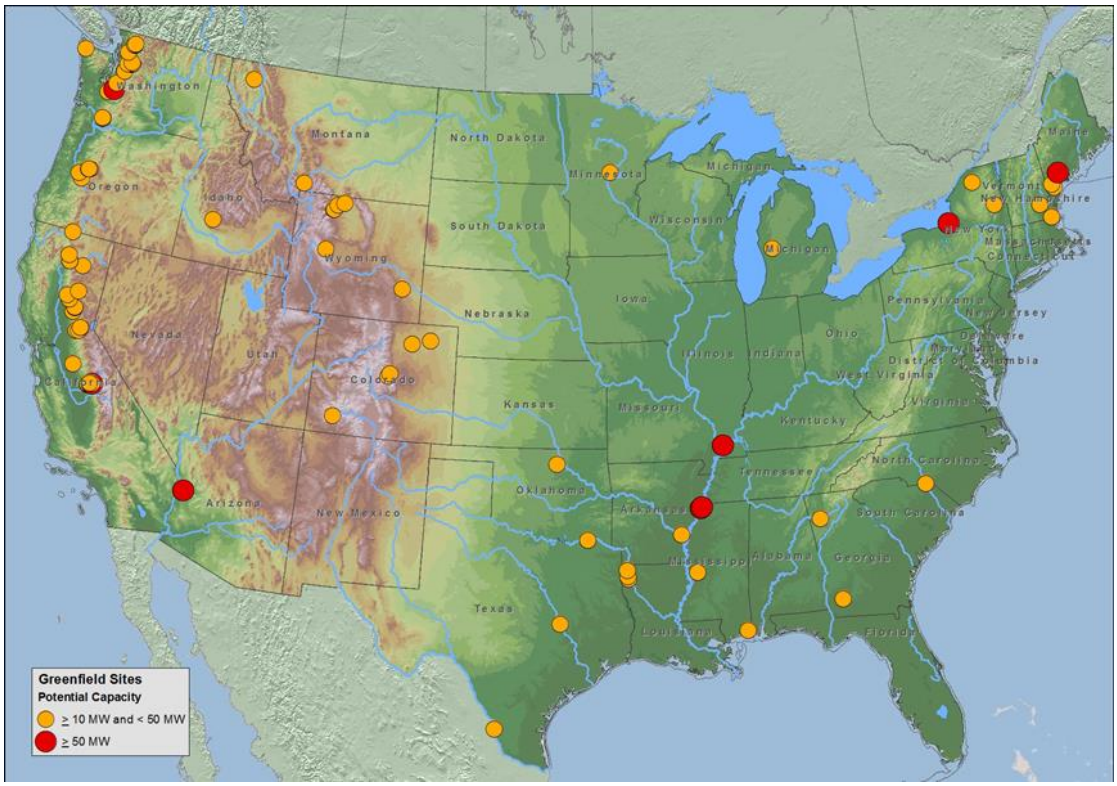

Figure 25. Potential new pumped storage plant sites at greenfield hydroelectric plant sites.

4.4 Paired Waterbodies

The results described in the previous subsection were based on the siting of a hydroelectric plant on a stream reach with a natural waterbody within two miles that met the screening criteria and thus offered a possible pump-up pumped storage configuration. The results presented in this subsection were produced by pairing waterbodies listed in the NHD (USGS 2011) meeting the screening criteria without reference to a watercourse. The waterbody pairs have sufficient size, proximity, and elevation difference to qualify them as possible candidates for siting a pump-up pump storage plant.

A total of 3,692 waterbody pairs met the screening criteria. However, adding the requirement that neither of the paired waterbodies located in an exclusion zone reduced the number of candidates to 2,370. Because of the large number of candidate sites, these sites were not visually verified. The elevation difference between these waterbody pairs ranged from 20 to 1,761 ft. Characteristic data for the 127 waterbody pairs having an elevation difference of 200 ft or greater is listed in Table 4. They are located in 26 states throughout the conterminous U.S. The characteristics of waterbody pairs are listed by state and elevation difference in Appendix E.

The distribution of elevation difference between paired waterbodies is shown in Figure 26. This distribution shows that a small percentage of the 2,370 sites offer substantial elevation differences [e.g. 356 sites (15 %) offering elevation differences of 100 ft or greater]. Elevation difference versus distance between waterbodies is shown in Figure 27. Sites offering elevation differences of 100 ft or more are scattered over the a proximity range from less than 0.1 to 2 miles.

Satellite images of three of the 127 sites offering elevation differences of 200 ft or greater Figures 28 and 29 – one in Vermont offering an elevation difference of 681 ft and the other two in Washington offering elevation differences of 244 ft and 1,038 ft, respectively.

A map showing the locations of 356 sites candidate pumped storage sites offering elevation differences between paired waterbodies of 100 ft or more is presented in Figure 30. The sites are distributed around the country except in the plains states with the greatest concentrations in mountainous regions of the East and West coasts and in the Rocky Mountains.

The characteristics of 3,692 sites which includes excluded sites divided by exclusion status are provided in Appendix F.

Table 4. Candidate paired waterbodies potential sites for pump-up configuration pumped storage plants.

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
1	WA	Palmer Lake	2,042	1,150	Chopaka Lake	133	2,911	7,802	1,761
2	ID	17050123000919	311	5,559	17050123000926	112	6,738	10,515	1,178
3	WA	Yale Lake	3,613	486	Merrill Lake	323	1,524	10,355	1,038
4	TN	Bennett Lake	7,259	634	Raccoon Mountain Pumped Station Reser	526	1,670	4,238	1,036
5	CA	Fordyce Lake	696	6,406	Meadow Lake	234	7,291	5,179	885
6	MA	Woods Pond	110	948	Washington Mountain Lake	190	1,797	8,568	850
7	CA	Lower Lake	9,190	4,471	Snake Lake	224	5,212	6,353	741
8	MA	01080203000498	107	870	Bear Swamp Upper Reservoir	108	1,600	1,263	730
9	ID	Anderson Ranch Reservoir	4,639	4,199	Little Camas Reservoir	991	4,927	6,365	728
10	VT	Lake Dunmore	1,015	569	Silver Lake	105	1,250	2,394	681
11	CA	Thermalito Diversion Pool	298	232	Lake Oroville	8,468	902	1,629	670
12	CA	Snake Lake	224	5,212	Sworinger Reservoir	203	5,862	4,913	651
13	CO	Mayflower Trailings Pond	275	10,493	Robinson Tailings Pond	619	11,137	9,853	644
14	OR	Fish Lake	120	4,756	Mud Lake Reservoir	135	5,379	8,073	623
15	CA	French Lake	347	6,678	Meadow Lake	234	7,291	6,417	614
16	WY	Beartooth Lake	174	8,911	Island Lake	150	9,520	9,770	609
17	CA	Union Valley Reservoir	2,735	4,845	Ice House Reservoir	648	5,438	9,392	593
18	CA	Fordyce Lake	696	6,406	Lake Sterling	104	6,991	1,533	585
19	WA	Cascade Lake	176	355	Mountain Lake	195	921	6,967	566
20	CA	Faucherie Lake	144	6,136	French Lake	347	6,678	5,647	542
21	OR	Smith Reservoir	105	5,200	Long Lake	126	5,735	5,480	535
22	WA	Fish Lake	102	1,807	17020006001195	292	2,323	9,142	517
23	NC	Bear Creek Lake	438	2,553	Wolf Creek Lake	165	3,067	5,339	514
24	VT	Lake Elligo	173	889	Caspian Lake	786	1,401	7,446	512
25	WY	Park Reservoir	309	8,261	Bighorn Reservoir	165	8,750	5,901	489
26	UT	7953	2,972	6,186	16020101005531	139	6,628	9,164	442
27	UT	Electric Lake	469	8,580	Huntington Reservoir	136	9,019	10,031	439
28	CO	Twin Lakes	2,064	9,205	Mount Elbert Forebay	250	9,639	3,307	435
29	CA	Camanche Reservoir	152	137	Pardee Reservoir	1,556	570	189	433
30	NV	Garden Lake	194	5,691	Willow Lake	181	6,123	9,252	432
31	CA	18040008001227	296	392	Lake McClure	5,691	822	6,971	430
32	CO	Mayflower Trailings Pond	275	10,493	14010002002892	504	10,911	4,995	419
33	WY	Sonnicant Lake	109	10,105	Lake Solitude	119	10,523	4,548	418
34	ME	Upper Richardson Lake	7,754	1,448	Metallak Pond	116	1,862	7,147	414
35	OR	Harpold Reservoir	122	5,340	Long Lake	126	5,735	5,048	395
36	GA	03150102001076	815	680	Carters Lake	2,972	1,072	941	392
37	OR	Fish Lake	120	4,756	Horsehead Lake	149	5,131	8,443	375
38	VT	Groton Pond	424	1,076	Kettle Pond	108	1,444	9,502	368
39	CA	Castaic Lagoon	190	1,153	Castaic Lake	2,231	1,518	3,106	366
40	WY	Half Moon Lake	1,035	7,604	Fayette Lake	333	7,961	3,715	357
41	AZ	15060103001811	215	3,325	15060103001810	127	3,668	6,903	343
42	AZ	Lower Lake Mary	149	6,803	Marshall Lake	106	7,138	8,047	335
43	NY	Mongaup Falls Reservoir	107	935	Mohican Lake	188	1,269	9,956	335
44	WY	Moraine Lake	143	10,418	Roberts Lake	107	10,750	8,259	332
45	MA	Holden Reservoir Number One	124	750	Kettle Brook Reservoir Number Four	113	1,082	8,554	332
46	ME	Ellis Pond	919	812	Little Ellis Pond	293	1,134	10,279	322
47	NJ	Charlotteburg Reservoir	326	720	Green Pond	507	1,041	9,472	321
48	AZ	15050301018616	387	2,899	15050301018643	123	3,213	9,100	314
49	UT	Mill Meadow Reservoir	161	7,686	Forsyth Reservoir	166	7,994	8,365	308
50	CA	15060103001811	820	5,561	0	111	5,867	3,981	305

Table 4. Candidate paired waterbodies potential sites for pump-up configuration pumped storage plants. (continued)

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
51	CA	Morris Reservoir	284	1,155	San Gabriel Reservoir	525	1,456	2,882	301
52	WY	Half Moon Lake	1,035	7,604	Meadow Lake	115	7,904	9,546	300
53	NV	Garden Lake	194	5,691	Dry Steer Lake	124	5,989	10,488	298
54	ME	Arnold Pond	148	1,378	01030002002111	218	1,676	8,569	298
55	AZ	15060103012349	324	3,370	15060103001810	127	3,668	7,504	298
56	WA	Lake Shannon	2,047	407	Baker Lake	4,745	703	190	296
57	MT	Georgetown Lake	2,819	6,382	Echo Lake	103	6,675	5,983	293
58	UT	Red Fleet Reservoir	501	5,511	Stauffer Chemical Tailings Pond North	168	5,801	7,277	290
59	PA	Prompton Lake	290	1,126	Elk Lake	158	1,414	8,759	288
60	NY	04140102001223	159	650	04140102001214	2,900	937	9,586	286
61	CO	Blunn Reservoir	163	5,761	Ralston Reservoir	154	6,045	5,765	284
62	AZ	15050301018613	398	2,934	15050301018646	163	3,216	8,419	282
63	WY	Fremont Lake	5,051	7,423	Willow Lake	1,807	7,703	9,483	280
64	NV	Willow Lake	181	6,123	SOB Lake	216	6,403	9,110	280
65	AZ	15050301018613	398	2,934	15050301018643	123	3,213	6,194	278
66	PA	Nesbitt Reservoir	118	1,153	Watres Reservoir	164	1,423	7,582	270
67	CA	0	111	5,867	Faucherie Lake	144	6,136	5,818	269
68	NY	04150302001522	150	1,077	04150302001519	144	1,344	5,130	267
69	MT	Whitefish Lake	3,317	2,999	Beaver Lake	145	3,265	5,332	266
70	NY	Swinging Bridge Reservoir	885	1,069	Sackett Lake	127	1,330	9,063	260
71	AZ	15050301018552	1,283	3,233	15050301018554	524	3,493	5,940	260
72	CA	Lake Amador	207	313	Pardee Reservoir	1,556	570	3,486	258
73	NY	Ashokan Reservoir	8,171	589	Yanketown Pond	117	844	9,737	255
74	WA	Ohop Lake	218	527	Clear Lake	156	781	6,821	254
75	AZ	15060103012373	238	3,628	15060103012374	172	3,877	5,720	249
76	WA	Lake Merwin	3,837	242	Yale Lake	3,613	486	611	244
77	NV	Garden Lake	194	5,691	Burnt Lake	417	5,934	6,492	243
78	CO	Narraguinnep Reservoir	544	6,685	McPhee Reservoir	4,335	6,928	5,844	243
79	NY	Simon Pond	780	1,545	04150305001386	146	1,788	6,059	243
80	NM	15040002005825	154	5,501	15040002005826	139	5,744	2,339	242
81	WY	Crystal Lake Reservoir	130	6,973	Granite Springs Reservoir	176	7,214	5,967	241
82	AZ	15050203011653	120	2,702	15050203011658	253	2,942	2,533	240
83	AZ	15040004009566	145	3,898	Tailings Water Reclamation Reservoir	538	4,138	4,233	240
84	PA	Prompton Lake	290	1,126	White Oak Pond	224	1,365	10,518	238
85	UT	Electric Lake	469	8,580	Cleveland Reservoir	139	8,817	6,316	237
86	AZ	15040004009565	165	3,901	Tailings Water Reclamation Reservoir	538	4,138	4,765	237
87	MI	Pine Lake	487	610	Mountain Lake	835	846	4,650	236
88	ME	Big Houston Pond	645	821	Indian Pond	290	1,056	6,816	234
89	ME	Sunday Pond (historical)	6,917	1,517	Lincoln Pond	327	1,751	7,186	234
90	MN	Northern Light Lake	371	1,537	Pine Mountain Lake	105	1,771	8,505	234
91	OR	Dexter Reservoir	884	700	Lookout Point Lake	4,088	933	169	232
92	FL	03100204001421	106	119	03100204003921	166	349	10,429	230
93	NC	Apalachia Lake	1,064	1,274	Persimmon Lake	5,915	1,504	177	229
94	NH	Connecticut Lakes	3,071	1,637	Second Connecticut Lake	1,102	1,866	9,828	229
95	ME	01020003000950	456	815	Pickett Mountain Pond	182	1,043	7,593	228
96	CA	Essex Reservoir	204	4,819	Kelley Reservoir	312	5,046	7,333	227
97	WY	Lake Solitude	119	10,523	Roberts Lake	107	10,750	9,101	227
98	NC	Cedar Cliff Lake	108	2,327	Bear Creek Lake	438	2,553	766	226
99	AZ	Tailings Pond Number Three	546	3,442	15060103001810	127	3,668	3,877	226
100	CO	14010002002892	504	10,911	Robinson Tailings Pond	619	11,137	56	225

Table 4. Candidate paired waterbodies potential sites for pump-up configuration pumped storage plants. (continued

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
101	TN	06010207004619	5,758	794	Big Ridge Lake	23,593	1,020	6,635	225
102	MN	04010201002800	126	1,241	04010201005958	119	1,466	6,447	224
103	NJ	Lake Denmark	242	821	Green Pond	507	1,041	6,487	220
104	NH	Perkins Pond	157	1,089	Ledge Pond	116	1,309	7,721	220
105	ME	Trues Pond	146	293	15060103001810	1,109	505	5,331	212
106	FL	03100204001260	189	147	03100204003718	100	358	3,866	211
107	NH	Sip Pond	141	888	Laurel Lake	180	1,098	10,062	210
108	CT	Lake Watrous	107	222	Lake Bethany	103	432	6,057	210
109	NY	South Colton Reservoir	227	974	Rainbow Falls Reservoir	666	1,181	8,109	207
110	MI	Hopkins Lake	115	699	04060101001493	792	906	2,096	207
111	NH	Akers Pond	276	1,228	Greenough Pond	234	1,435	8,824	207
112	VT	Lake Bomoseen	2,383	410	Beebe Pond	108	616	9,650	207
113	MI	Rush Lake	313	640	Mountain Lake	835	846	3,190	206
114	ME	Thompson Lake	4,300	324	Saturday Pond	180	529	9,668	205
115	FL	03100204001263	164	153	03100204003718	100	358	743	205
116	NY	Little Tupper Lake	2,288	1,718	Loon Pond	102	1,923	8,328	204
117	NY	Round Lake	754	1,718	Loon Pond	102	1,923	5,904	204
118	ME	Stevens Pond	340	301	01050003001109	1,109	505	4,746	204
119	TX	Lake Tanglewood	249	3,352	11120103001361	175	3,555	9,035	203
120	FL	03100204001260	189	147	03100204003921	166	349	8,550	202
121	UT	Cleveland Reservoir	139	8,817	Huntington Reservoir	136	9,019	5,049	202
122	MA	Buffumville Lake	106	492	Baker Pond	169	693	8,196	201
123	FL	03100204001173	360	149	03100204003921	166	349	8,297	201
124	NJ	Oak Ridge Reservoir	464	841	Green Pond	507	1,041	10,248	200
125	NH	Lake Coniston	129	1,109	Ledge Pond	116	1,309	6,586	200
126	NJ	Lake Mohawk	759	721	Morris Lake	142	921	8,588	200
127	NY	Mongaup Falls Reservoir	107	935	Lebanon Lake	358	1,134	6,780	200

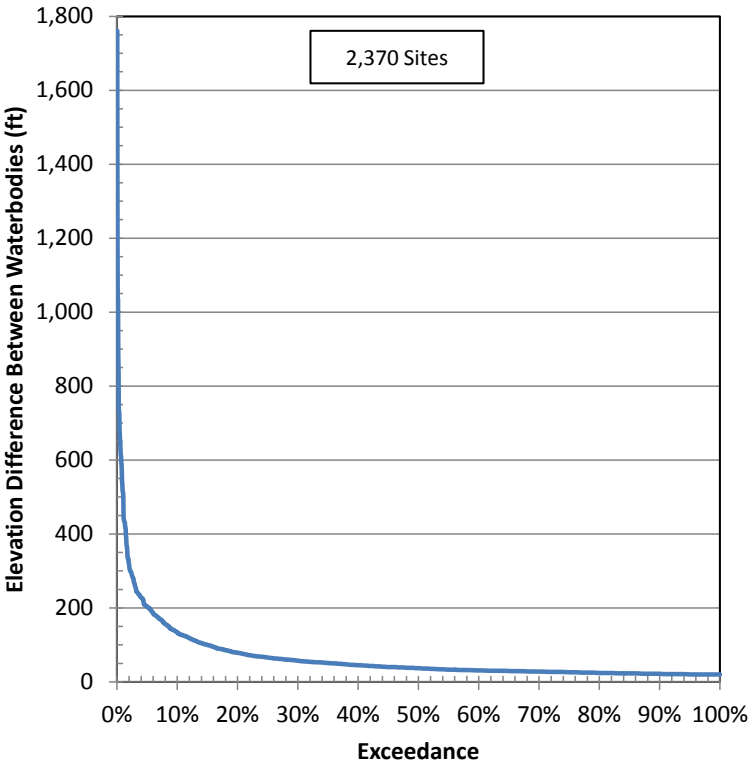

Figure 26. Distribution of the elevation difference between paired waterbodies.

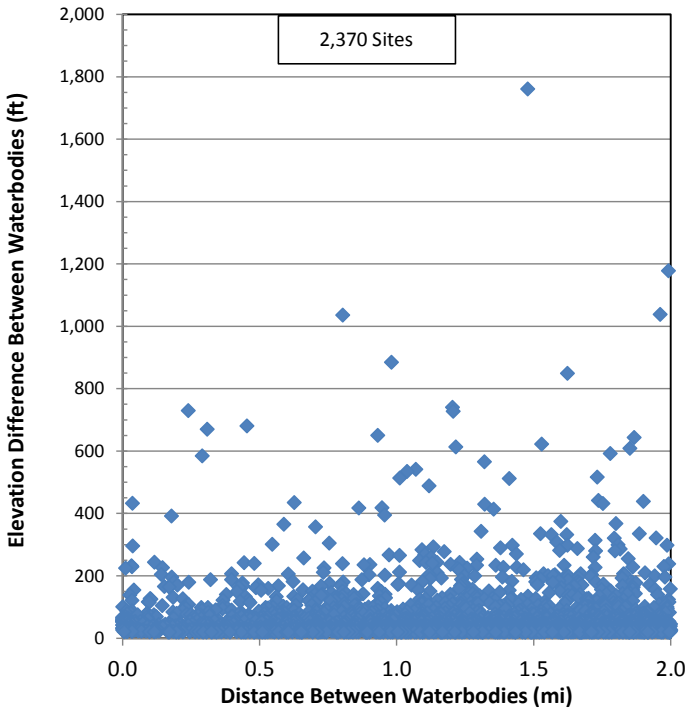

Figure 27. Elevation difference between paired waterbodies versus the distance between them.

