Final Application for New License for Major Water Power Project – Existing Dam

Northfield Project

Northfield Mountain Pumped Storage Project (FERC Project Number 2485)
Turners Falls Hydroelectric Project (FERC Project Number 1889)

EXHIBIT B-PROJECT OPERATION AND RESOURCE UTILIZATION

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EXHIBIT B – PROJECT OPERATION AND RESOURCE UTILIZATION

The following excerpt from the Code of Federal Regulations (CFR) at 18 CFR § 4.51 (c) describes the required content of this Exhibit.

Exhibit B is a statement of project operation and resource utilization. If the project includes more than one dam with associated facilities, the information must be provided separately for each such discrete development. The exhibit must contain:

(1) A statement whether operation of the powerplant will be manual or automatic, an estimate of the annual plant factor, and a statement of how the project will be operated during adverse, mean, and high water years;

(2) An estimate of the dependable capacity and average annual energy production in kilowatt hours (or a mechanical equivalent), supported by the following data:

(i) The minimum, mean, and maximum recorded flows in cubic feet per second of the stream or other body of water at the powerplant intake or point of diversion, with a specification of any adjustments made for evaporation, leakage, minimum flow releases (including duration of releases), or other reductions in available flow; monthly flow duration curves indicating the period of record and the gauging stations used in deriving the curves; and a specification of the period of critical streamflow used to determine the dependable capacity;

(ii) An area-capacity curve showing the gross storage capacity and usable storage capacity of the impoundment, with a rule curve showing the proposed operation of the impoundment and how the usable storage capacity is to be utilized;

(iii) The estimated hydraulic capacity of the powerplant (minimum and maximum flow through the powerplant) in cubic feet per second;

(iv) A tailwater rating curve; and

(v) A curve showing powerplant capability versus head and specifying maximum, normal, and minimum heads;

(3) A statement, with load curves and tabular data, if necessary, of the manner in which the power generated at the project is to be utilized, including the amount of power to be used on-site, if any, the amount of power to be sold, and the identity of any proposed purchasers; and

(4) A statement of the applicant's plans, if any, for future development of the project or of any other existing or proposed water power project on the stream or other body of water, indicating the approximate location and estimated installed capacity of the proposed developments.

1 EXISTING AND PROPOSED PROJECT OPERATIONS

1.1 Existing Project Operation

The Turners Falls Development consists of two facilities- Cabot Station and Station No. 1. Cabot Station is used at all river flows. During low flow periods, Cabot Station is operated as a peaking plant; during high flows in excess of 13,728 cfs (its approximate maximum hydraulic capacity), it operates as a base load plant. Station No. 1 is a base load plant and typically operates when inflows to the Turners Falls Impoundment (TFI) are less than Station No. 1's hydraulic capacity of approximately 2,210 cfs or when inflows exceed the hydraulic capacity of Cabot Station.

The Northfield Mountain Pumped Storage Development is a pumped storage hydroelectric facility. Water is pumped from the TFI to the Upper Reservoir which has 12,318 acre-feet of useable storage available for pumped storage operations. Typically, pumping occurs during low-load periods when energy costs are low, while generation occurs during high-load periods when energy costs are high.

2 PROPOSED PROJECT OPERATIONS

At the time of filing the license application, not all of the FirstLight studies are complete. As such, FirstLight has not finalized its proposed operation for the Project. However, FirstLight is proposing to utilize more of the Upper Reservoir storage capacity. As noted in Exhibit A, the current FERC license allows the Upper Reservoir to operate between 1000.5 feet to 938 feet, for a 62.5 foot drawdown. FirstLight proposes to increase the useable storage of the Upper Reservoir from 1004.5 feet to 920 feet year-round, for an 84.5 foot drawdown.

2.1 Annual Plant Factor

The average annual plant factor is determined using the following equation:

Average Annual Generation/Nameplate Capacity x 8,760 hrs per year= Avg. Annual Plant Factor

The Turners Falls Development has an average annual generation of approximately 328,022 MWh per year for the period 2000-2014, and an annual plant factor of approximately 55% (328,022/593,043) based on its current combined nameplate capacities of Cabot Station and Station No. 1 of 62.016 MW and 5.683 MW, respectively (total of 67.699 MW).

The Northfield Mountain Pumped Storage Development has an average annual generation of approximately 1,053,891 MWh per year and an average annual energy consumption of approximately 1,437,464 MWh/year for the period 2000-2014 (excluding 2010 due to the Northfield Mountain Pumped Storage Development being out of operation for several months). The Northfield Mountain Pumped Storage Development's annual plant factor is approximately 11% (1,053,891/9,804,192) based on a nameplate capacity of 1119.2 MW per FERC Order issued March 23, 2012 after the efficiency improvements on Units 3 and 2. On May 23, 2014, FirstLight notified the FERC of the completion of the efficiency upgrade of Unit 4, and on March 2, 2016, FirstLight notified the FERC of the completion of a generator rewind of Unit 1. The current nameplate capacity of the Northfield Mountain Pumped Storage Development, as reflected