Figure 28. Potential pumped storage configuration between Silver and Dunmore Lakes in Vermont.

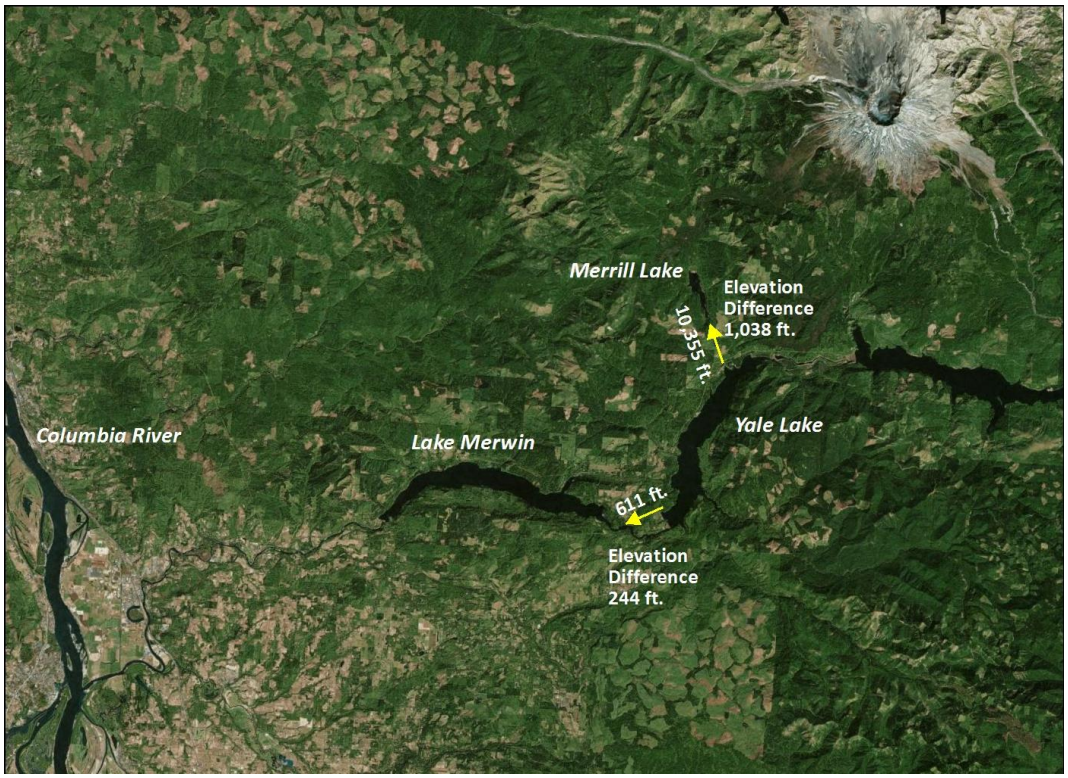

Figure 29. Potential pumped storage configurations between Yale Lake and Merrill Lake or Lake Merwin in Washington.

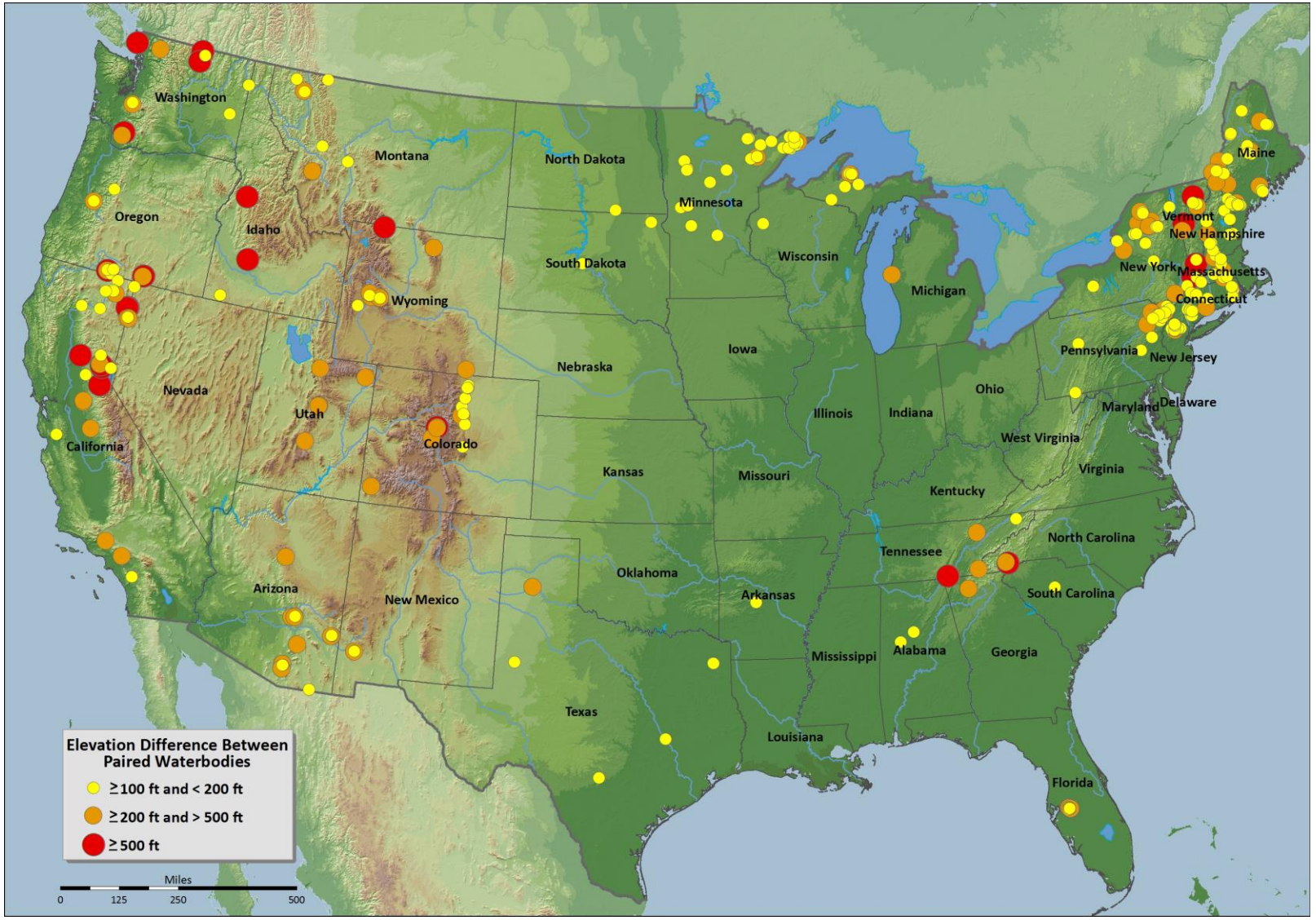

Figure 30. Potential new pumped storage plant sites based on paired natural waterbodies.

5. CONCLUSIONS

This study has shown that it is possible to identify candidate sites for new pumped storage plants worthy of further investigation through virtual prospecting using GIS analysis. However, as with the assessment of non-powered dams as sites for new power generation, what initially appears to be a large pool of opportunities reduces to a relatively small number of candidates when even the most basic screening criteria are applied. Considering screening criteria based on the characteristics of the 43 existing U.S. pumped storage plants, candidate sites at existing conventional hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites, and paired waterbodies sites in the conterminous U.S. number as follows:

- Hydroelectric plants – 31 sites
- Non-powered dams – 7 sites
- Greenfield hydroelectric plant sites – 97 sites
- Paired waterbodies sites - 2,370 sites

for a total of 2,505 sites. These sites both met the basic plant characteristic screening criteria as well as not having the base plant location or the associated potential auxiliary reservoir in an exclusion zone defined by federal land use designations or in environmentally sensitive areas. The sites are principally located in mountainous areas of East and West coast states and in Rocky Mountain states. Candidate sites at existing hydroelectric plants, greenfield hydroelectric plant sites, and paired waterbodies sites are also located in the upper mid-West and Texas. Additional candidate greenfield hydroelectric plant sites are located in the Southeast.

All the candidate sites offered a pump-up configuration consisting of a base plant and an associated waterbody separated from the base plant by distance and elevation. The waterbody was considered to be a potential upper reservoir, if it was located above the base plant. However, in a significant number of cases, the associated waterbody was at an elevation below what was considered to be the base plant. In these cases, the pump-turbine power house would be located at the waterbody and what was considered to be the base plant would become the location of the upper reservoir of the pumped storage plant.

Relaxation of the basic screening criteria that the base plant should have a nameplate capacity or capacity potential of 10 MW or greater to 1 MW or greater added a significant number of additional potential sites:

- Hydroelectric plants – 44 sites
- Non-powered dams – 20 sites
- Greenfield hydroelectric plant sites – 1829 sites

for a total of 1893 additional sites. However, only the additional sites at existing hydroelectric plants and non-powered dams were visually inspected to ensure they were configured in a pump-up configuration like the 38 prime candidate sites were for these base plant types. Based on typical, existing, U.S. pumped storage plants, it seems unlikely that sites with so little installed or conventional capacity potential (<10 MW) would actually be viable candidate sites. However, if the demand for pumped storage is high enough, sites with little installed or potential conventional capacity may be developed to provide needed pumped storage capacity.

Operation of a pumped storage plant requires that frequent significant changes in the water level of the storage reservoir and corresponding frequent significant changes in the flow rate downstream of the plant are acceptable. This study was limited to identifying pairings of four types of potential base plants with existing waterbodies meeting basic screening criteria based on the characteristics of existing pumped storage plants. It is anticipated that further investigation of what have been identified as candidate sites will reveal that some sites are not feasible for development as pumped storage sites because attendant water level and flow rate fluctuations that would not be acceptable to project stakeholders and perhaps for other reasons not visible at the depth the research was conducted.

6. RECOMMENDATIONS

1. Basic Feasibility Assessment

Considering the number of candidate pumped storage sites identified in this study, determination of basic feasibility based on factors affecting site development could be researched to identify feasible sites albeit still within limited visibility. Basic feasibility could include factors such as: power benefits, site accessibility, proximity to transmission and load, constructability, and operational factors like release rates and water level fluctuations. Such a study could include expanded research of potential licensing issues, but most likely could not anticipate all the issues surrounding a site that might surface as a result of applying for a use or operating permit.

2. Estimate of Reverse Power Potential

Power potentials stated in the study were for conventional power potential of non-powered dams or greenfield hydroelectric plant sites. Reverse power and generation resulting from drawing water from the upper storage reservoir was not estimated, since this would require estimation of the storage capacity of the upper reservoir and an assumption of plant physical characteristics and equipment. Storage capacity might well be determined in the feasibility assessment described in Recommendation #1 and plant characteristics and equipment could be defined based on existing pumped storage plants and using pumped storage hydropower subject matter experts. With this information, the reverse power potential of the new plant could be estimated albeit within the limits of the assumed development model.

3. Pump-back Pumped Storage Assessment

The present assessment was limited to a pumped storage plant configuration in which the storage reservoir is located above and separated from the location of the pump-turbine powerhouse (pump-up configuration). However, some existing plants are of the pump-back configuration in which water is pumped back over the dam during off-peak hours to provide water for power production during peak demand or for power firming. An assessment of new pumped storage sites similar to the one that has been conducted, but with the objective of identifying potential pump-back pumped storage plant sites should be conducted to have a complete assessment of opportunities for new pumped storage plants.

With regard to the plant sites for pump-back pumped storage opportunities, this assessment would benefit from the techniques in the greenfield hydroelectric plant site assessment performed by INL that estimated dam dimensions and inundation area at greenfield sites at which a stream obstructing dam is installed (Hall, Verdin, Lee 2012).

4. Topography-based Assessment of Opportunities for New Pumped Storage Sites

The assessment of sites for new pumped storage plants considering existing waterbodies as potential auxiliary storage reservoirs used existing waterbody locations and extents from the NHD database. A more challenging assessment is to perform the same assessment, but looking for topography in reasonably close proximity to the four types of base plants (conventional hydroelectric plants, non-powered dams, greenfield hydroelectric plant sites, and existing waterbody sites) that would lend itself to development of an upper reservoir. Termed the “sinks and bowls” study, this assessment would use digital elevation models to identify topography with the requisite characteristics to be considered for reservoir development.

5. Opportunities for Closed-Loop Pumped Storage Plants

This assessment would determine types of sites and configurations for closed-loop pumped storage plants and then proceed to identify potential development sites. Abandoned mines are one such type and thus identifying abandon mines having the requisite characteristics would be one part of this study.

6. Shoreline Pumped Storage Assessment

This assessment would investigate shoreline locations for pumped storage plants where saltwater would be used as the working medium and shoreline topography provides the necessary hydraulic head for water supplied to and from an existing or constructed on-shore waterbody serving as the upper reservoir.

7. Pumped Storage Assessment of Alaska and Hawaii

The present assessment did not include Alaska and Hawaii because requisite data for these states was less readily available which put them beyond the scope of the assessment. However, sources for the required data are known. Considering the vast hydropower resources of Alaska, the fact that Hawaii has the highest density of hydropower resources of the 50 states, and the importance of energy storage in activating other renewable resources, the assessments of these two states should be performed.

8. Feasibility Assessments

Feasibility assessments of the type described in Recommendation #1 above could be included in the assessments described in Recommendations #3 through #7 or could be undertake as follow-on assessments once candidate sites and their characteristics have been determined.

9. Availability of Site Specific Data for Potential New Pumped Storage Sites Identified in this Assessment

The assessment results as presented in this report provide a general view of the potential and characteristics of potential sites for new pumped storage plants. However, other than informing the reader of the possibilities and providing tabular characteristic data, it is not optimal in facilitating the addition of new pumped storage capacity. Such facilitation necessitates access to site-specific information in the context of features affecting project development. Full value of the assessment results should be obtained by including these data in the Virtual Hydropower Prospector GIS application (VHP 2012) and being made available via any other appropriate graphical or database sources.

7. REFERENCES

EIA, 2013, "EIA-860 Data 2011Generator Year 2012", U.S. Energy Information Agency, October 2013, http://www.eia.gov/electricity/data/eia860/index.html (Click on Year 2012 – See GeneratorY2012).

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VHP 2012, "Virtual Hydropower Prospector", February 2012, http://hydropower.inl.gov/prospector/index.shtml.

APPENDIX A

Characteristic Data for U.S. Pumped Storage Hydroelectric Plants

Appendix A
Characteristic Data for U.S. Pumped Storage Hydroelectric Plants

This appendix provides characteristic data for U.S. pumped storage hydroelectric plants both from published references and from geographic information system (GIS) analysis of the sites.

A-1. Characteristic Data

The characteristic data for existing U.S. pumped storage plants from published sources and resulting from INL GIS analyses is presented in Table A-1.

The summary information about the U.S. pumped storage fleet is:

- 43 plants
- Located in 20 states
- Year of last installation 1929-2012
- Total reverse generation capacity 21,586 MW

The basic characteristic data were primarily taken from an Energy Information Administration listing of U.S. pumped storage plants (EIA 2013). Additional data was obtained from an extensive report on U.S. pumped storage plants published by the Army Corps of Engineers (ACE 1981) and Internet websites. The ACE report provided gross hydraulic heads defined to be between the water surfaces of the upper and lower reservoirs. These data were useful in corroborating the elevation differences derived by GIS analysis. Information and data taken from various websites is footnoted and referenced at the bottom of Table A-1.

The data under the "INL Derived Data" banner in Table A-1 was derived through GIS analyses. Upper reservoirs were located using satellite imagery. In most cases, reservoirs were identified as a waterbody in the National Hydrography Dataset (USGS 2011), which provided the surface area of the waterbody and in some cases, its name. A reference point for the base plant was chosen just upstream of the main dam and approximately at the center of the dam. The planimetric distance from this point to the nearest point on the upper reservoir shoreline was determined using GIS tools and was labeled as the proximity between the base plant and the upper reservoir. Digital elevation models (DEMs) developed using USGS National Elevation Dataset (USGS 2009) 10 meter data were used to determine both the elevation at the base plant reference point and the elevation of the upper reservoir water surface. The difference in these elevations provided what has been termed the gross hydraulic head.

While most of the plants had the typical configuration of a base plant housing the pump-turbines and generators and a separate upper reservoir located some distance away and above the base plant, a significant number of the plants were configured such that water was simply pumped back to the reservoir behind the dam from the dam tailwater. The former configuration has been termed a "pump-up" configuration, and the latter termed a "pump-back" configuration in Table A-1. Pump-back plants have proximities between the base plant and upper reservoir of 0 ft, since the base plant reservoir is the upper reservoir. For these plants, the elevation difference is between the water surface downstream of the dam and the water surface at the reference point upstream of the dam. The table also includes a plant type attribute, since some plants are only used for generation from pumped storage units (designated PMP), while others include conventional turbines units and pump-turbine units (designated CMB).

A-2. References

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Table A-1. Characteristic data for U.S. pumped storage hydroelectric plants.

	Sourced Data														INL Derived Data		
	PlantCode	ProjectNam	OwnerName	State	County	River	Lower Waterbody[10]	Upper Waterbody[10]	*Most Recent Year of Installation*	Plan Type	Plant Configuration	No. of Reversible Generation Units	*Reversible Capacity (MW)*	Gross Hydraulic Head (ACE 1981) (ft)	Upper Reservoir Area (acres)	Upper Reservoir Proximity (ft)	Lower to Upper Waterbody Elevation Difference (ft)
1	*7125*	Bad Creek	Duke Power Div Duke Energy Corp	SC	Oconee	Bad Cr	Lake Jocassee	Upper Bad Creek Res.	*1991*	PMP	Pumpup	4	*1065.2*	U.A.	12,762	5,021	1,046
2	6167	Bath County	Virginia Elec & Pwr Co Et Al	VA	Bath	Back Cr	Lower Reservoir	Upper Reservoir	*1985*	PMP	Pumpup	6	**2772**[1]	1050	215	7,739	880
3	8005	Bear Swamp	Usgen New England, Inc. & Bear Swamp Generating Trust No. 1	MA	Franklin	Deerfield R	Lower Bear Swamp Res	Upper Bear Swamp Res	*1974*	PMP	Pumpup	2	*600*	680-770	108	2,899	892
4	3374	Big Bend	Corps Of Engineers	SD	Buffalo	Missouri R	Missouri River	Lake Sharpe	**1964**	CMB	Pumpback	8	**493.3**[8]	-	58,420	0	37
5	2691	Blenheim Gilboa	New York Power Authority	NY	Schoharie	Schoharie Cr	Lower Belnheim Gilboa	Upper Belnheim Gilboa	*1973*	PMP	Pumpup	4	*1000*	1055-1143	371	3,186	1,059
6	3595	Buchanan	Lower Colorado R Auth	TX	Llano	Colorado R	Inks Lake	Buchanan Lake	**1938**	CMB	Pumpback	3	**11.22**	U.A.	21,983	0	47
7	198	Bull Shoals	Corps Of Engineers	AR	Baxter	White R	White River	Bull Shoals Lake	**1952**	CMB	Pumpback	8	**399**	U.A.	18,811	0	123
8	467	Cabin Creek	Public Service Co Of Co	CO	Clear Creek	S Clear Cr	Lower Cabin Creek Res	Upper Cabin Creek Res	*1967*	PMP	Pumpup	2	*300*	1170-1226	24	3,112	1,259
9	6130	Carters	Corps Of Engineers	GA	Murray	Coosawattee R	Regulation Reservoir	Carters Lake	*1977*	CMB	Pumpback	*2*	*250*	352-392	2,972	0	225
10	392	Castaic	CA Dept Of Water Resources, City Of LA	CA	Los Angeles	W Br Ca Aque(Castaic Cr)	Elderberry Forebay	Pyramid Lake	*1978*	PMP	Pumpup	6	*1275*	1022-1088	1,177	39,479	1,054
11	6140	Clarence F Cannon	Bureau Of Reclamation	MO	Ralls	Salt R	Regulation Dam	Mark Twain Lake	*1984*	CMB	Pumpback	*1*	*31*	59-107	18,133	0	73
12	187	Degray	Corps Of Engineers	AR	Clark	Caddo R	Impoundment	DeGray Lake	*1972*	CMB	Pumpup	*1*	*28*	144-188	11,530	939	217
13	104	Eastwood Pwr Station (J S Eastwood)	Southern California Edison Co	CA	Fresno	Tunnel 7(S Fk San Joaquin R)	Shaver Lake	Balsam Meadows Forbay	*1987*	PMP	Pumpup	1	*199.8*	-	60	16,400	1,300
14	437	Edward G Hyatt	Ca Dept Of Water Resources	CA	Butte	Feather R	Tailwater pool	Lake Oroville	*1969*	CMB	Pumpup	*3*	*293.1*	508-670	8,468	3,023	669
15	6126	Fairfield	South Carolina Elec & Gas Co	SC	Fairfield	Frees Cr	Broad River	Monticello Reservoir	*1978*	PMP	Pumpup	8	*511.2*	155-169	6,659	14,285	215
16	518	Flatiron 3	Bureau Of Reclamation	CO	Larimer	Dry Cr	Flatiron Reservoir	Carter Lake	*1954*	PMP	Pumpup	1	*8.5*	140-290	1,120	5,729	292
17	6163	Grand Coulee P/G	Bureau Of Reclamation	WA	Grant	Columbia R	Banks Lake	Franklin D Roosevelt lake	*1984*	PMP	Pumpup	6	*314*	266-362	71,395	9,692	281
18	6141	Harry S Truman	Corps Of Engineers	MO	Benton	Osage R	Lake of the Ozarks	Truman Reservoir	*1982*	CMB	Pumpback	*6*	*161.4*	U.A.	23,848	0	22
19	6100	Helms (Courtright)	Pacific Gas & Electric Co	CA	Fresno	Helms Cr	Lake Wishon	Courtwright Lake	*1984*	**PMP**[2]	Pumpup	*3*	**1212**[2]	1560	1,630	19,232	1,645
20	2780	Hiwassee	Tennessee Valley Auth	NC	Cherokee	Hiwassee R	Apalachia Reservoir	Hiwassee Reservoir	*1956*	CMB	Pumpback	*1*	**59**	134-243	5,914	0	224
21	145	Horse Mesa	Salt R Proj Ag Imp P Dist	AZ	Maricopa	Salt R	Salt River	Apache Lake	*1972*	CMB	Pumpback	*1*	*99.8*	151-295	2,193	0	91
22	3262	Jocassee	Duke Power Div Duke Energy Corp	SC	Pickens	Keowee R	Lake Keowee	Lake Jocassee	*1975*	CMB	Pumpback	*4*	*612*	280-335	7,980	0	300
23	8225	Kinzua Intake (Seneca)	Firstenergy Generation Corp	PA	Warren	Allegheny R	Kinzua Lake	Seneca Power Res.	*1970*	CMB	Pumpup	*3*	*469*	668-813	104	2,137	875
24	57729	Lake Hodges	San Diego County Water Authority	CA	San Diego		Hodges Reservoir	Olivenhain Reservoir	*2012*	PUP	Pumpup	*2*	*40*	770[10]	200	4,248	756
25	1713	Ludington	Consumers Energy Co	MI	Mason	Lake Michigan	Lake Michigan	Ludington Reservoir	*1973*	PMP	Pumpup	6	**1872**[3]	296-363	792	1,306	333
26	148	Mormon Flat	Salt R Proj Ag Imp P Dist	AZ	Maricopa	Salt R	Salt River	Canyon Lake	*1971*	CMB	Pumpback	*1*	*54.3*	132	453	0	155
27	6208	Mt Elbert	Bureau Of Reclamation	CO	Lake	Arkansas Cnl(Arkansas R)	Twin Lakes	Mt. Elbert Forbay	*1984*	PMP	Pumpup	2	*200*	430-485	250	3,229	436
28	3164	Muddy Run	Exelon Generation Company, L.L.C	PA	Lancaster	Susquehanna R	Conowingo Pond	Muddy Run Reservoir	*1968*	PMP	Pumpback	8	**1070**[9]	361-411	811	0	402
29	547	Northfield Mtn	Northeast Generation Co	MA	Franklin	Connecticut R	Connecticut River	Northfield Moutain Res.	*1973*	PMP	Pumpup	4	**1080**[4]	720-825	237	6,452	812
30	446	O Neill	Bureau Of Reclamation	CA	Merced	Delta Mendota Cnl(San Joaquin R)	Delta-Mendota Canal	O' Neill Forbay	*1968*	PMP	Pumpback	6	*25.2*	44-56	2,246	0	45
31	2693	R Moses Niagara (Lewiston Niagara)	New York Power Authority	NY	Niagara	Niagara R	Niagara Forebay	Upper Reservoir	*1962*	CMB	Pumpup	*12*	*240*	65-100	1,887	4,794	409
32	6151	Raccoon Mt	Tennessee Valley Auth	TN	Marion	Tennessee R	Nickajack Reservoir	Raccoon MT Upper Reservoir	*1979*	PMP	Pumpup	4	*1530*	890-1040	528	62,640	1,033
33	6132	Richard B Russell	Corps Of Engineers	GA	Elbert	Savannah R	Savannah River	Russell Lake	*2002*	CMB	Pumpback	4	**300**[5]	-	26,653	0	135
34	6189	Rocky Mountain	Georgia Power Et Al	GA	Floyd	Heath Cr	Lower Reservoir	Upper Reservoir	*1995*	PMP	Pumpup	3	*847.8*	652	221	2,331	637
35	539	Rocky River	Northeast Generation Co	CT	Litchfield	Rocky R	Housatonic River	Lake Candlewood	*1929*	CMB	Pumpup	2[6]	**6**	200-230	5,086	1,833	182
36	2982	Salina	Grand River Dam Auth	OK	Mayes	Salina Cr	W.R. Holway Reservoir	Lake Hudson	*1971*	PMP	Pumpup	6	*288*	228-246	9,714	764	221
37	448	San Luis (W R Gianelli)	Bureau Of Reclamation	CA	San Joaquin	Calif Aqueduct	O Neill Forebay	San Luis Reservoir	*1968*	PMP	Pumpup	8	*424*	101-327	167	13,682	115
38	3780	Smith Mtn	Appalachian Power Co	VA	Bedford	Roanoke R	Leesville Lake	Smith Mountain Lake	*1980*	CMB	Pumpback	*3*	*247.3*	174-195	19,676	0	192
39	2108	Taum Sauk	Union Electric Co	MO	Reynolds	E Fk Black R	Sauk Lake (Lower Res.)	Upper Reservoir	*1963*	PMP	Pumpup	2	*408*	755-863	54	5,994	843
40	438	Thermalito	Ca Dept Of Water Resources	CA	Butte	Off Stream Feather R	Thermalito Afterbay	Thermalito Forebay	*1968*	CMB	Pumpback	*3*	*82.5*	86-102	630	0	105
41	7164	Waddell	Central Arizona Water Conservation Dist	AZ	Maricopa	**Agua Fria R7**	Colorado River	Lake Pleasant	*1993*	**PMP**[7]	Pumpback	8[7]	**45**[7]	-	12040	0	135
42	6087	Wallace(Laurens Shoals)	Georgia Power Co	GA	Putnam	Oconee R	Lake Sinclair	Lake O'conee	*1980*	CMB	Pumpback	*4*	*208.8*	94-97	17,436	0	92
43	6522	Yards Creek	Jersey Central P&L & Pseg Fossil Llc	NJ	Warren	Blairs Cr	Lower Yards Creek Res.	Upper Yards Creek Res.	*1965*	PMP	Pumpup	3	*453*	688-760	155	3,493	735
												Total	**21,586**				

ACE 1981 *National Hydroelectric Power Resources Study* , Vol. X, "An Assessment of Hydroelectri Pumped Storage", U.S. Army Corps of Engineers, 1981.

Not in EIA list

[1] http://www.dom.com/about/stations/hydro/bath-county-pumped-storage-station.jsp

[2] http://www.nwcouncil.org/energy/wind/meetings/2008/10/ManhoYeung.pdf

[3] http://www.consumersenergy.com/content.aspx?id=1830

[4] http://www.firstlightpower.com/generation/north.asp

[5] http://www.sas.usace.army.mil/lakes/russell/hydropower.htm

[6] http://files.asme.org/asmeorg/Communities/History/Landmarks/3137.pdf

[7] http://www.usbr.gov/lc/phoenix/projects/waddelldamproj.html

[8] http://www.sas.usace.army.mil/lakes/russell/intro.html

[9] http://www.exeloncorp.com/powerplants/muddyrun/Pages/profile.aspx

[10] Site Internet webpages

APPENDIX B

Potential Sites for Pumped Storage at Existing Hydroelectric Plants Having Nameplate Capacities of 1 MW or Greater

Appendix B

Potential Sites for Pumped Storage at Existing Hydroelectric Plants Having Nameplate Capacities of 1 MW or Greater

Table B-1. Candidate pump-up configuration pumped storage sites at existing hydroelectric plants sorted by state.

	Hydroelectric Plant Characteristics							Potential Reservoir Characteristics				
	State	Project Name	Owner Name	River	Nameplate Rating (MW)	Base Plant Elevation (MSL) (ft)	Reservoir	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Plant to Waterbody (ft)
1	AL	Holt L&D	Alabama Power Co	Black Warrior R	40	168	Holt Lake	Lake Harris	139	203	6,726	35
2	AR	Arkansas L&D 2	Arkansas Elec Coop Corp	Arkansas R	120	193	Pool 2		619	152	9,271	-42
3	CA	Parker	Bureau Of Reclamation	Colorado R	120	417	Lake Havasu	Gene Wash Reservoir	200	739	7,180	321
4	CA	Exchequer	Merced Irrig Dist	Merced R	80	476	Exchequer Res		296	402	6,490	-74
5	CA	Donnells	Oakdale & San Joaquin Irr Dist	M Fk Stanislaus R	54	3,460	Donnells Res	Beardsley Lake	704	3,408	1,000	-52
6	CA	Chicago Park	Nevada Irrig Dist	Chicago Park Flm(Bear R)	40	2,289	Chicago Park Forebay	Rollins Reservoir	777	2,193	5,562	-95
7	CA	De Sabla	Pacific Gas & Electric Co	Butte Cr	18	1,287	De Sabla Fb	Paradise Lake	149	2,556	9,491	1,269
8	CA	Forks Of Butte	Hypower, Inc	Butte Cr	13	1,299	Butte Creek Diversion	Paradise Lake	149	2,556	9,662	1,257
9	CA	Merced Falls	Pacific Gas & Electric Co	Merced R	3	343	Merced Falls Res		296	391	5,316	48
10	CA	Deadwood Creek	Yuba County Water Agency	Deadwood Cr	2	1,994	Deadwood Creek Diversion	New Bullards Bar Reservoir	4,021	1,910	8,655	-85
11	CA	Toadtown	Pacific Gas & Electric Co	Hendricks Cnl	2	2,842	Hendricks Head	Paradise Lake	149	2,560	9,445	-282
12	CA	Lake Combie	Nevada Irrig Dist	Bear R	2	1,530	Lake Combie	Lake of the Pines	220	1,507	7,765	-23
13	GA	Burton	Georgia Power Co	Tallulah R	8	1,803	Burton Lake	Seed Lake	190	1,753	5,248	-50
14	GA	Nacoochee	Georgia Power Co	Tallulah R	5	1,721	Seed Lake	Lake Rabun	723	1,683	3,440	-38
15	MA	Cabot	Northeast Generation Co	Connecticut R	51	132	Turners Falls Pond		229	180	9,279	48
16	MA	Cobble Mountain	Western Mass Electric Co	Little R	33	565		Cobble Mountain Reservoir	1,034	954	6,788	390
17	MA	Fife Brook (Bear Swamp Lwr)	Usgen New England, Inc. & Bear Swamp Generating Trust No. 1	Deerfield R	11	886	Fife Brook Res	Bear Swamp Upper Reservoir	108	1,600	2,414	713
18	ME	Deer Rips	Fpl Energy Maine Hydro, LLC	Androscoggin R	7	173	Deer Rips Res	Gulf Island Pond	908	261	7,015	88
19	ME	West Buxton Lower	Fpl Energy Maine Hydro, LLC	Saco R	4	160	West Buxton Res	Bonny Eagle Pond	211	271	8,959	112
20	ME	Androscoggin No 3	Fpl Energy Maine Hydro, LLC	Androscoggin R	4	166	Androscoggin No 3	Gulf Island Pond	908	262	6,799	96
21	ME	North Gorham	Fpl Energy Maine Hydro, LLC	Presumpscot R	2	190	North Gorham Res	The Notch	30,543	268	9,850	79
22	MI	Mc Clure	Upper Penisula Power Co (Uppco)	Dead R	10	795			110	657	8,522	-138
23	MI	Brule	Wisconsin Electric Power Co	Brule R	5	1,156	Brule Res		480	1,184	5,358	28
24	MI	Hemlock Falls	Wisconsin Electric Power Co	Michigamme R	3	1,321	Hemlock Falls Res		5,443	1,380	7,418	59
25	MI	Ford Lake(Rawsonville)	Charter Township Of Ypsilanti	Huron R	2	679	Ford Lake	Belleville Lake	1,248	650	4,112	-29
26	MN	Rapidan	Rapidan Redevelopment Ltd	Blue Earth R	5	845		Mills Lake	231	978	8,469	133
27	MN	Winton	Allete, Inc	Kawishiwi R	4	1,344	Garden Lake	Cedar Lake	460	1,395	9,009	51
28	MN	Brainerd	Missota Paper Co	Mississippi R	3	1,156	Brainerd Res	Gilbert Lake	363	1,181	1,904	25
29	MN	Sylvan	Allete, Inc	Crow Wing R	2	1,165	Sylvan Res	Mud Lake	173	1,202	8,283	37
30	MN	Prairie River	Allete, Inc	Prairie R	1	1,263	Prairie River Res	Lind Greenway Tailings Basin	130	1,300	3,363	37
31	MN	Dayton Hollow	Otter Tail Power Co	Otter Tail R	1	1,092			579	1,071	6,692	-21
32	MN	Dayton Hollow	Otter Tail Power Co	Otter Tail R	1	1,092		Horseshoe Lake	108	1,157	8,919	65
33	NC	Thorpe	Duke Energy Corporation	W Fk Tuckasegee R	22	2,295	Thorpe Res	Cedar Cliff Lake	108	2,327	10,424	32
34	NC	Tuckasegee	Duke Energy Corporation	W Fk Tuckasegee R	3	2,173	Tuckasegee Res	Cedar Cliff Lake	108	2,327	8,339	154
35	NH	Eastman Falls	Public Service Co Of Nh	Pemigewasset R	6	295	Eastman Falls Res	Webster Lake	606	402	6,536	106
36	NH	South Milton	Salmon River Falls Hydro Corp	Salmon Falls R	2	382	South Milton	Spaulding Pond	104	250	6,268	-132
37	NV	26 Foot Drop	Sierra Pacific Power Co	Carson R	2	4,019		Sheckler Reservoir	2,768	3,997	10,538	-22
38	NY	Bennetts Bridge	Erie Boulevard Hydropower LP	Salmon R	29	937	Salmon River Reservoir		159	660	9,596	-276
39	NY	Neversink	Cent Hudson G & El Corp	Neversink Div	25	913		Rondout Reservoir	2,046	839	4,544	-74
40	NY	Schaghticoke	Erie Boulevard Hydropower, LP	Hoosic R	16	248	Schaghticoke Res		1,709	391	8,927	143

Table B-1. Candidate pump-up configuration pumped storage sites at existing hydroelectric plants sorted by state. (continued)

	Hydroelectric Plant Characteristics							Potential Reservoir Characteristics				
	State	Project Name	Owner Name	River	Nameplate Rating (MW)	Base Plant Elevation (MSL) (ft)	Reservoir	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Plant to Waterbody (ft)
41	NY	Browns Falls	Erie Boulevard Hydropower LP	E Br Oswegatchie R	15	1,096	Browns Falls Res		144	1,346	5,081	251
42	NY	Blake Falls	Erie Boulevard Hydropower, LP	Raquette R	14	1,195	Blake Falls Res	Joe Indian Pond	357	1,299	9,041	104
43	NY	Vischer Ferry	New York Power Authority	Mohawk R	12	203	Vischer Ferry		359	271	6,075	68
44	NY	Granby (New)	Erie Boulevard Hydropower, L.P.	Oswego R	10	307	Fulton Lwr Dam 4 Res	Lake Neatahwanta	776	368	4,433	61
45	NY	Swinging Bridge 1 & 2	Mirant Ny-Gen, LLC	Mongaup R	7	1,062	Swinging Bridge Res	Lebanon Lake	358	1,137	4,189	75
46	NY	Swinging Bridge 1 & 2	Mirant Ny-Gen, LLC	Mongaup R	7	1,062	Swinging Bridge Res	Mongaup Falls Reservoir	107	942	6,911	-120
47	NY	Flat Rock	Erie Boulevard Hydropower LP	E Br Oswegatchie R	6	1,038	Flat Rock Res		144	1,346	9,547	308
48	NY	Dolgeville	Fortisus Energy Corp	E Canada Cr	5	720	Dolgeville	Kyser Lake	153	659	5,950	-61
49	NY	Mongaup	Mirant Ny-Gen, LLC	Mongaup R	4	920	Mongaup Falls Res	Rio Reservoir	422	813	3,549	-106
50	NY	Mongaup	Mirant Ny-Gen, LLC	Mongaup R	4	920	Mongaup Falls Res	Mohican Lake	188	1,269	10,510	350
51	NY	Phoenix(Oswego L&D 1)	Oswego Hydro Partners	Oswego R	3	355	L&D Pool 1		238	399	9,164	44
52	NY	Effley	Erie Boulevard Hydropower LP	Beaver R	3	1,117	Effley Res	Taylorville Pond	111	1,071	2,833	-46
53	NY	Belfort	Erie Boulevard Hydropower LP	Beaver R	2	926	Belfort Res	Taylorville Pond	111	1,069	5,259	143
54	NY	Oswego Falls W	Erie Boulevard Hydropower LP	Oswego R	2	334	Oswego Falls	Lake Neatahwanta	776	370	2,835	36
55	NY	Newton Falls	Orion Power New York Gp Ii, Inc	E Br Oswegatchie R	2	1,399	Newton Falls Upper		144	1,346	5,903	-53
56	NY	Newton Falls	Orion Power New York Gp Ii, Inc	E Br Oswegatchie R	2	1,399	Newton Falls Upper		161	1,438	9,179	38
57	NY	Elmer	Erie Boulevard Hydropower LP	Beaver R	2	1,101	Elmer Res	Effley Falls Pond	313	1,163	2,585	62
58	NY	Fulton	Erie Boulevard Hydropower, LP	Oswego R	1	310	Fulton Lower Res	Lake Neatahwanta	776	366	4,205	57
59	OR	Lookout Point	Corps Of Engineers	M Fk Willamette R	120	724	Lookout Point Lake	Fall Creek Lake	1,716	841	8,744	117
60	OR	Stone Creek	Eugene Water & Electric Board	Oak Grove Fk	12	3,077		Timothy Lake	1,400	3,231	3,398	154
61	OR	East Side	Pacificorp	Klamath R	3	4,139	Upper Klamath Lake	Lake Ewauna	371	4,091	6,732	-48
62	PA	Holtwood	Ppl Holtwood, LLC	Susquehanna R	108	154	Lake Aldred		811	501	6,004	347
63	PA	Wallenpaupack	Ppl Holtwood, LLC	Wallenpaupack Cr	40	850	Lake Wallenpaupack	Tinkwig Lake	117	1,101	8,919	251
64	SC	Dearborn	Duke Power Co	Catawba R	45	330	Dearborn-Gt Falls Re	Wateree Lake	11,756	257	7,574	-72
65	SC	Great Falls	Duke Power Co	Catawba R	24	297	Dearborn-Gt Falls Re	Wateree Lake	11,756	257	7,836	-40
66	TX	Denison	Corps Of Engineers	Red R	70	546	Lake Texoma	Randell Lake	242	616	6,576	70
67	VA	Pinnacles(Townes Dam)	Danville, City Of	Dan R	11	2,120	Pinnacles	Talbott Reservoir	140	2,531	7,971	410
68	VT	Harriman	Usgen New England, Inc	Deerfield R	34	1,320	Harriman Res	Sadawga Lake	160	1,669	8,908	348
69	VT	Milton	Central Vt Pub Serv Corp	Lamoille R	6	214	Milton Res	Arrowhead Mountain Lake	717	289	2,433	75
70	WA	Electron	Puget Sound Pwr And Lt Co	Puyallup R	26	709	Electron Res	Lake Kapowsin	497	585	6,790	-125
71	WA	Koma Kulshan	Koma Kulshan Assoc	Sandy Cr	12	1,105		Baker Lake	4,745	729	8,506	-377
72	WI	Oconto Falls	N.E.W. Hydro Inc	Oconto R	2	694	Oconto Falls Res	Oconto Falls Pond 729	180	725	2,106	31
73	WI	Hat Rapids	Wisconsin Public Service Corp	Wisconsin R	2	1,502	Hat Rapids Res	Emma Lake	227	1,571	6,117	69
74	WI	Hat Rapids	Wisconsin Public Service Corp	Wisconsin R	2	1,502	Hat Rapids Res	Crescent Lake	616	1,570	10,019	68
75	WI	Danbury	Flambeau Hydro LLC.	Yellow R	1	916	Danbury Res	Minerva Lake	222	940	9,590	24

EIA	Energy Information Administration & other
NHD	National Hydrography Dataset
INL	Idaho National Laboratory

Table B-2. Candidate pump-up configuration pumped storage sites at existing hydroelectric plants sorted by plant nameplate capacity.

	Hydroelectric Plant Characteristics							Potential Reservoir Characteristics				
	State	Project Name	Owner Name	River	Nameplate Rating (MW)	Base Plant Elevation (MSL) (ft)	Reservoir	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Plant to Waterbody (ft)
1	CA	Parker	Bureau Of Reclamation	Colorado R	120	417	Lake Havasu	Gene Wash Reservoir	200	739	7,180	321
2	OR	Lookout Point	Corps Of Engineers	M Fk Willamette R	120	724	Lookout Point Lake	Fall Creek Lake	1,716	841	8,744	117
3	AR	Arkansas L&D 2	Arkansas Elec Coop Corp	Arkansas R	120	193	Pool 2		619	152	9,271	-42
4	PA	Holtwood	Ppl Holtwood, LLC	Susquehanna R	108	154	Lake Aldred		811	501	6,004	347
5	CA	Exchequer	Merced Irrig Dist	Merced R	80	476	Exchequer Res		296	402	6,490	-74
6	TX	Denison	Corps Of Engineers	Red R	70	546	Lake Texoma	Randell Lake	242	616	6,576	70
7	CA	Donnells	Oakdale & San Joaquin Irr Dist	M Fk Stanislaus R	54	3,460	Donnells Res	Beardsley Lake	704	3,408	1,000	-52
8	MA	Cabot	Northeast Generation Co	Connecticut R	51	132	Turners Falls Pond		229	180	9,279	48
9	SC	Dearborn	Duke Power Co	Catawba R	45	330	Dearborn-Gt Falls Re	Wateree Lake	11,756	257	7,574	-72
10	AL	Holt L&D	Alabama Power Co	Black Warrior R	40	168	Holt Lake	Lake Harris	139	203	6,726	35
11	PA	Wallenpaupack	Ppl Holtwood, LLC	Wallenpaupack Cr	40	850	Lake Wallenpaupack	Tinkwig Lake	117	1,101	8,919	251
12	CA	Chicago Park	Nevada Irrig Dist	Chicago Park Flm(Bear R)	40	2,289	Chicago Park Forebay	Rollins Reservoir	777	2,193	5,562	-95
13	VT	Harriman	Usgen New England, Inc	Deerfield R	34	1,320	Harriman Res	Sadawga Lake	160	1,669	8,908	348
14	MA	Cobble Mountain	Western Mass Electric Co	Little R	33	565		Cobble Mountain Reservoir	1,034	954	6,788	390
15	NY	Bennetts Bridge	Erie Boulevard Hydropower LP	Salmon R	29	937	Salmon River Reservoir		159	660	9,596	-276
16	WA	Electron	Puget Sound Pwr And Lt Co	Puyallup R	26	709	Electron Res	Lake Kapowsin	497	585	6,790	-125
17	NY	Neversink	Cent Hudson G & El Corp	Neversink Div	25	913		Rondout Reservoir	2,046	839	4,544	-74
18	SC	Great Falls	Duke Power Co	Catawba R	24	297	Dearborn-Gt Falls Re	Wateree Lake	11,756	257	7,836	-40
19	NC	Thorpe	Duke Energy Corporation	W Fk Tuckasegee R	22	2,295	Thorpe Res	Cedar Cliff Lake	108	2,327	10,424	32
20	CA	De Sabla	Pacific Gas & Electric Co	Butte Cr	18	1,287	De Sabla Fb	Paradise Lake	149	2,556	9,491	1,269
21	NY	Schaghticoke	Erie Boulevard Hydropower, LP	Hoosic R	16	248	Schaghticoke Res		1,709	391	8,927	143
22	NY	Browns Falls	Erie Boulevard Hydropower LP	E Br Oswegatchie R	15	1,096	Browns Falls Res		144	1,346	5,081	251
23	NY	Blake Falls	Erie Boulevard Hydropower, LP	Raquette R	14	1,195	Blake Falls Res	Joe Indian Pond	357	1,299	9,041	104
24	CA	Forks Of Butte	Hypower, Inc	Butte Cr	13	1,299	Butte Creek Diversion	Paradise Lake	149	2,556	9,662	1,257
25	OR	Stone Creek	Eugene Water & Electric Board	Oak Grove Fk	12	3,077		Timothy Lake	1,400	3,231	3,398	154
26	WA	Koma Kulshan	Koma Kulshan Assoc	Sandy Cr	12	1,105		Baker Lake	4,745	729	8,506	-377
27	NY	Vischer Ferry	New York Power Authority	Mohawk R	12	203	Vischer Ferry		359	271	6,075	68
28	MA	Fife Brook (Bear Swamp Lwr)	Usgen New England, Inc. & Bear Swamp Generating Trust	Deerfield R	11	886	Fife Brook Res	Bear Swamp Upper Reservoir	108	1,600	2,414	713
29	VA	Pinnacles(Townes Dam)	Danville, City Of	Dan R	11	2,120	Pinnacles	Talbott Reservoir	140	2,531	7,971	410
30	NY	Granby (New)	Erie Boulevard Hydropower, L.P.	Oswego R	10	307	Fulton Lwr Dam 4 Res	Lake Neatahwanta	776	368	4,433	61
31	MI	Mc Clure	Upper Penisula Power Co (Uppco)	Dead R	10	795			110	657	8,522	-138
32	GA	Burton	Georgia Power Co	Tallulah R	8	1,803	Burton Lake	Seed Lake	190	1,753	5,248	-50
33	NY	Swinging Bridge 1 & 2	Mirant Ny-Gen, LLC	Mongaup R	7	1,062	Swinging Bridge Res	Lebanon Lake	358	1,137	4,189	75
34	NY	Swinging Bridge 1 & 2	Mirant Ny-Gen, LLC	Mongaup R	7	1,062	Swinging Bridge Res	Mongaup Falls Reservoir	107	942	6,911	-120
35	ME	Deer Rips	Fpl Energy Maine Hydro, LLC	Androscoggin R	7	173	Deer Rips Res	Gulf Island Pond	908	261	7,015	88
36	NH	Eastman Falls	Public Service Co Of Nh	Pemigewasset R	6	295	Eastman Falls Res	Webster Lake	606	402	6,536	106
37	VT	Milton	Central Vt Pub Serv Corp	Lamoille R	6	214	Milton Res	Arrowhead Mountain Lake	717	289	2,433	75
38	NY	Flat Rock	Erie Boulevard Hydropower LP	E Br Oswegatchie R	6	1,038	Flat Rock Res		144	1,346	9,547	308
39	MI	Brule	Wisconsin Electric Power Co	Brule R	5	1,156	Brule Res		480	1,184	5,358	28
40	NY	Dolgeville	Fortisus Energy Corp	E Canada Cr	5	720	Dolgeville	Kyser Lake	153	659	5,950	-61

Table B-2. Candidate pump-up configuration pumped storage sites at existing hydroelectric plants sorted by plant nameplate capacity. (continued)

	Hydroelectric Plant Characteristics							Potential Reservoir Characteristics				
	State	Project Name	Owner Name	River	Nameplate Rating (MW)	Base Plant Elevation (MSL) (ft)	Reservoir	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Plant to Waterbody (ft)
41	MN	Rapidan	Rapidan Redevelopment Ltd	Blue Earth R	5	845		Mills Lake	231	978	8,469	133
42	GA	Nacoochee	Georgia Power Co	Tallulah R	5	1,721	Seed Lake	Lake Rabun	723	1,683	3,440	-38
43	NY	Mongaup	Mirant Ny-Gen, LLC	Mongaup R	4	920	Mongaup Falls Res	Rio Reservoir	422	813	3,549	-106
44	ME	West Buxton Lower	Fpl Energy Maine Hydro, LLC	Saco R	4	160	West Buxton Res	Bonny Eagle Pond	211	271	8,959	112
45	MN	Winton	Allete, Inc	Kawishiwi R	4	1,344	Garden Lake	Cedar Lake	460	1,395	9,009	51
46	NY	Mongaup	Mirant Ny-Gen, LLC	Mongaup R	4	920	Mongaup Falls Res	Mohican Lake	188	1,269	10,510	350
47	ME	Androscoggin No 3	Fpl Energy Maine Hydro, LLC	Androscoggin R	4	166	Androscoggin No 3	Gulf Island Pond	908	262	6,799	96
48	CA	Merced Falls	Pacific Gas & Electric Co	Merced R	3	343	Merced Falls Res		296	391	5,316	48
49	NY	Phoenix(Oswego L&D 1)	Oswego Hydro Partners	Oswego R	3	355	L&D Pool 1		238	399	9,164	44
50	MN	Brainerd	Missota Paper Co	Mississippi R	3	1,156	Brainerd Res	Gilbert Lake	363	1,181	1,904	25
51	OR	East Side	Pacificorp	Klamath R	3	4,139	Upper Klamath Lake	Lake Ewauna	371	4,091	6,732	-48
52	NC	Tuckasegee	Duke Energy Corporation	W Fk Tuckasegee R	3	2,173	Tuckasegee Res	Cedar Cliff Lake	108	2,327	8,339	154
53	NY	Effley	Erie Boulevard Hydropower LP	Beaver R	3	1,117	Effley Res	Taylorville Pond	111	1,071	2,833	-46
54	MI	Hemlock Falls	Wisconsin Electric Power Co	Michigamme R	3	1,321	Hemlock Falls Res		5,443	1,380	7,418	59
55	ME	North Gorham	Fpl Energy Maine Hydro, LLC	Presumpscot R	2	190	North Gorham Res	The Notch	30,543	268	9,850	79
56	NY	Belfort	Erie Boulevard Hydropower LP	Beaver R	2	926	Belfort Res	Taylorville Pond	111	1,069	5,259	143
57	CA	Deadwood Creek	Yuba County Water Agency	Deadwood Cr	2	1,994	Deadwood Creek Diversion	New Bullards Bar Reservoir	4,021	1,910	8,655	-85
58	MI	Ford Lake(Rawsonville)	Charter Township Of Ypsilanti	Huron R	2	679	Ford Lake	Belleville Lake	1,248	650	4,112	-29
59	NY	Oswego Falls W	Erie Boulevard Hydropower LP	Oswego R	2	334	Oswego Falls	Lake Neatahwanta	776	370	2,835	36
60	WI	Oconto Falls	N.E.W. Hydro Inc	Oconto R	2	694	Oconto Falls Res	Oconto Falls Pond 729	180	725	2,106	31
61	MN	Sylvan	Allete, Inc	Crow Wing R	2	1,165	Sylvan Res	Mud Lake	173	1,202	8,283	37
62	CA	Toadtown	Pacific Gas & Electric Co	Hendricks Cnl	2	2,842	Hendricks Head	Paradise Lake	149	2,560	9,445	-282
63	WI	Hat Rapids	Wisconsin Public Service Corp	Wisconsin R	2	1,502	Hat Rapids Res	Emma Lake	227	1,571	6,117	69
64	WI	Hat Rapids	Wisconsin Public Service Corp	Wisconsin R	2	1,502	Hat Rapids Res	Crescent Lake	616	1,570	10,019	68
65	NV	26 Foot Drop	Sierra Pacific Power Co	Carson R	2	4,019		Sheckler Reservoir	2,768	3,997	10,538	-22
66	NY	Newton Falls	Orion Power New York Gp Ii, Inc	E Br Oswegatchie R	2	1,399	Newton Falls Upper		144	1,346	5,903	-53
67	NY	Newton Falls	Orion Power New York Gp Ii, Inc	E Br Oswegatchie R	2	1,399	Newton Falls Upper		161	1,438	9,179	38
68	NY	Elmer	Erie Boulevard Hydropower LP	Beaver R	2	1,101	Elmer Res	Effley Falls Pond	313	1,163	2,585	62
69	NH	South Milton	Salmon River Falls Hydro Corp	Salmon Falls R	2	382	South Milton	Spaulding Pond	104	250	6,268	-132
70	CA	Lake Combie	Nevada Irrig Dist	Bear R	2	1,530	Lake Combie	Lake of the Pines	220	1,507	7,765	-23
71	NY	Fulton	Erie Boulevard Hydropower, LP	Oswego R	1	310	Fulton Lower Res	Lake Neatahwanta	776	366	4,205	57
72	MN	Prairie River	Allete, Inc	Prairie R	1	1,263	Prairie River Res	Lind Greenway Tailings Basin	130	1,300	3,363	37
73	WI	Danbury	Flambeau Hydro LLC.	Yellow R	1	916	Danbury Res	Minerva Lake	222	940	9,590	24
74	MN	Dayton Hollow	Otter Tail Power Co	Otter Tail R	1	1,092			579	1,071	6,692	-21
75	MN	Dayton Hollow	Otter Tail Power Co	Otter Tail R	1	1,092		Horseshoe Lake	108	1,157	8,919	65

EIA	Energy Information Administration & other
NHD	National Hydrography Dataset
INL	Idaho National Laboratory

Table B-3. Candidate pump-up configuration pumped storage sites at existing hydroelectric plants sorted by gross potential hydraulic head.[6]

	Hydroelectric Plant Characteristics							Potential Reservoir Characteristics				
	State	Project Name	Owner Name	River	Nameplate Rating (MW)	Base Plant Elevation (MSL) (ft)	Reservoir	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Plant to Waterbody (ft)
1	CA	De Sabla	Pacific Gas & Electric Co	Butte Cr	18	1,287	De Sabla Fb	Paradise Lake	149	2,556	9,491	1,269
2	CA	Forks Of Butte	Hypower, Inc	Butte Cr	13	1,299	Butte Creek Diversion	Paradise Lake	149	2,556	9,662	1,257
3	MA	Fife Brook (Bear Swamp Lwr)	Usgen New England, Inc. & Bear Swamp Generating Trust	Deerfield R	11	886	Fife Brook Res	Bear Swamp Upper Reservoir	108	1,600	2,414	713
4	VA	Pinnacles(Townes Dam)	Danville, City Of	Dan R	11	2,120	Pinnacles	Talbott Reservoir	140	2,531	7,971	410
5	MA	Cobble Mountain	Western Mass Electric Co	Little R	33	565		Cobble Mountain Reservoir	1,034	954	6,788	390
6	NY	Mongaup	Mirant Ny-Gen, LLC	Mongaup R	4	920	Mongaup Falls Res	Mohican Lake	188	1,269	10,510	350
7	VT	Harriman	Usgen New England, Inc	Deerfield R	34	1,320	Harriman Res	Sadawga Lake	160	1,669	8,908	348
8	PA	Holtwood	Ppl Holtwood, LLC	Susquehanna R	108	154	Lake Aldred		811	501	6,004	347
9	CA	Parker	Bureau Of Reclamation	Colorado R	120	417	Lake Havasu	Gene Wash Reservoir	200	739	7,180	321
10	NY	Flat Rock	Erie Boulevard Hydropower LP	E Br Oswegatchie R	6	1,038	Flat Rock Res		144	1,346	9,547	308
11	PA	Wallenpaupack	Ppl Holtwood, LLC	Wallenpaupack Cr	40	850	Lake Wallenpaupack	Tinkwig Lake	117	1,101	8,919	251
12	NY	Browns Falls	Erie Boulevard Hydropower LP	E Br Oswegatchie R	15	1,096	Browns Falls Res		144	1,346	5,081	251
13	OR	Stone Creek	Eugene Water & Electric Board	Oak Grove Fk	12	3,077		Timothy Lake	1,400	3,231	3,398	154
14	NC	Tuckasegee	Duke Energy Corporation	W Fk Tuckasegee R	3	2,173	Tuckasegee Res	Cedar Cliff Lake	108	2,327	8,339	154
15	NY	Schaghticoke	Erie Boulevard Hydropower, LP	Hoosic R	16	248	Schaghticoke Res		1,709	391	8,927	143
16	NY	Belfort	Erie Boulevard Hydropower LP	Beaver R	2	926	Belfort Res	Taylorville Pond	111	1,069	5,259	143
17	MN	Rapidan	Rapidan Redevelopment Ltd	Blue Earth R	5	845		Mills Lake	231	978	8,469	133
18	OR	Lookout Point	Corps Of Engineers	M Fk Willamette R	120	724	Lookout Point Lake	Fall Creek Lake	1,716	841	8,744	117
19	ME	West Buxton Lower	Fpl Energy Maine Hydro, LLC	Saco R	4	160	West Buxton Res	Bonny Eagle Pond	211	271	8,959	112
20	NH	Eastman Falls	Public Service Co Of Nh	Pemigewasset R	6	295	Eastman Falls Res	Webster Lake	606	402	6,536	106
21	NY	Blake Falls	Erie Boulevard Hydropower, LP	Raquette R	14	1,195	Blake Falls Res	Joe Indian Pond	357	1,299	9,041	104
22	ME	Androscoggin No 3	Fpl Energy Maine Hydro, LLC	Androscoggin R	4	166	Androscoggin No 3	Gulf Island Pond	908	262	6,799	96
23	ME	Deer Rips	Fpl Energy Maine Hydro, LLC	Androscoggin R	7	173	Deer Rips Res	Gulf Island Pond	908	261	7,015	88
24	ME	North Gorham	Fpl Energy Maine Hydro, LLC	Presumpscot R	2	190	North Gorham Res	The Notch	30,543	268	9,850	79
25	VT	Milton	Central Vt Pub Serv Corp	Lamoille R	6	214	Milton Res	Arrowhead Mountain Lake	717	289	2,433	75
26	NY	Swinging Bridge 1 & 2	Mirant Ny-Gen, LLC	Mongaup R	5	1,062	Swinging Bridge Res	Lebanon Lake	358	1,137	4,189	75
27	TX	Denison	Corps Of Engineers	Red R	70	546	Lake Texoma	Randell Lake	242	616	6,576	70
28	WI	Hat Rapids	Wisconsin Public Service Corp	Wisconsin R	2	1,502	Hat Rapids Res	Emma Lake	227	1,571	6,117	69
29	WI	Hat Rapids	Wisconsin Public Service Corp	Wisconsin R	2	1,502	Hat Rapids Res	Crescent Lake	616	1,570	10,019	68
30	NY	Vischer Ferry	New York Power Authority	Mohawk R	12	203	Vischer Ferry		359	271	6,075	68
31	MN	Dayton Hollow	Otter Tail Power Co	Otter Tail R	1	1,092		Horseshoe Lake	108	1,157	8,919	65
32	NY	Elmer	Erie Boulevard Hydropower LP	Beaver R	2	1,101	Elmer Res	Effley Falls Pond	313	1,163	2,585	62
33	NY	Granby (New)	Erie Boulevard Hydropower, L.P.	Oswego R	10	307	Fulton Lwr Dam 4 Res	Lake Neatahwanta	776	368	4,433	61
34	MI	Hemlock Falls	Wisconsin Electric Power Co	Michigamme R	3	1,321	Hemlock Falls Res		5,443	1,380	7,418	59
35	NY	Fulton	Erie Boulevard Hydropower, LP	Oswego R	1	310	Fulton Lower Res	Lake Neatahwanta	776	366	4,205	57
36	MN	Winton	Allete, Inc	Kawishiwi R	4	1,344	Garden Lake	Cedar Lake	460	1,395	9,009	51
37	MA	Cabot	Northeast Generation Co	Connecticut R	51	132	Turners Falls Pond		229	180	9,279	48
38	CA	Merced Falls	Pacific Gas & Electric Co	Merced R	3	343	Merced Falls Res		296	391	5,316	48
39	NY	Phoenix(Oswego L&D 1)	Oswego Hydro Partners	Oswego R	3	355	L&D Pool 1		238	399	9,164	44
40	NY	Newton Falls	Orion Power New York Gp Ii, Inc	E Br Oswegatchie R	2	1,399	Newton Falls Upper		161	1,438	9,179	38

[6] Gross potential hydraulic head is the elevation difference between the existing hydroelectric plant elevation and the potential reservoir elevation.

Table B-3. Candidate pump-up configuration pumped storage sites at existing hydroelectric plants sorted by gross potential hydraulic head. (continued)

	Hydroelectric Plant Characteristics							Potential Reservoir Characteristics				
	State	Project Name	Owner Name	River	Nameplate Rating (MW)	Base Plant Elevation (MSL) (ft)	Reservoir	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Plant to Waterbody (ft)
41	MN	Prairie River	Allete, Inc	Prairie R	1	1,263	Prairie River Res	Lind Greenway Tailings Basin	130	1,300	3,363	37
42	MN	Sylvan	Allete, Inc	Crow Wing R	2	1,165	Sylvan Res	Mud Lake	173	1,202	8,283	37
43	NY	Oswego Falls W	Erie Boulevard Hydropower LP	Oswego R	2	334	Oswego Falls	Lake Neatahwanta	776	370	2,835	36
44	AL	Holt L&D	Alabama Power Co	Black Warrior R	40	168	Holt Lake	Lake Harris	139	203	6,726	35
45	NC	Thorpe	Duke Energy Corporation	W Fk Tuckasegee R	22	2,295	Thorpe Res	Cedar Cliff Lake	108	2,327	10,424	32
46	WI	Oconto Falls	N.E.W. Hydro Inc	Oconto R	2	694	Oconto Falls Res	Oconto Falls Pond 729	180	725	2,106	31
47	MI	Brule	Wisconsin Electric Power Co	Brule R	5	1,156	Brule Res		480	1,184	5,358	28
48	MN	Brainerd	Missota Paper Co	Mississippi R	3	1,156	Brainerd Res	Gilbert Lake	363	1,181	1,904	25
49	WI	Danbury	Flambeau Hydro LLC.	Yellow R	1	916	Danbury Res	Minerva Lake	222	940	9,590	24
50	MN	Dayton Hollow	Otter Tail Power Co	Otter Tail R	1	1,092			579	1,071	6,692	-21
51	NV	26 Foot Drop	Sierra Pacific Power Co	Carson R	2	4,019		Sheckler Reservoir	2,768	3,997	10,538	-22
52	CA	Lake Combie	Nevada Irrig Dist	Bear R	2	1,530	Lake Combie	Lake of the Pines	220	1,507	7,765	-23
53	MI	Ford Lake(Rawsonville)	Charter Township Of Ypsilanti	Huron R	2	679	Ford Lake	Belleville Lake	1,248	650	4,112	-29
54	GA	Nacoochee	Georgia Power Co	Tallulah R	5	1,721	Seed Lake	Lake Rabun	723	1,683	3,440	-38
55	SC	Great Falls	Duke Power Co	Catawba R	24	297	Dearborn-Gt Falls Re	Wateree Lake	11,756	257	7,836	-40
56	AR	Arkansas L&D 2	Arkansas Elec Coop Corp	Arkansas R	120	193	Pool 2		619	152	9,271	-42
57	NY	Effley	Erie Boulevard Hydropower LP	Beaver R	3	1,117	Effley Res	Taylorville Pond	111	1,071	2,833	-46
58	OR	East Side	Pacificorp	Klamath R	3	4,139	Upper Klamath Lake	Lake Ewauna	371	4,091	6,732	-48
59	GA	Burton	Georgia Power Co	Tallulah R	8	1,803	Burton Lake	Seed Lake	190	1,753	5,248	-50
60	CA	Donnells	Oakdale & San Joaquin Irr Dist	M Fk Stanislaus R	54	3,460	Donnells Res	Beardsley Lake	704	3,408	1,000	-52
61	NY	Newton Falls	Orion Power New York Gp Ii, Inc	E Br Oswegatchie R	2	1,399	Newton Falls Upper		144	1,346	5,903	-53
62	NY	Dolgeville	Fortisus Energy Corp	E Canada Cr	5	720	Dolgeville	Kyser Lake	153	659	5,950	-61
63	SC	Dearborn	Duke Power Co	Catawba R	45	330	Dearborn-Gt Falls Re	Wateree Lake	11,756	257	7,574	-72
64	NY	Neversink	Cent Hudson G & El Corp	Neversink Div	25	913		Rondout Reservoir	2,046	839	4,544	-74
65	CA	Exchequer	Merced Irrig Dist	Merced R	80	476	Exchequer Res		296	402	6,490	-74
66	CA	Deadwood Creek	Yuba County Water Agency	Deadwood Cr	2	1,994	Deadwood Creek Diversion	New Bullards Bar Reservoir	4,021	1,910	8,655	-85
67	CA	Chicago Park	Nevada Irrig Dist	Chicago Park Flm(Bear R)	40	2,289	Chicago Park Forebay	Rollins Reservoir	777	2,193	5,562	-95
68	NY	Mongaup	Mirant Ny-Gen, LLC	Mongaup R	4	920	Mongaup Falls Res	Rio Reservoir	422	813	3,549	-106
69	NY	Swinging Bridge 1 & 2	Mirant Ny-Gen, LLC	Mongaup R	5	1,062	Swinging Bridge Res	Mongaup Falls Reservoir	107	942	6,911	-120
70	WA	Electron	Puget Sound Pwr And Lt Co	Puyallup R	26	709	Electron Res	Lake Kapowsin	497	585	6,790	-125
71	NH	South Milton	Salmon River Falls Hydro Corp	Salmon Falls R	2	382	South Milton	Spaulding Pond	104	250	6,268	-132
72	MI	Mc Clure	Upper Penisula Power Co (Uppco)	Dead R	10	795			110	657	8,522	-138
73	NY	Bennetts Bridge	Erie Boulevard Hydropower LP	Salmon R	29	937	Salmon River Reservoir		159	660	9,596	-276
74	CA	Toadtown	Pacific Gas & Electric Co	Hendricks Cnl	2	2,842	Hendricks Head	Paradise Lake	149	2,560	9,445	-282
75	WA	Koma Kulshan	Koma Kulshan Assoc	Sandy Cr	12	1,105		Baker Lake	4,745	729	8,506	-377

EIA	Energy Information Administration & other
NHD	National Hydrography Dataset
INL	Idaho National Laboratory

APPENDIX C

Potential Sites for Pumped Storage at Non-powered Dams Having Capacity Potentials 1 MW or Greater

Appendix C

Potential Sites for Pumped Storage at Non-powered Dams Having Capacity Potentials of 1 MW or Greater

Table C-1. Candidate pump-up configuration pumped storage sites at non-powered dams sorted by state.

	Non-Powered Dam Characteristics									Potential Reservoir Characteristics			
	NIDID	Dam Name	Owner	State	River	NID Height (ft)	Hydraulic Hgt (ft)	MAFLOWU (cfs)	Potential Capacity Based on Hydraulic Hgt or 70% NID HGT (MW)	Name	Area (acres)	Proximity Dam to Waterbody (ft)	Elevation Difference Dam to Waterbody (ft)
1	CA00260	Goodwin	Tri-Dam Project	CA	Stanislaus Rv	81	101	1,441	20	Tulloch Reservoir	938	8,460	183
2	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Forebay	563	9,662	82
3	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Diversion Pool	298	3,167	76
4	CA10179	PROSSER CREEK	DOI BR	CA	PROSSER CREEK	133	163	87	2	Boca Reservoir	963	9,636	-138
5	CA00287	Coyote	Santa Clara Valley Wd	CA	Coyote Creek	115	140	63	1	Anderson Lake	1,021	9,509	-152
6	CT00674	COLLINS CO. DAM (UPPER)	DEP	CT	FARMINGTON RIVER	0	32	676	3	Nepaug Reservoir	826	3,868	217
7	CT00380	LOWER DAM	DEP	CT		0	51	676	4	Nepaug Reservoir	826	1,143	190
8	IA01292	FRASER MILLDAM	CITY OF FRASER	IA	DES MOINES RIVER	0	7	1,866	2	Don Williams Lake	142	9,845	180
9	KY03005	GREEN RIVER LOCK & DAM 5	CELRL	KY	GREEN RIVER	32	32	4,418	24	Shanty Hollow Lake	109	5,942	29
10	MA00250	Rising Paper Co. Dam	Neenah Paper Inc	MA	Housatonic River	30	38	494	3	Long Pond	114	8,403	190
11	MN00094	ST LOUIS RIVER	OGLEBAY NORTON CO	MN	ST. LOUIS RIVER	19	28	683	2	Eveleth Taconite Tailings Ba	534	5,251	45
12	ND00129	GRAND FORKS RIVERSIDE PARK	CITY OF GRAND FORKS	ND	RED RIVER	0	19	3,588	8		232	8,503	36
13	NH00003	FRANKLIN FALLS DAM	CENAE	NH	PEMIGEWASSET RIVER	112	116	2,215	42	Webster Lake	606	3,550	80
14	NJ00316	Charlotteburg Dam	City of Newark, Division of Sewers and Water Supply	NJ	Pequannock River	0	102	103	1	Echo Lake	280	8,974	224
15	NJ00213	Raymond Dam	North Jersey District Water Supply Authority	NJ	Wanaque River	0	188	111	2	Glen Wild Lake	111	9,265	49
16	NV10468	SAGOUSPIE DIVERSION DAM	TRUCKEE-CARSON IRRIGATION DISTRICT	NV	CARSON RIVER	7	10	1,399	2	Old Reservoir	264	9,647	27
17	NY00031	SODOM DAM	CITY OF NEW YORK - DEP	NY	EAST BRANCH CROTON RIVER	0	78	128	1		125	7,759	-111
18	OH00032	BERLIN DAM	CELRP	OH	MAHONING RIVER	94	96	251	4	Lake Milton	1,655	9,849	-55
19	SC02451	WOODSIDE MILLS DAM #2	CONSOLIDATED HYDRO S E	SC	TWELVEMILE CREEK	0	40	349	2		19,673	2,003	-41
20	SC02450	WOODSIDE MILLS DAM #1	NELLIE BALL	SC	TWELVEMILE CREEK	0	40	343	2		19,673	6,476	-93
21	TN05101	ELK RIVER DAM	USAF AFMC	TN	ELK RIVER	75	90	464	6	Murray Lake	7,742	9,297	-72
22	TX07058	NEW FRASIER DAM	CITY OF DALLAS	TX	ELM FORK OF TRINITY	16	16	686	2	Bachman Lake	128	5,730	31
23	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		254	9,762	-21
24	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		408	5,795	-29
25	TX00007	LAVON LAKE	CESWF	TX	EAST FORK OF TRINITY RIVER	76	81	495	6	Corder Lake	21,835	8,261	-65
26	TX01787	MEDINA LAKE DAM	BEXAR MEDINA ATASCOSA COUNTIES WCID 1	TX	MEDINA RIVER	165	165	160	4	Diversion Lake	169	2,802	-155
27	VA10730	Goose Creek DMCA	City of Fairfax	VA	TR-Goose Creek	65	68	354	4	Beaverdam Reservoir	301	5,104	47

NID	National Inventory of Dams
NHDPlus	National Hydrography Dataset Plus
NHD	National Hydrography Dataset
INL	Idaho National Laboratory

Table C-2. Candidate pump-up configuration pumped storage sites at non-powered dams sorted by non-powered dam capacity potential.

	Non-Powered Dam Characteristics									Potential Reservoir Characteristics			
	NIDID	Dam Name	Owner	State	River	NID Height (ft)	Hydraulic Hgt (ft)	MAFLOWU (cfs)	Potential Capacity Based on Hydraulic Hgt or 70% NID HGT (MW)	Name	Area (acres)	Proximity Dam to Waterbody (ft)	Elevation Difference Dam to Waterbody (ft)
1	NH00003	FRANKLIN FALLS DAM	CENAE	NH	PEMIGEWASSET RIVER	112	116	2,215	42	Webster Lake	606	3,550	80
2	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Forebay	563	9,662	82
3	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Diversion Pool	298	3,167	76
4	KY03005	GREEN RIVER LOCK & DAM 5	CELRL	KY	GREEN RIVER	32	32	4,418	24	Shanty Hollow Lake	109	5,942	29
5	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		254	9,762	-21
6	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		408	5,795	-29
7	CA00260	Goodwin	Tri-Dam Project	CA	Stanislaus Rv	81	101	1,441	20	Tulloch Reservoir	938	8,460	183
8	ND00129	GRAND FORKS RIVERSIDE PARK	CITY OF GRAND FORKS	ND	RED RIVER	0	19	3,588	8		232	8,503	36
9	TX00007	LAVON LAKE	CESWF	TX	EAST FORK OF TRINITY RIVER	76	81	495	6	Corder Lake	21,835	8,261	-65
10	TN05101	ELK RIVER DAM	USAF AFMC	TN	ELK RIVER	75	90	464	6	Murray Lake	7,742	9,297	-72
11	TX01787	MEDINA LAKE DAM	BEXAR MEDINA ATASCOSA COUNTIES WCID 1	TX	MEDINA RIVER	165	165	160	4	Diversion Lake	169	2,802	-155
12	CT00380	LOWER DAM	DEP	CT		0	51	676	4	Nepaug Reservoir	826	1,143	190
13	OH00032	BERLIN DAM	CELRP	OH	MAHONING RIVER	94	96	251	4	Lake Milton	1,655	9,849	-55
14	VA10730	Goose Creek DMCA	City of Fairfax	VA	TR-Goose Creek	65	68	354	4	Beaverdam Reservoir	301	5,104	47
15	CT00674	COLLINS CO. DAM (UPPER)	DEP	CT	FARMINGTON RIVER	0	32	676	3	Nepaug Reservoir	826	3,868	217
16	MA00250	Rising Paper Co. Dam	Neenah Paper Inc	MA	Housatonic River	30	38	494	3	Long Pond	114	8,403	190
17	NJ00213	Raymond Dam	North Jersey District Water Supply Authority	NJ	Wanaque River	0	188	111	2	Glen Wild Lake	111	9,265	49
18	MN00094	ST LOUIS RIVER	OGLEBAY NORTON CO	MN	ST. LOUIS RIVER	19	28	683	2	Eveleth Taconite Tailings Ba	534	5,251	45
19	CA10179	PROSSER CREEK	DOI BR	CA	PROSSER CREEK	133	163	87	2	Boca Reservoir	963	9,636	-138
20	TX07058	NEW FRASIER DAM	CITY OF DALLAS	TX	ELM FORK OF TRINITY	16	16	686	2	Bachman Lake	128	5,730	31
21	NV10468	SAGOUSPIE DIVERSION DAM	TRUCKEE-CARSON IRRIGATION DISTRICT	NV	CARSON RIVER	7	10	1,399	2	Old Reservoir	264	9,647	27
22	SC02451	WOODSIDE MILLS DAM #2	CONSOLIDATED HYDRO S E	SC	TWELVEMILE CREEK	0	40	349	2		19,673	2,003	-41
23	SC02450	WOODSIDE MILLS DAM #1	NELLIE BALL	SC	TWELVEMILE CREEK	0	40	343	2		19,673	6,476	-93
24	IA01292	FRASER MILLDAM	CITY OF FRASER	IA	DES MOINES RIVER	0	7	1,866	2	Don Williams Lake	142	9,845	180
25	NJ00316	Charlotteburg Dam	City of Newark, Division of Sewers and Water Supply	NJ	Pequannock River	0	102	103	1	Echo Lake	280	8,974	224
26	CA00287	Coyote	Santa Clara Valley Wd	CA	Coyote Creek	115	140	63	1	Anderson Lake	1,021	9,509	-152
27	NY00031	SODOM DAM	CITY OF NEW YORK - DEP	NY	EAST BRANCH CROTON RIVER	0	78	128	1		125	7,759	-111

NID	National Inventory of Dams
NHDPlus	National Hydrography Dataset Plus
NHD	National Hydrography Dataset
INL	Idaho National Laboratory

Table C-3. Candidate pump-up configuration pumped storage sites at non-powered dams sorted by gross potential hydraulic head.[6]

	Non-Powered Dam Characteristics									Potential Reservoir Characteristics			
	NIDID	Dam Name	Owner	State	River	NID Height (ft)	Hydraulic Hgt (ft)	MAFLOWU (cfs)	Potential Capacity Based on Hydraulic Hgt or 70% NID HGT (MW)	Name	Area (acres)	Proximity Dam to Waterbody (ft)	Elevation Difference Dam to Waterbody (ft)
1	NJ00316	Charlotteburg Dam	City of Newark, Division of Sewers and Water Supply	NJ	Pequannock River	0	102	103	1	Echo Lake	280	8,974	224
2	CT00674	COLLINS CO. DAM (UPPER)	DEP	CT	FARMINGTON RIVER	0	32	676	3	Nepaug Reservoir	826	3,868	217
3	MA00250	Rising Paper Co. Dam	Neenah Paper Inc	MA	Housatonic River	30	38	494	3	Long Pond	114	8,403	190
4	CT00380	LOWER DAM	DEP	CT		0	51	676	4	Nepaug Reservoir	826	1,143	190
5	CA00260	Goodwin	Tri-Dam Project	CA	Stanislaus Rv	81	101	1,441	20	Tulloch Reservoir	938	8,460	183
6	IA01292	FRASER MILLDAM	CITY OF FRASER	IA	DES MOINES RIVER	0	7	1,866	2	Don Williams Lake	142	9,845	180
7	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Forebay	563	9,662	82
8	NH00003	FRANKLIN FALLS DAM	CENAE	NH	PEMIGEWASSET RIVER	112	116	2,215	42	Webster Lake	606	3,550	80
9	CA00034	Fish Barrier	California Department of Water Resources	CA	Feather River	61	91	3,591	37	Thermalito Diversion Pool	298	3,167	76
10	NJ00213	Raymond Dam	North Jersey District Water Supply Authority	NJ	Wanaque River	0	188	111	2	Glen Wild Lake	111	9,265	49
11	VA10730	Goose Creek DMCA	City of Fairfax	VA	TR-Goose Creek	65	68	354	4	Beaverdam Reservoir	301	5,104	47
12	MN00094	ST LOUIS RIVER	OGLEBAY NORTON CO	MN	ST. LOUIS RIVER	19	28	683	2	Eveleth Taconite Tailings Ba	534	5,251	45
13	ND00129	GRAND FORKS RIVERSIDE PARK	CITY OF GRAND FORKS	ND	RED RIVER	0	19	3,588	8		232	8,503	36
14	TX07058	NEW FRASIER DAM	CITY OF DALLAS	TX	ELM FORK OF TRINITY	16	16	686	2	Bachman Lake	128	5,730	31
15	KY03005	GREEN RIVER LOCK & DAM 5	CELRL	KY	GREEN RIVER	32	32	4,418	24	Shanty Hollow Lake	109	5,942	29
16	NV10468	SAGOUSPIE DIVERSION DAM	TRUCKEE-CARSON IRRIGATION DISTRICT	NV	CARSON RIVER	7	10	1,399	2	Old Reservoir	264	9,647	27
17	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		254	9,762	-21
18	TX03557	FERGUSON LAKE DAM	EASTMAN CHEMICAL COMPANY	TX	FERGUSON CREEK	50	50	2,385	20		408	5,795	-29
19	SC02451	WOODSIDE MILLS DAM #2	CONSOLIDATED HYDRO S E	SC	TWELVEMILE CREEK	0	40	349	2		19,673	2,003	-41
20	OH00032	BERLIN DAM	CELRP	OH	MAHONING RIVER	94	96	251	4	Lake Milton	1,655	9,849	-55
21	TX00007	LAVON LAKE	CESWF	TX	EAST FORK OF TRINITY RIVER	76	81	495	6	Corder Lake	21,835	8,261	-65
22	TN05101	ELK RIVER DAM	USAF AFMC	TN	ELK RIVER	75	90	464	6	Murray Lake	7,742	9,297	-72
23	SC02450	WOODSIDE MILLS DAM #1	NELLIE BALL	SC	TWELVEMILE CREEK	0	40	343	2		19,673	6,476	-93
24	NY00031	SODOM DAM	CITY OF NEW YORK - DEP	NY	EAST BRANCH CROTON RIVER	0	78	128	1		125	7,759	-111
25	CA10179	PROSSER CREEK	DOI BR	CA	PROSSER CREEK	133	163	87	2	Boca Reservoir	963	9,636	-138
26	CA00287	Coyote	Santa Clara Valley Wd	CA	Coyote Creek	115	140	63	1	Anderson Lake	1,021	9,509	-152
27	TX01787	MEDINA LAKE DAM	BEXAR MEDINA ATASCOSA COUNTIES WCID 1	TX	MEDINA RIVER	165	165	160	4	Diversion Lake	169	2,802	-155

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[6] Gross potential hydraulic head is the elevation difference between the non-powered dam elevation and the potential reservoir elevation.

APPENDIX D

Potential Pumped Storage at Greenfield Hydroelectric Plant Sites Having Capacity Potentials 10 MW or Greater

APPENDIX D
Potential Pumped Storage at Greenfield Hydroelectric Plant Sites Having Capacity Potentials 10 MW or Greater

Table D-1. Candidate pump-up configuration pumped storage sites at greenfield hydroelectric plant sites sorted by state.

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
1	AR	Mississippi River	08020100000230	22,270	588,466	4	360	167	Porter Lake	476	192	10,395	25
2	AR	Mississippi River	08020100000212	19,534	588,448	2	209	172	Horseshoe Lake	2,364	192	9,322	20
3	AR	Arkansas River	08020401000006	11,398	49,893	5	43	130		619	155	6,740	25
4	AZ	Colorado River	15030104003180	3,261	33,785	62	354	366	Gene Wash Reservoir	200	738	8,661	372
5	CA	San Joaquin River	18040006001544	6,936	2,096	223	79	1,641		453	1,404	8,449	-237
6	CA	North Fork Feather River	18020121000003	13,704	1,450	152	37	934	Lake Oroville	8,468	914	6,168	-21
7	CA	Stevenson Creek	18040006000527	14,692	55	2,849	26	1,641		453	1,404	8,449	-237
8	CA	Butte Creek	18020120000186	20,886	158	898	24	1,155	Paradise Lake	149	2,556	9,932	1,401
9	CA	Pit River	18020003000078	16,608	1,049	134	24	3,375		256	4,059	8,498	684
10	CA	South Fork American River	18020129000081	12,877	774	173	23	1,883	Slab Creek Reservoir	242	1,859	3,899	-24
11	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622	Kerckhoff Lake	161	986	10,234	-635
12	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622		453	1,403	9,238	-218
13	CA	South Fork American River	18020129000075	7,336	879	149	22	1,400	Slab Creek Reservoir	242	1,827	10,325	427
14	CA	San Joaquin River	18040006000009	5,646	2,472	50	21	731	Kerckhoff Lake	161	957	9,344	226
15	CA	Slate Creek	18020125000339	22,503	156	795	21	1,978	New Bullards Bar Reservoir	4,021	1,910	9,102	-68
16	CA	Pit River	18020003000036	6,627	3,068	40	21	1,502	Pit Six Reservoir	292	1,428	9,453	-74
17	CA	North Yuba River	18020125000407	4,275	1,247	97	21	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792
18	CA	Tuolumne River	18040002002243	9,931	1,575	74	20	176	Dawson Lake	118	262	5,668	86
19	CA	San Joaquin River	18040006000010	11,152	2,470	45	19	786	Kerckhoff Lake	161	957	7,666	171
20	CA	North Yuba River	18020125000218	10,633	989	91	15	2,001	New Bullards Bar Reservoir	4,021	1,908	9,814	-93
21	CA	Pit River	18020003000034	2,589	3,071	25	13	1,477	Pit Six Reservoir	292	1,428	8,330	-49
22	CA	Rubicon River	18020128000085	5,328	535	144	13	2,569	Stumpy Meadows Lake	343	4,276	6,611	1,706
23	CA	McCloud River	18020004000026	11,673	593	129	13	2,709	Lake McCloud	481	2,686	4,747	-23
24	CA	North Fork Feather River	18020121000068	4,039	547	139	13	3,033	Butt Valley Reservoir	1,538	4,147	10,423	1,114
25	CA	Rubicon River	18020128000084	6,106	540	115	11	2,471	Stumpy Meadows Lake	343	4,280	7,302	1,809
26	CA	Pit River	18020003000033	2,234	3,072	20	10	1,459	Pit Six Reservoir	292	1,428	6,364	-31
27	CA	Klamath River	18010206000972	2,674	3,987	15	10	2,645	Copco Lake	977	2,624	9,583	-21
28	CA	Middle Yuba River	18020125000152	3,510	485	116	10	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792
29	CO	South Platte River	10190003000030	13,356	5,667	19	19	4,469	Riverside Reservoir	3,633	4,512	5,601	43
30	CO	South Platte River	10190002000213	9,301	684	142	16	6,960	Cheesman Lake	885	6,846	7,979	-114
31	CO	South Platte River	10190002000192	14,554	754	120	15	6,462	Cheesman Lake	885	6,850	10,163	388
32	CO	South Platte River	10190012002216	4,373	6,474	11	12	4,042	Prewitt Reservoir	1,888	4,090	9,737	48
33	CO	Animas River	14080104000110	11,470	367	194	12	7,745	Electra Lake	800	8,353	9,269	608
34	GA	Flint River	03130008000419	17,831	6,917	10	11	118		264	149	6,888	32
35	GA	Etowah River	03150104002130	19,075	2,598	23	10	639		224	717	3,376	78
36	ID	South Fork Boise River	17050113000172	6,644	745	81	10	4,253	Anderson Ranch Reservoir	4,639	4,201	7,651	-52
37	KY	Mississippi River	08010100000827	6,880	572,319	5	487	294		106	321	1,727	28
38	LA	Red River	11140202000015	7,287	22,490	11	43	159	Dutch Johns Lake	322	188	5,405	29
39	LA	Red River	11140202000015	24,318	22,540	3	11	147	Bossier City Reservoir	101	184	9,902	37
40	LA	Red River	11140202000015	34,147	22,535	3	10	149	Bossier City Reservoir	101	184	5,462	35
41	MA	Merrimack River	01070006000363	10,781	8,481	8	12	6	Chadwick Pond	173	102	10,454	95
42	ME	Androscoggin River	01040002000748	8,855	5,875	78	77	167	Gulf Island Pond	908	261	8,006	94
43	ME	Saco River	01060002001655	3,648	3,825	27	18	174	Bonny Eagle Pond	211	272	5,294	98
44	ME	Saco River	01060002000026	20,689	3,236	19	11	242	Horne Pond	139	279	5,610	37
45	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Hess Lake	764	763	9,916	125
46	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Brooks Lake	285	764	6,837	126
47	MN	Mississippi River	07010104000118	23,907	3,872	27	18	1,151	Perch Lake	266	1,186	9,192	35
48	MS	Yazoo River	08030206002332	15,315	12,959	9	20	65	Dump Lake	440	87	9,205	23
49	MS	Pascagoula River	03170006000902	8,274	11,766	6	12	0	Black Creek Cooling Pond	1,129	25	9,319	25
50	MT	Logan Creek	17010210000214	10,338	229	312	12	3,541	Tally Lake	1,212	3,355	8,143	-185

Table D-1. Candidate pump-up configuration pumped storage sites at greenfield hydroelectric plant sites sorted by state. (continued)

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
51	MT	Yellowstone River	10070002002418	2,680	3,337	18	10	4,947	Dailey Lake	207	5,248	7,376	301
52	NC	Pee Dee River	03040201000154	4,560	8,230	10	14	79	Everetts Lake	110	178	7,095	99
53	NH	Merrimack River	01070006001803	4,583	4,456	16	12	219	Penacook Lake	362	401	3,887	182
54	NY	Oswego River	04140203000003	27,638	11,162	45	85	307	Lake Neatahwanta	776	368	8,936	61
55	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Blake Falls Reservoir	631	1,251	1,568	71
56	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Joe Indian Pond	357	1,299	8,871	119
57	NY	Hudson River	02020001000092	7,375	1,586	39	11	779	Friends Lake	448	916	7,458	137
58	NY	Hudson River	02020001000093	13,757	1,484	39	10	900	Loon Lake	525	868	10,148	-32
59	OK	Arkansas River	11060006001569	2,290	11,082	9	16	830	Sooner Lake	5,162	855	5,266	25
60	OK	Red River	11140101000007	16,837	7,477	10	13	384	Roebuck Lake	147	414	8,668	31
61	OR	McKenzie River	17090004000246	17,890	1,910	95	31	1,081	Blue River Lake	797	1,357	5,398	276
62	OR	McKenzie River	17090004000243	10,863	1,881	80	26	1,187	Blue River Lake	797	1,366	9,139	179
63	OR	Middle Fork Willamette River	17090001000087	11,621	3,040	38	20	980	Lookout Point Lake	4,088	945	8,579	-35
64	OR	McKenzie River	17090004000157	8,898	2,817	38	18	1,043	Blue River Lake	797	1,392	7,187	349
65	OR	South Fork McKenzie River	17090004000161	18,970	884	110	16	1,083	Blue River Lake	797	1,357	5,757	274
66	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Dexter Reservoir	884	712	10,339	-93
67	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Lookout Point Lake	4,088	935	9,787	131
68	TX	Grande, Rio	13080002000796	4,150	9,540	8	12	312		143	365	2,576	53
69	TX	Brazos River	12070101000990	6,686	3,242	19	10	268	Robertson Lake	266	294	9,441	25
70	WA	Puyallup River	17110014000071	38,235	632	740	79	693	Lake Kapowsin	497	585	8,471	-109
71	WA	Deer Creek	17110008000204	19,862	412	391	27	714	Lake Cavanaugh	833	1,016	5,696	302
72	WA	Elk Creek	17110009000423	27,257	65	1,642	18	1,625	Spada Lake	1,687	1,455	7,615	-169
73	WA	Sultan River	17110009000406	8,750	570	175	17	441	Lake Chaplain	423	649	8,778	208
74	WA	Canyon Creek	17080002000123	13,451	323	274	15	237	Yale Lake	3,613	493	5,686	256
75	WA		17110005000959	17,375	29	2,951	15	943	Lake Shannon	2,047	439	5,191	-504
76	WA	Bear Creek	17110005000960	16,299	35	2,322	14	943	Lake Shannon	2,047	439	5,191	-504
77	WA	Sol Duc River	17100101000243	13,652	1,623	47	13	321	Lake Pleasant	492	399	6,257	78
78	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Lake Merwin	3,837	242	9,839	-274
79	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Yale Lake	3,613	491	7,994	-26
80	WA	Williamson Creek	17110009000426	18,609	49	1,430	12	1,606	Spada Lake	1,687	1,455	8,402	-151
81	WA		17110014000845	26,237	71	946	11	694	Lake Kapowsin	497	586	5,748	-108
82	WA		17110014000845	26,237	71	946	11	694	Tanwax Lake	174	613	7,475	-81
83	WA		17110014000845	26,237	71	946	11	694	Clear Lake	156	782	9,418	88
84	WA	Tolt River	17110010000426	11,850	644	104	11	200	Lake Joy	103	532	9,415	333
85	WA	Nisqually River	17110015000054	11,168	1,953	34	11	376	Clear Lake	181	520	10,360	144
86	WA	Thunder Creek	17110005000485	14,065	94	698	11	1,047	Lake Shannon	2,047	443	6,276	-604
87	WA	North Fork South Fork Sultan Riv	17110009000421	21,342	45	1,391	11	1,725	Spada Lake	1,687	1,459	7,339	-265
88	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Lake Shannon	2,047	475	9,018	-935
89	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Baker Lake	4,745	727	2,425	-683
90	WA	White River	17110014000467	3,825	2,268	26	10	398	Lake Tapps	2,434	547	7,667	149
91	WA	Sultan River	17110009000407	8,179	545	105	10	621	Lake Chaplain	423	652	6,970	31
92	WY	Bull Lake Creek	10080001000510	22,241	270	362	17	5,878	Bull Lake	2,942	5,822	6,020	-56
93	WY	Shoshone River	10080014001956	9,820	2,081	38	13	4,009		322	4,052	9,087	43
94	WY	Shoshone River	10080014000202	8,261	1,768	43	13	4,861	Beck Lake	100	5,087	8,041	225
95	WY	Shoshone River	10080014000143	10,102	1,919	39	13	4,400	Ralston Reservoir	110	4,603	7,427	204
96	WY	Shoshone River	10080014000201	7,507	1,787	41	12	4,827	Beck Lake	100	5,086	7,897	258
97	WY	Laramie River	10180011000122	14,843	1,808	41	12	4,554	Reservoir Number 3	165	4,650	10,478	96

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Table D-2. Candidate pump-up configuration pumped storage sites at greenfield sites sorted by greenfield site capacity potential.

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
1	KY	Mississippi River	08010100000827	6,880	572,319	5	487	294		106	321	1,727	28
2	AR	Mississippi River	08020100000230	22,270	588,466	4	360	167	Porter Lake	476	192	10,395	25
3	AZ	Colorado River	15030104003180	3,261	33,785	62	354	366	Gene Wash Reservoir	200	738	8,661	372
4	AR	Mississippi River	08020100000212	19,534	588,448	2	209	172	Horseshoe Lake	2,364	192	9,322	20
5	NY	Oswego River	04140203000003	27,638	11,162	45	85	307	Lake Neatahwanta	776	368	8,936	61
6	CA	San Joaquin River	18040006001544	6,936	2,096	223	79	1,641		453	1,404	8,449	-237
7	WA	Puyallup River	17110014000071	38,235	632	740	79	693	Lake Kapowsin	497	585	8,471	-109
8	ME	Androscoggin River	01040002000748	8,855	5,875	78	77	167	Gulf Island Pond	908	261	8,006	94
9	AR	Arkansas River	08020401000006	11,398	49,893	5	43	130		619	155	6,740	25
10	LA	Red River	11140202000015	7,287	22,490	11	43	159	Dutch Johns Lake	322	188	5,405	29
11	CA	North Fork Feather River	18020121000003	13,704	1,450	152	37	934	Lake Oroville	8,468	914	6,168	-21
12	OR	McKenzie River	17090004000246	17,890	1,910	95	31	1,081	Blue River Lake	797	1,357	5,398	276
13	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Hess Lake	764	763	9,916	125
14	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Brooks Lake	285	764	6,837	126
15	WA	Deer Creek	17110008000204	19,862	412	391	27	714	Lake Cavanaugh	833	1,016	5,696	302
16	CA	Stevenson Creek	18040006000527	14,692	55	2,849	26	1,641		453	1,404	8,449	-237
17	OR	McKenzie River	17090004000243	10,863	1,881	80	26	1,187	Blue River Lake	797	1,366	9,139	179
18	CA	Butte Creek	18020120000186	20,886	158	898	24	1,155	Paradise Lake	149	2,556	9,932	1,401
19	CA	Pit River	18020003000078	16,608	1,049	134	24	3,375		256	4,059	8,498	684
20	CA	South Fork American River	18020129000081	12,877	774	173	23	1,883	Slab Creek Reservoir	242	1,859	3,899	-24
21	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622	Kerckhoff Lake	161	986	10,234	-635
22	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622		453	1,403	9,238	-218
23	CA	South Fork American River	18020129000075	7,336	879	149	22	1,400	Slab Creek Reservoir	242	1,827	10,325	427
24	CA	San Joaquin River	18040006000009	5,646	2,472	50	21	731	Kerckhoff Lake	161	957	9,344	226
25	CA	Slate Creek	18020125000339	22,503	156	795	21	1,978	New Bullards Bar Reservoir	4,021	1,910	9,102	-68
26	CA	Pit River	18020003000036	6,627	3,068	40	21	1,502	Pit Six Reservoir	292	1,428	9,453	-74
27	CA	North Yuba River	18020125000407	4,275	1,247	97	21	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792
28	CA	Tuolumne River	18040002002243	9,931	1,575	74	20	176	Dawson Lake	118	262	5,668	86
29	MS	Yazoo River	08030206002332	15,315	12,959	9	20	65	Dump Lake	440	87	9,205	23
30	OR	Middle Fork Willamette River	17090001000087	11,621	3,040	38	20	980	Lookout Point Lake	4,088	945	8,579	-35
31	CA	San Joaquin River	18040006000010	11,152	2,470	45	19	786	Kerckhoff Lake	161	957	7,666	171
32	CO	South Platte River	10190003000030	13,356	5,667	19	19	4,469	Riverside Reservoir	3,633	4,512	5,601	43
33	WA	Elk Creek	17110009000423	27,257	65	1,642	18	1,625	Spada Lake	1,687	1,455	7,615	-169
34	OR	McKenzie River	17090004000157	8,898	2,817	38	18	1,043	Blue River Lake	797	1,392	7,187	349
35	MN	Mississippi River	07010104000118	23,907	3,872	27	18	1,151	Perch Lake	266	1,186	9,192	35
36	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Blake Falls Reservoir	631	1,251	1,568	71
37	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Joe Indian Pond	357	1,299	8,871	119
38	ME	Saco River	01060002001655	3,648	3,825	27	18	174	Bonny Eagle Pond	211	272	5,294	98
39	WA	Sultan River	17110009000406	8,750	570	175	17	441	Lake Chaplain	423	649	8,778	208
40	WY	Bull Lake Creek	10080001000510	22,241	270	362	17	5,878	Bull Lake	2,942	5,822	6,020	-56
41	OR	South Fork McKenzie River	17090004000161	18,970	884	110	16	1,083	Blue River Lake	797	1,357	5,757	274
42	CO	South Platte River	10190002000213	9,301	684	142	16	6,960	Cheesman Lake	885	6,846	7,979	-114
43	OK	Arkansas River	11060006001569	2,290	11,082	9	16	830	Sooner Lake	5,162	855	5,266	25
44	CO	South Platte River	10190002000192	14,554	754	120	15	6,462	Cheesman Lake	885	6,850	10,163	388
45	CA	North Yuba River	18020125000218	10,633	989	91	15	2,001	New Bullards Bar Reservoir	4,021	1,908	9,814	-93
46	WA	Canyon Creek	17080002000123	13,451	323	274	15	237	Yale Lake	3,613	493	5,686	256
47	WA		17110005000959	17,375	29	2,951	15	943	Lake Shannon	2,047	439	5,191	-504
48	NC	Pee Dee River	03040201000154	4,560	8,230	10	14	79	Everetts Lake	110	178	7,095	99
49	WA	Bear Creek	17110005000960	16,299	35	2,322	14	943	Lake Shannon	2,047	439	5,191	-504
50	WY	Shoshone River	10080014001956	9,820	2,081	38	13	4,009		322	4,052	9,087	43

Table D-2. Candidate pump-up configuration pumped storage sites at greenfield hydroelectric plant sites sorted by capacity potential. (continued)

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
51	CA	Pit River	18020003000034	2,589	3,071	25	13	1,477	Pit Six Reservoir	292	1,428	8,330	-49
52	CA	Rubicon River	18020128000085	5,328	535	144	13	2,569	Stumpy Meadows Lake	343	4,276	6,611	1,706
53	WA	Sol Duc River	17100101000243	13,652	1,623	47	13	321	Lake Pleasant	492	399	6,257	78
54	CA	McCloud River	18020004000026	11,673	593	129	13	2,709	Lake McCloud	481	2,686	4,747	-23
55	WY	Shoshone River	10080014000202	8,261	1,768	43	13	4,861	Beck Lake	100	5,087	8,041	225
56	CA	North Fork Feather River	18020121000068	4,039	547	139	13	3,033	Butt Valley Reservoir	1,538	4,147	10,423	1,114
57	WY	Shoshone River	10080014000143	10,102	1,919	39	13	4,400	Ralston Reservoir	110	4,603	7,427	204
58	OK	Red River	11140101000007	16,837	7,477	10	13	384	Roebuck Lake	147	414	8,668	31
59	WY	Shoshone River	10080014000201	7,507	1,787	41	12	4,827	Beck Lake	100	5,086	7,897	258
60	WY	Laramie River	10180011000122	14,843	1,808	41	12	4,554	Reservoir Number 3	165	4,650	10,478	96
61	CO	South Platte River	10190012002216	4,373	6,474	11	12	4,042	Prewitt Reservoir	1,888	4,090	9,737	48
62	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Lake Merwin	3,837	242	9,839	-274
63	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Yale Lake	3,613	491	7,994	-26
64	NH	Merrimack River	01070006001803	4,583	4,456	16	12	219	Penacook Lake	362	401	3,887	182
65	MS	Pascagoula River	03170006000902	8,274	11,766	6	12	0	Black Creek Cooling Pond	1,129	25	9,319	25
66	TX	Grande, Rio	13080002000796	4,150	9,540	8	12	312		143	365	2,576	53
67	MT	Logan Creek	17010210000214	10,338	229	312	12	3,541	Tally Lake	1,212	3,355	8,143	-185
68	CO	Animas River	14080104000110	11,470	367	194	12	7,745	Electra Lake	800	8,353	9,269	608
69	WA	Williamson Creek	17110009000426	18,609	49	1,430	12	1,606	Spada Lake	1,687	1,455	8,402	-151
70	MA	Merrimack River	01070006000363	10,781	8,481	8	12	6	Chadwick Pond	173	102	10,454	95
71	WA		17110014000845	26,237	71	946	11	694	Lake Kapowsin	497	586	5,748	-108
72	WA		17110014000845	26,237	71	946	11	694	Tanwax Lake	174	613	7,475	-81
73	WA		17110014000845	26,237	71	946	11	694	Clear Lake	156	782	9,418	88
74	WA	Tolt River	17110010000426	11,850	644	104	11	200	Lake Joy	103	532	9,415	333
75	WA	Nisqually River	17110015000054	11,168	1,953	34	11	376	Clear Lake	181	520	10,360	144
76	GA	Flint River	03130008000419	17,831	6,917	10	11	118		264	149	6,888	32
77	WA	Thunder Creek	17110005000485	14,065	94	698	11	1,047	Lake Shannon	2,047	443	6,276	-604
78	WA	North Fork South Fork Sultan Riv	17110009000421	21,342	45	1,391	11	1,725	Spada Lake	1,687	1,459	7,339	-265
79	ME	Saco River	01060002000026	20,689	3,236	19	11	242	Horne Pond	139	279	5,610	37
80	LA	Red River	11140202000015	24,318	22,540	3	11	147	Bossier City Reservoir	101	184	9,902	37
81	CA	Rubicon River	18020128000084	6,106	540	115	11	2,471	Stumpy Meadows Lake	343	4,280	7,302	1,809
82	NY	Hudson River	02020001000092	7,375	1,586	39	11	779	Friends Lake	448	916	7,458	137
83	TX	Brazos River	12070101000990	6,686	3,242	19	10	268	Robertson Lake	266	294	9,441	25
84	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Dexter Reservoir	884	712	10,339	-93
85	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Lookout Point Lake	4,088	935	9,787	131
86	CA	Pit River	18020003000033	2,234	3,072	20	10	1,459	Pit Six Reservoir	292	1,428	6,364	-31
87	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Lake Shannon	2,047	475	9,018	-935
88	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Baker Lake	4,745	727	2,425	-683
89	MT	Yellowstone River	10070002002418	2,680	3,337	18	10	4,947	Dailey Lake	207	5,248	7,376	301
90	ID	South Fork Boise River	17050113000172	6,644	745	81	10	4,253	Anderson Ranch Reservoir	4,639	4,201	7,651	-52
91	GA	Etowah River	03150104002130	19,075	2,598	23	10	639		224	717	3,376	78
92	CA	Klamath River	18010206000972	2,674	3,987	15	10	2,645	Copco Lake	977	2,624	9,583	-21
93	WA	White River	17110014000467	3,825	2,268	26	10	398	Lake Tapps	2,434	547	7,667	149
94	NY	Hudson River	02020001000093	13,757	1,484	39	10	900	Loon Lake	525	868	10,148	-32
95	LA	Red River	11140202000015	34,147	22,535	3	10	149	Bossier City Reservoir	101	184	5,462	35
96	WA	Sultan River	17110009000407	8,179	545	105	10	621	Lake Chaplain	423	652	6,970	31
97	CA	Middle Yuba River	18020125000152	3,510	485	116	10	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792

NHDPlus	National Hydrography Dataset Plus
NHD	National Hydrography Dataset
INL	Idaho National Laboratory

Table D-3. Candidate pump-up configuration pumped storage sites at greenfield hydroelectric plant sites sorted by gross potential hydraulic head.[7]

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
1	CA	Rubicon River	18020128000084	6,106	540	115	11	2,471	Stumpy Meadows Lake	343	4,280	7,302	1,809
2	CA	Rubicon River	18020128000085	5,328	535	144	13	2,569	Stumpy Meadows Lake	343	4,276	6,611	1,706
3	CA	Butte Creek	18020120000186	20,886	158	898	24	1,155	Paradise Lake	149	2,556	9,932	1,401
4	CA	North Fork Feather River	18020121000068	4,039	547	139	13	3,033	Butt Valley Reservoir	1,538	4,147	10,423	1,114
5	CA	North Yuba River	18020125000407	4,275	1,247	97	21	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792
6	CA	Middle Yuba River	18020125000152	3,510	485	116	10	1,122	New Bullards Bar Reservoir	4,021	1,914	8,499	792
7	CA	Pit River	18020003000078	16,608	1,049	134	24	3,375		256	4,059	8,498	684
8	CO	Animas River	14080104000110	11,470	367	194	12	7,745	Electra Lake	800	8,353	9,269	608
9	CA	South Fork American River	18020129000075	7,336	879	149	22	1,400	Slab Creek Reservoir	242	1,827	10,325	427
10	CO	South Platte River	10190002000192	14,554	754	120	15	6,462	Cheesman Lake	885	6,850	10,163	388
11	AZ	Colorado River	15030104003180	3,261	33,785	62	354	366	Gene Wash Reservoir	200	738	8,661	372
12	OR	McKenzie River	17090004000157	8,898	2,817	38	18	1,043	Blue River Lake	797	1,392	7,187	349
13	WA	Tolt River	17110010000426	11,850	644	104	11	200	Lake Joy	103	532	9,415	333
14	WA	Deer Creek	17110008000204	19,862	412	391	27	714	Lake Cavanaugh	833	1,016	5,696	302
15	MT	Yellowstone River	10070002002418	2,680	3,337	18	10	4,947	Dailey Lake	207	5,248	7,376	301
16	OR	McKenzie River	17090004000246	17,890	1,910	95	31	1,081	Blue River Lake	797	1,357	5,398	276
17	OR	South Fork McKenzie River	17090004000161	18,970	884	110	16	1,083	Blue River Lake	797	1,357	5,757	274
18	WY	Shoshone River	10080014000201	7,507	1,787	41	12	4,827	Beck Lake	100	5,086	7,897	258
19	WA	Canyon Creek	17080002000123	13,451	323	274	15	237	Yale Lake	3,613	493	5,686	256
20	CA	San Joaquin River	18040006000009	5,646	2,472	50	21	731	Kerckhoff Lake	161	957	9,344	226
21	WY	Shoshone River	10080014000202	8,261	1,768	43	13	4,861	Beck Lake	100	5,087	8,041	225
22	WA	Sultan River	17110009000406	8,750	570	175	17	441	Lake Chaplain	423	649	8,778	208
23	WY	Shoshone River	10080014000143	10,102	1,919	39	13	4,400	Ralston Reservoir	110	4,603	7,427	204
24	NH	Merrimack River	01070006001803	4,583	4,456	16	12	219	Penacook Lake	362	401	3,887	182
25	OR	McKenzie River	17090004000243	10,863	1,881	80	26	1,187	Blue River Lake	797	1,366	9,139	179
26	CA	San Joaquin River	18040006000010	11,152	2,470	45	19	786	Kerckhoff Lake	161	957	7,666	171
27	WA	White River	17110014000467	3,825	2,268	26	10	398	Lake Tapps	2,434	547	7,667	149
28	WA	Nisqually River	17110015000054	11,168	1,953	34	11	376	Clear Lake	181	520	10,360	144
29	NY	Hudson River	02020001000092	7,375	1,586	39	11	779	Friends Lake	448	916	7,458	137
30	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Lookout Point Lake	4,088	935	9,787	131
31	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Brooks Lake	285	764	6,837	126
32	MI	Muskegon River	04060102000014	61,670	1,604	109	30	639	Hess Lake	764	763	9,916	125
33	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Joe Indian Pond	357	1,299	8,871	119
34	NC	Pee Dee River	03040201000154	4,560	8,230	10	14	79	Everetts Lake	110	178	7,095	99
35	ME	Saco River	01060002001655	3,648	3,825	27	18	174	Bonny Eagle Pond	211	272	5,294	98
36	WY	Laramie River	10180011000122	14,843	1,808	41	12	4,554	Reservoir Number 3	165	4,650	10,478	96
37	MA	Merrimack River	01070006000363	10,781	8,481	8	12	6	Chadwick Pond	173	102	10,454	95
38	ME	Androscoggin River	01040002000748	8,855	5,875	78	77	167	Gulf Island Pond	908	261	8,006	94
39	WA		17110014000845	26,237	71	946	11	694	Clear Lake	156	782	9,418	88
40	CA	Tuolumne River	18040002002243	9,931	1,575	74	20	176	Dawson Lake	118	262	5,668	86
41	WA	Sol Duc River	17100101000243	13,652	1,623	47	13	321	Lake Pleasant	492	399	6,257	78
42	GA	Etowah River	03150104002130	19,075	2,598	23	10	639		224	717	3,376	78
43	NY	Raquette River	04150305001610	3,868	1,691	62	18	1,181	Blake Falls Reservoir	631	1,251	1,568	71
44	NY	Oswego River	04140203000003	27,638	11,162	45	85	307	Lake Neatahwanta	776	368	8,936	61
45	TX	Grande, Rio	13080002000796	4,150	9,540	8	12	312		143	365	2,576	53
46	CO	South Platte River	10190012002216	4,373	6,474	11	12	4,042	Prewitt Reservoir	1,888	4,090	9,737	48
47	CO	South Platte River	10190003000030	13,356	5,667	19	19	4,469	Riverside Reservoir	3,633	4,512	5,601	43
48	WY	Shoshone River	10080014001956	9,820	2,081	38	13	4,009		322	4,052	9,087	43
49	ME	Saco River	01060002000026	20,689	3,236	19	11	242	Horne Pond	139	279	5,610	37
50	LA	Red River	11140202000015	24,318	22,540	3	11	147	Bossier City Reservoir	101	184	9,902	37

[7] Gross potential hydraulic head is the elevation difference between the greenfield hydroelectric plant site elevation and the potential reservoir elevation.

Table D-3. Candidate pump-up configuration pumped storage sites at greenfield sites sorted by gross potential hydraulic head. (continued)

	Greenfield Site Characteristics								Potential Reservoir Characteristics				
	State	GNIS_NAME	REACHCODE	Reach Length (ft)	MAFLOWU (cfs)	Hydraulic Head (ft)	Potential Capacity (MW)	Greenfield Site Elevation (MSL) (ft)	Waterbody Name	Area (acres)	Waterbody Elevation (MSL) (ft)	Proximity (ft)	Elevation Difference Site to Waterbody (ft)
51	LA	Red River	11140202000015	34,147	22,535	3	10	149	Bossier City Reservoir	101	184	5,462	35
52	MN	Mississippi River	07010104000118	23,907	3,872	27	18	1,151	Perch Lake	266	1,186	9,192	35
53	GA	Flint River	03130008000419	17,831	6,917	10	11	118		264	149	6,888	32
54	OK	Red River	11140101000007	16,837	7,477	10	13	384	Roebuck Lake	147	414	8,668	31
55	WA	Sultan River	17110009000407	8,179	545	105	10	621	Lake Chaplain	423	652	6,970	31
56	LA	Red River	11140202000015	7,287	22,490	11	43	159	Dutch Johns Lake	322	188	5,405	29
57	KY	Mississippi River	08010100000827	6,880	572,319	5	487	294		106	321	1,727	28
58	TX	Brazos River	12070101000990	6,686	3,242	19	10	268	Robertson Lake	266	294	9,441	25
59	AR	Arkansas River	08020401000006	11,398	49,893	5	43	130		619	155	6,740	25
60	OK	Arkansas River	11060006001569	2,290	11,082	9	16	830	Sooner Lake	5,162	855	5,266	25
61	MS	Pascagoula River	03170006000902	8,274	11,766	6	12	0	Black Creek Cooling Pond	1,129	25	9,319	25
62	AR	Mississippi River	08020100000230	22,270	588,466	4	360	167	Porter Lake	476	192	10,395	25
63	MS	Yazoo River	08030206002332	15,315	12,959	9	20	65	Dump Lake	440	87	9,205	23
64	AR	Mississippi River	08020100000212	19,534	588,448	2	209	172	Horseshoe Lake	2,364	192	9,322	20
65	CA	North Fork Feather River	18020121000003	13,704	1,450	152	37	934	Lake Oroville	8,468	914	6,168	-21
66	CA	Klamath River	18010206000972	2,674	3,987	15	10	2,645	Copco Lake	977	2,624	9,583	-21
67	CA	McCloud River	18020004000026	11,673	593	129	13	2,709	Lake McCloud	481	2,686	4,747	-23
68	CA	South Fork American River	18020129000081	12,877	774	173	23	1,883	Slab Creek Reservoir	242	1,859	3,899	-24
69	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Yale Lake	3,613	491	7,994	-26
70	CA	Pit River	18020003000033	2,234	3,072	20	10	1,459	Pit Six Reservoir	292	1,428	6,364	-31
71	NY	Hudson River	02020001000093	13,757	1,484	39	10	900	Loon Lake	525	868	10,148	-32
72	OR	Middle Fork Willamette River	17090001000087	11,621	3,040	38	20	980	Lookout Point Lake	4,088	945	8,579	-35
73	CA	Pit River	18020003000034	2,589	3,071	25	13	1,477	Pit Six Reservoir	292	1,428	8,330	-49
74	ID	South Fork Boise River	17050113000172	6,644	745	81	10	4,253	Anderson Ranch Reservoir	4,639	4,201	7,651	-52
75	WY	Bull Lake Creek	10080001000510	22,241	270	362	17	5,878	Bull Lake	2,942	5,822	6,020	-56
76	CA	Slate Creek	18020125000339	22,503	156	795	21	1,978	New Bullards Bar Reservoir	4,021	1,910	9,102	-68
77	CA	Pit River	18020003000036	6,627	3,068	40	21	1,502	Pit Six Reservoir	292	1,428	9,453	-74
78	WA		17110014000845	26,237	71	946	11	694	Tanwax Lake	174	613	7,475	-81
79	CA	North Yuba River	18020125000218	10,633	989	91	15	2,001	New Bullards Bar Reservoir	4,021	1,908	9,814	-93
80	OR	Fall Creek	17090001007505	3,901	613	100	10	804	Dexter Reservoir	884	712	10,339	-93
81	WA		17110014000845	26,237	71	946	11	694	Lake Kapowsin	497	586	5,748	-108
82	WA	Puyallup River	17110014000071	38,235	632	740	79	693	Lake Kapowsin	497	585	8,471	-109
83	CO	South Platte River	10190002000213	9,301	684	142	16	6,960	Cheesman Lake	885	6,846	7,979	-114
84	WA	Williamson Creek	17110009000426	18,609	49	1,430	12	1,606	Spada Lake	1,687	1,455	8,402	-151
85	WA	Elk Creek	17110009000423	27,257	65	1,642	18	1,625	Spada Lake	1,687	1,455	7,615	-169
86	MT	Logan Creek	17010210000214	10,338	229	312	12	3,541	Tally Lake	1,212	3,355	8,143	-185
87	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622		453	1,403	9,238	-218
88	CA	San Joaquin River	18040006001544	6,936	2,096	223	79	1,641		453	1,404	8,449	-237
89	CA	Stevenson Creek	18040006000527	14,692	55	2,849	26	1,641		453	1,404	8,449	-237
90	WA	North Fork South Fork Sultan Rivi	17110009000421	21,342	45	1,391	11	1,725	Spada Lake	1,687	1,459	7,339	-265
91	WA	Canyon Creek	17080002000130	22,484	235	312	12	516	Lake Merwin	3,837	242	9,839	-274
92	WA		17110005000959	17,375	29	2,951	15	943	Lake Shannon	2,047	439	5,191	-504
93	WA	Bear Creek	17110005000960	16,299	35	2,322	14	943	Lake Shannon	2,047	439	5,191	-504
94	WA	Thunder Creek	17110005000485	14,065	94	698	11	1,047	Lake Shannon	2,047	443	6,276	-604
95	CA	Willow Creek	18040006000291	23,268	174	771	23	1,622	Kerckhoff Lake	161	986	10,234	-635
96	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Baker Lake	4,745	727	2,425	-683
97	WA	Anderson Creek	17110005000538	19,741	23	2,681	10	1,410	Lake Shannon	2,047	475	9,018	-935

NHDPlus	National Hydrography Dataset Plus
NHD	National Hydrography Dataset
INL	Idaho National Laboratory

APPENDIX E

Potential Pumped Storage at Greenfield Paired Waterbody Sites

APPENDIX E
Potential Pumped Storage at Greenfield Paired Waterbody Sites

Table E-1. Candidate pump-up configuration pumped storage sites at paired waterbody sites sorted by state.

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
1	AZ	15060103001811	215	3,325	15060103001810	127	3,668	6,903	343
2	AZ	Lower Lake Mary	149	6,803	Marshall Lake	106	7,138	8,047	335
3	AZ	15050301018616	387	2,899	15050301018643	123	3,213	9,100	314
4	AZ	15060103012349	324	3,370	15060103001810	127	3,668	7,504	298
5	AZ	15050301018613	398	2,934	15050301018646	163	3,216	8,419	282
6	AZ	15050301018613	398	2,934	15050301018643	123	3,213	6,194	278
7	AZ	15050301018552	1,283	3,233	15050301018554	524	3,493	5,940	260
8	AZ	15060103012373	238	3,628	15060103012374	172	3,877	5,720	249
9	AZ	15050203011653	120	2,702	15050203011658	253	2,942	2,533	240
10	AZ	15040004009566	145	3,898	Tailings Water Reclamation Reservoir	538	4,138	4,233	240
11	AZ	15040004009565	165	3,901	Tailings Water Reclamation Reservoir	538	4,138	4,765	237
12	AZ	Tailings Pond Number Three	546	3,442	15060103001810	127	3,668	3,877	226
13	CA	Fordyce Lake	696	6,406	Meadow Lake	234	7,291	5,179	885
14	CA	Lower Lake	9,190	4,471	Snake Lake	224	5,212	6,353	741
15	CA	Thermalito Diversion Pool	298	232	Lake Oroville	8,468	902	1,629	670
16	CA	Snake Lake	224	5,212	Sworinger Reservoir	203	5,862	4,913	651
17	CA	French Lake	347	6,678	Meadow Lake	234	7,291	6,417	614
18	CA	Union Valley Reservoir	2,735	4,845	Ice House Reservoir	648	5,438	9,392	593
19	CA	Fordyce Lake	696	6,406	Lake Sterling	104	6,991	1,533	585
20	CA	Faucherie Lake	144	6,136	French Lake	347	6,678	5,647	542
21	CA	Camanche Reservoir	152	137	Pardee Reservoir	1,556	570	189	433
22	CA	18040008001227	296	392	Lake McClure	5,691	822	6,971	430
23	CA	Castaic Lagoon	190	1,153	Castaic Lake	2,231	1,518	3,106	366
24	CA	15060103001811	820	5,561	0	111	5,867	3,981	305
25	CA	Morris Reservoir	284	1,155	San Gabriel Reservoir	525	1,456	2,882	301
26	CA	0	111	5,867	Faucherie Lake	144	6,136	5,818	269
27	CA	Lake Amador	207	313	Pardee Reservoir	1,556	570	3,486	258
28	CA	Essex Reservoir	204	4,819	Kelley Reservoir	312	5,046	7,333	227
29	CO	Mayflower Trailings Pond	275	10,493	Robinson Tailings Pond	619	11,137	9,853	644
30	CO	Twin Lakes	2,064	9,205	Mount Elbert Forebay	250	9,639	3,307	435
31	CO	Mayflower Trailings Pond	275	10,493	14010002002892	504	10,911	4,995	419
32	CO	Blunn Reservoir	163	5,761	Ralston Reservoir	154	6,045	5,765	284
33	CO	Narraguinnep Reservoir	544	6,685	McPhee Reservoir	4,335	6,928	5,844	243
34	CO	14010002002892	504	10,911	Robinson Tailings Pond	619	11,137	56	225
35	CT	Lake Watrous	107	222	Lake Bethany	103	432	6,057	210
36	FL	03100204001421	106	119	03100204003921	166	349	10,429	230
37	FL	03100204001260	189	147	03100204003718	100	358	3,866	211
38	FL	03100204001263	164	153	03100204003718	100	358	743	205
39	FL	03100204001260	189	147	03100204003921	166	349	8,550	202
40	FL	03100204001173	360	149	03100204003921	166	349	8,297	201
41	GA	03150102001076	815	680	Carters Lake	2,972	1,072	941	392
42	ID	17050123000919	311	5,559	17050123000926	112	6,738	10,515	1,178
43	ID	Anderson Ranch Reservoir	4,639	4,199	Little Camas Reservoir	991	4,927	6,365	728
44	MA	Woods Pond	110	948	Washington Mountain Lake	190	1,797	8,568	850
45	MA	01080203000498	107	870	Bear Swamp Upper Reservoir	108	1,600	1,263	730
46	MA	Holden Reservoir Number One	124	750	Kettle Brook Reservoir Number Four	113	1,082	8,554	332
47	MA	Buffumville Lake	106	492	Baker Pond	169	693	8,196	201
48	ME	Upper Richardson Lake	7,754	1,448	Metallak Pond	116	1,862	7,147	414
49	ME	Ellis Pond	919	812	Little Ellis Pond	293	1,134	10,279	322
50	ME	Arnold Pond	148	1,378	01030002002111	218	1,676	8,569	298

Table E-1. Candidate pump-up configuration pumped storage sites at paired waterbody sites sorted by state. (continued).

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
51	ME	Big Houston Pond	645	821	Indian Pond	290	1,056	6,816	234
52	ME	Sunday Pond (historical)	6,917	1,517	Lincoln Pond	327	1,751	7,186	234
53	ME	01020003000950	456	815	Pickett Mountain Pond	182	1,043	7,593	228
54	ME	Trues Pond	146	293	15060103001810	1,109	505	5,331	212
55	ME	Thompson Lake	4,300	324	Saturday Pond	180	529	9,668	205
56	ME	Stevens Pond	340	301	01050003001109	1,109	505	4,746	204
57	MI	Pine Lake	487	610	Mountain Lake	835	846	4,650	236
58	MI	Hopkins Lake	115	699	04060101001493	792	906	2,096	207
59	MI	Rush Lake	313	640	Mountain Lake	835	846	3,190	206
60	MN	Northern Light Lake	371	1,537	Pine Mountain Lake	105	1,771	8,505	234
61	MN	04010201002800	126	1,241	04010201005958	119	1,466	6,447	224
62	MT	Georgetown Lake	2,819	6,382	Echo Lake	103	6,675	5,983	293
63	MT	Whitefish Lake	3,317	2,999	Beaver Lake	145	3,265	5,332	266
64	NC	Bear Creek Lake	438	2,553	Wolf Creek Lake	165	3,067	5,339	514
65	NC	Apalachia Lake	1,064	1,274	Persimmon Lake	5,915	1,504	177	229
66	NC	Cedar Cliff Lake	108	2,327	Bear Creek Lake	438	2,553	766	226
67	NH	Connecticut Lakes	3,071	1,637	Second Connecticut Lake	1,102	1,866	9,828	229
68	NH	Perkins Pond	157	1,089	Ledge Pond	116	1,309	7,721	220
69	NH	Sip Pond	141	888	Laurel Lake	180	1,098	10,062	210
70	NH	Akers Pond	276	1,228	Greenough Pond	234	1,435	8,824	207
71	NH	Lake Coniston	129	1,109	Ledge Pond	116	1,309	6,586	200
72	NJ	Charlotteburg Reservoir	326	720	Green Pond	507	1,041	9,472	321
73	NJ	Lake Denmark	242	821	Green Pond	507	1,041	6,487	220
74	NJ	Oak Ridge Reservoir	464	841	Green Pond	507	1,041	10,248	200
75	NJ	Lake Mohawk	759	721	Morris Lake	142	921	8,588	200
76	NM	15040002005825	154	5,501	15040002005826	139	5,744	2,339	242
77	NV	Garden Lake	194	5,691	Willow Lake	181	6,123	9,252	432
78	NV	Garden Lake	194	5,691	Dry Steer Lake	124	5,989	10,488	298
79	NV	Willow Lake	181	6,123	SOB Lake	216	6,403	9,110	280
80	NV	Garden Lake	194	5,691	Burnt Lake	417	5,934	6,492	243
81	NY	Mongaup Falls Reservoir	107	935	Mohican Lake	188	1,269	9,956	335
82	NY	04140102001223	159	650	04140102001214	2,900	937	9,586	286
83	NY	04150302001522	150	1,077	04150302001519	144	1,344	5,130	267
84	NY	Swinging Bridge Reservoir	885	1,069	Sackett Lake	127	1,330	9,063	260
85	NY	Ashokan Reservoir	8,171	589	Yanketown Pond	117	844	9,737	255
86	NY	Simon Pond	780	1,545	04150305001386	146	1,788	6,059	243
87	NY	South Colton Reservoir	227	974	Rainbow Falls Reservoir	666	1,181	8,109	207
88	NY	Little Tupper Lake	2,288	1,718	Loon Pond	102	1,923	8,328	204
89	NY	Round Lake	754	1,718	Loon Pond	102	1,923	5,904	204
90	NY	Mongaup Falls Reservoir	107	935	Lebanon Lake	358	1,134	6,780	200
91	OR	Fish Lake	120	4,756	Mud Lake Reservoir	135	5,379	8,073	623
92	OR	Smith Reservoir	105	5,200	Long Lake	126	5,735	5,480	535
93	OR	Harpold Reservoir	122	5,340	Long Lake	126	5,735	5,048	395
94	OR	Fish Lake	120	4,756	Horsehead Lake	149	5,131	8,443	375
95	OR	Dexter Reservoir	884	700	Lookout Point Lake	4,088	933	169	232
96	PA	Prompton Lake	290	1,126	Elk Lake	158	1,414	8,759	288
97	PA	Nesbitt Reservoir	118	1,153	Watres Reservoir	164	1,423	7,582	270
98	PA	Prompton Lake	290	1,126	White Oak Pond	224	1,365	10,518	238
99	TN	Bennett Lake	7,259	634	Raccoon Mountain Pumped Station Reser	526	1,670	4,238	1,036
100	TN	06010207004619	5,758	794	Big Ridge Lake	23,593	1,020	6,635	225

Table E-1. Candidate pump-up configuration pumped storage sites at paired waterbody sites sorted by state. (continued).

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
101	TX	Lake Tanglewood	249	3,352	11120103001361	175	3,555	9,035	203
102	UT	7953	2,972	6,186	16020101005531	139	6,628	9,164	442
103	UT	Electric Lake	469	8,580	Huntington Reservoir	136	9,019	10,031	439
104	UT	Mill Meadow Reservoir	161	7,686	Forsyth Reservoir	166	7,994	8,365	308
105	UT	Red Fleet Reservoir	501	5,511	Stauffer Chemical Tailings Pond North	168	5,801	7,277	290
106	UT	Electric Lake	469	8,580	Cleveland Reservoir	139	8,817	6,316	237
107	UT	Cleveland Reservoir	139	8,817	Huntington Reservoir	136	9,019	5,049	202
108	VT	Lake Dunmore	1,015	569	Silver Lake	105	1,250	2,394	681
109	VT	Lake Elligo	173	889	Caspian Lake	786	1,401	7,446	512
110	VT	Groton Pond	424	1,076	Kettle Pond	108	1,444	9,502	368
111	VT	Lake Bomoseen	2,383	410	Beebe Pond	108	616	9,650	207
112	WA	Palmer Lake	2,042	1,150	Chopaka Lake	133	2,911	7,802	1,761
113	WA	Yale Lake	3,613	486	Merrill Lake	323	1,524	10,355	1,038
114	WA	Cascade Lake	176	355	Mountain Lake	195	921	6,967	566
115	WA	Fish Lake	102	1,807	17020006001195	292	2,323	9,142	517
116	WA	Lake Shannon	2,047	407	Baker Lake	4,745	703	190	296
117	WA	Ohop Lake	218	527	Clear Lake	156	781	6,821	254
118	WA	Lake Merwin	3,837	242	Yale Lake	3,613	486	611	244
119	WY	Beartooth Lake	174	8,911	Island Lake	150	9,520	9,770	609
120	WY	Park Reservoir	309	8,261	Bighorn Reservoir	165	8,750	5,901	489
121	WY	Sonnicant Lake	109	10,105	Lake Solitude	119	10,523	4,548	418
122	WY	Half Moon Lake	1,035	7,604	Fayette Lake	333	7,961	3,715	357
123	WY	Moraine Lake	143	10,418	Roberts Lake	107	10,750	8,259	332
124	WY	Half Moon Lake	1,035	7,604	Meadow Lake	115	7,904	9,546	300
125	WY	Fremont Lake	5,051	7,423	Willow Lake	1,807	7,703	9,483	280
126	WY	Crystal Lake Reservoir	130	6,973	Granite Springs Reservoir	176	7,214	5,967	241
127	WY	Lake Solitude	119	10,523	Roberts Lake	107	10,750	9,101	227
	NHD+								
	NHD+								
	INL								

Table E-2. Candidate pump-up configuration pumped storage sites at paired waterbody sites sorted by gross potential hydraulic head[8].

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
1	WA	Palmer Lake	2,042	1,150	Chopaka Lake	133	2,911	7,802	1,761
2	ID	17050123000919	311	5,559	17050123000926	112	6,738	10,515	1,178
3	WA	Yale Lake	3,613	486	Merrill Lake	323	1,524	10,355	1,038
4	TN	Bennett Lake	7,259	634	Raccoon Mountain Pumped Station Reser	526	1,670	4,238	1,036
5	CA	Fordyce Lake	696	6,406	Meadow Lake	234	7,291	5,179	885
6	MA	Woods Pond	110	948	Washington Mountain Lake	190	1,797	8,568	850
7	CA	Lower Lake	9,190	4,471	Snake Lake	224	5,212	6,353	741
8	MA	01080203000498	107	870	Bear Swamp Upper Reservoir	108	1,600	1,263	730
9	ID	Anderson Ranch Reservoir	4,639	4,199	Little Camas Reservoir	991	4,927	6,365	728
10	VT	Lake Dunmore	1,015	569	Silver Lake	105	1,250	2,394	681
11	CA	Thermalito Diversion Pool	298	232	Lake Oroville	8,468	902	1,629	670
12	CA	Snake Lake	224	5,212	Sworinger Reservoir	203	5,862	4,913	651
13	CO	Mayflower Trailings Pond	275	10,493	Robinson Tailings Pond	619	11,137	9,853	644
14	OR	Fish Lake	120	4,756	Mud Lake Reservoir	135	5,379	8,073	623
15	CA	French Lake	347	6,678	Meadow Lake	234	7,291	6,417	614
16	WY	Beartooth Lake	174	8,911	Island Lake	150	9,520	9,770	609
17	CA	Union Valley Reservoir	2,735	4,845	Ice House Reservoir	648	5,438	9,392	593
18	CA	Fordyce Lake	696	6,406	Lake Sterling	104	6,991	1,533	585
19	WA	Cascade Lake	176	355	Mountain Lake	195	921	6,967	566
20	CA	Faucherie Lake	144	6,136	French Lake	347	6,678	5,647	542
21	OR	Smith Reservoir	105	5,200	Long Lake	126	5,735	5,480	535
22	WA	Fish Lake	102	1,807	17020006001195	292	2,323	9,142	517
23	NC	Bear Creek Lake	438	2,553	Wolf Creek Lake	165	3,067	5,339	514
24	VT	Lake Elligo	173	889	Caspian Lake	786	1,401	7,446	512
25	WY	Park Reservoir	309	8,261	Bighorn Reservoir	165	8,750	5,901	489
26	UT	7953	2,972	6,186	16020101005531	139	6,628	9,164	442
27	UT	Electric Lake	469	8,580	Huntington Reservoir	136	9,019	10,031	439
28	CO	Twin Lakes	2,064	9,205	Mount Elbert Forebay	250	9,639	3,307	435
29	CA	Camanche Reservoir	152	137	Pardee Reservoir	1,556	570	189	433
30	NV	Garden Lake	194	5,691	Willow Lake	181	6,123	9,252	432
31	CA	18040008001227	296	392	Lake McClure	5,691	822	6,971	430
32	CO	Mayflower Trailings Pond	275	10,493	14010002002892	504	10,911	4,995	419
33	WY	Sonnicant Lake	109	10,105	Lake Solitude	119	10,523	4,548	418
34	ME	Upper Richardson Lake	7,754	1,448	Metallak Pond	116	1,862	7,147	414
35	OR	Harpold Reservoir	122	5,340	Long Lake	126	5,735	5,048	395
36	GA	03150102001076	815	680	Carters Lake	2,972	1,072	941	392
37	OR	Fish Lake	120	4,756	Horsehead Lake	149	5,131	8,443	375
38	VT	Groton Pond	424	1,076	Kettle Pond	108	1,444	9,502	368
39	CA	Castaic Lagoon	190	1,153	Castaic Lake	2,231	1,518	3,106	366
40	WY	Half Moon Lake	1,035	7,604	Fayette Lake	333	7,961	3,715	357
41	AZ	15060103001811	215	3,325	15060103001810	127	3,668	6,903	343
42	AZ	Lower Lake Mary	149	6,803	Marshall Lake	106	7,138	8,047	335
43	NY	Mongaup Falls Reservoir	107	935	Mohican Lake	188	1,269	9,956	335
44	WY	Moraine Lake	143	10,418	Roberts Lake	107	10,750	8,259	332
45	MA	Holden Reservoir Number One	124	750	Kettle Brook Reservoir Number Four	113	1,082	8,554	332
46	ME	Ellis Pond	919	812	Little Ellis Pond	293	1,134	10,279	322
47	NJ	Charlotteburg Reservoir	326	720	Green Pond	507	1,041	9,472	321
48	AZ	15050301018616	387	2,899	15050301018643	123	3,213	9,100	314
49	UT	Mill Meadow Reservoir	161	7,686	Forsyth Reservoir	166	7,994	8,365	308
50	CA	15060103001811	820	5,561	0	111	5,867	3,981	305

[8] Gross potential hydraulic head is the elevation difference between the lower waterbody where the electromechanical equipment would be sited and the upper waterbody.

Table E-2. Candidate pump-up configuration pumped storage sites at paired waterbody sites sorted by gross potential hydraulic head (continued).

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
51	CA	Morris Reservoir	284	1,155	San Gabriel Reservoir	525	1,456	2,882	301
52	WY	Half Moon Lake	1,035	7,604	Meadow Lake	115	7,904	9,546	300
53	NV	Garden Lake	194	5,691	Dry Steer Lake	124	5,989	10,488	298
54	ME	Arnold Pond	148	1,378	01030002002111	218	1,676	8,569	298
55	AZ	15060103012349	324	3,370	15060103001810	127	3,668	7,504	298
56	WA	Lake Shannon	2,047	407	Baker Lake	4,745	703	190	296
57	MT	Georgetown Lake	2,819	6,382	Echo Lake	103	6,675	5,983	293
58	UT	Red Fleet Reservoir	501	5,511	Stauffer Chemical Tailings Pond North	168	5,801	7,277	290
59	PA	Prompton Lake	290	1,126	Elk Lake	158	1,414	8,759	288
60	NY	04140102001223	159	650	04140102001214	2,900	937	9,586	286
61	CO	Blunn Reservoir	163	5,761	Ralston Reservoir	154	6,045	5,765	284
62	AZ	15050301018613	398	2,934	15050301018646	163	3,216	8,419	282
63	WY	Fremont Lake	5,051	7,423	Willow Lake	1,807	7,703	9,483	280
64	NV	Willow Lake	181	6,123	SOB Lake	216	6,403	9,110	280
65	AZ	15050301018613	398	2,934	15050301018643	123	3,213	6,194	278
66	PA	Nesbitt Reservoir	118	1,153	Watres Reservoir	164	1,423	7,582	270
67	CA	0	111	5,867	Faucherie Lake	144	6,136	5,818	269
68	NY	04150302001522	150	1,077	04150302001519	144	1,344	5,130	267
69	MT	Whitefish Lake	3,317	2,999	Beaver Lake	145	3,265	5,332	266
70	NY	Swinging Bridge Reservoir	885	1,069	Sackett Lake	127	1,330	9,063	260
71	AZ	15050301018552	1,283	3,233	15050301018554	524	3,493	5,940	260
72	CA	Lake Amador	207	313	Pardee Reservoir	1,556	570	3,486	258
73	NY	Ashokan Reservoir	8,171	589	Yanketown Pond	117	844	9,737	255
74	WA	Ohop Lake	218	527	Clear Lake	156	781	6,821	254
75	AZ	15060103012373	238	3,628	15060103012374	172	3,877	5,720	249
76	WA	Lake Merwin	3,837	242	Yale Lake	3,613	486	611	244
77	NV	Garden Lake	194	5,691	Burnt Lake	417	5,934	6,492	243
78	CO	Narraguinnep Reservoir	544	6,685	McPhee Reservoir	4,335	6,928	5,844	243
79	NY	Simon Pond	780	1,545	04150305001386	146	1,788	6,059	243
80	NM	15040002005825	154	5,501	15040002005826	139	5,744	2,339	242
81	WY	Crystal Lake Reservoir	130	6,973	Granite Springs Reservoir	176	7,214	5,967	241
82	AZ	15050203011653	120	2,702	15050203011658	253	2,942	2,533	240
83	AZ	15040004009566	145	3,898	Tailings Water Reclamation Reservoir	538	4,138	4,233	240
84	PA	Prompton Lake	290	1,126	White Oak Pond	224	1,365	10,518	238
85	UT	Electric Lake	469	8,580	Cleveland Reservoir	139	8,817	6,316	237
86	AZ	15040004009565	165	3,901	Tailings Water Reclamation Reservoir	538	4,138	4,765	237
87	MI	Pine Lake	487	610	Mountain Lake	835	846	4,650	236
88	ME	Big Houston Pond	645	821	Indian Pond	290	1,056	6,816	234
89	ME	Sunday Pond (historical)	6,917	1,517	Lincoln Pond	327	1,751	7,186	234
90	MN	Northern Light Lake	371	1,537	Pine Mountain Lake	105	1,771	8,505	234
91	OR	Dexter Reservoir	884	700	Lookout Point Lake	4,088	933	169	232
92	FL	03100204001421	106	119	03100204003921	166	349	10,429	230
93	NC	Apalachia Lake	1,064	1,274	Persimmon Lake	5,915	1,504	177	229
94	NH	Connecticut Lakes	3,071	1,637	Second Connecticut Lake	1,102	1,866	9,828	229
95	ME	01020003000950	456	815	Pickett Mountain Pond	182	1,043	7,593	228
96	CA	Essex Reservoir	204	4,819	Kelley Reservoir	312	5,046	7,333	227
97	WY	Lake Solitude	119	10,523	Roberts Lake	107	10,750	9,101	227
98	NC	Cedar Cliff Lake	108	2,327	Bear Creek Lake	438	2,553	766	226
99	AZ	Tailings Pond Number Three	546	3,442	15060103001810	127	3,668	3,877	226
100	CO	14010002002892	504	10,911	Robinson Tailings Pond	619	11,137	56	225

Table E-2. Candidate pump-up configuration pumped storage sites at paired waterbody sites sorted by gross potential hydraulic head (continued).

	Lower Waterbody Characteristics				Upper Waterbody Characteristics			Waterbody to Waterbody	
	Lower WB State	Lower WB Name or NHD+ Object ID	Lower WB Area (Acres)	Lower WB Elevation (Feet)	Upper WB Name or NHD+ Object ID	Upper WB Area (Acres)	Upper WB Elevation (Feet)	Proximity (ft)	Lower WB to Upper WB Elevation Difference (Feet)
101	TN	06010207004619	5,758	794	Big Ridge Lake	23,593	1,020	6,635	225
102	MN	04010201002800	126	1,241	04010201005958	119	1,466	6,447	224
103	NJ	Lake Denmark	242	821	Green Pond	507	1,041	6,487	220
104	NH	Perkins Pond	157	1,089	Ledge Pond	116	1,309	7,721	220
105	ME	Trues Pond	146	293	15060103001810	1,109	505	5,331	212
106	FL	03100204001260	189	147	03100204003718	100	358	3,866	211
107	NH	Sip Pond	141	888	Laurel Lake	180	1,098	10,062	210
108	CT	Lake Watrous	107	222	Lake Bethany	103	432	6,057	210
109	NY	South Colton Reservoir	227	974	Rainbow Falls Reservoir	666	1,181	8,109	207
110	MI	Hopkins Lake	115	699	04060101001493	792	906	2,096	207
111	NH	Akers Pond	276	1,228	Greenough Pond	234	1,435	8,824	207
112	VT	Lake Bomoseen	2,383	410	Beebe Pond	108	616	9,650	207
113	MI	Rush Lake	313	640	Mountain Lake	835	846	3,190	206
114	ME	Thompson Lake	4,300	324	Saturday Pond	180	529	9,668	205
115	FL	03100204001263	164	153	03100204003718	100	358	743	205
116	NY	Little Tupper Lake	2,288	1,718	Loon Pond	102	1,923	8,328	204
117	NY	Round Lake	754	1,718	Loon Pond	102	1,923	5,904	204
118	ME	Stevens Pond	340	301	01050003001109	1,109	505	4,746	204
119	TX	Lake Tanglewood	249	3,352	11120103001361	175	3,555	9,035	203
120	FL	03100204001260	189	147	03100204003921	166	349	8,550	202
121	UT	Cleveland Reservoir	139	8,817	Huntington Reservoir	136	9,019	5,049	202
122	MA	Buffumville Lake	106	492	Baker Pond	169	693	8,196	201
123	FL	03100204001173	360	149	03100204003921	166	349	8,297	201
124	NJ	Oak Ridge Reservoir	464	841	Green Pond	507	1,041	10,248	200
125	NH	Lake Coniston	129	1,109	Ledge Pond	116	1,309	6,586	200
126	NJ	Lake Mohawk	759	721	Morris Lake	142	921	8,588	200
127	NY	Mongaup Falls Reservoir	107	935	Lebanon Lake	358	1,134	6,780	200
	NHD+								
	NHD+								
	INL								

APPENDIX F

Potential Pumped Storage Hydroelectric Plant Sites Databases

Appendix F

Potential Pumped Storage Hydroelectric Plant Sites Databases

This appendix includes four datasets in Excel format that are discussed in the body of the report. Each dataset is composed of a population of sites for which attribute information is provided. For the potential pumped storage sites, base plant and potential auxiliary reservoir characteristics are included. The datasets are:

- Existing U.S. pumped storage plants
- Potential pumped storage plants at existing hydroelectric plants
- Potential pumped storage plants at non-powered dams
- Potential pumped storage plants at greenfield hydroelectric plant sites
- Potential pumped storage plants at paired waterbody sites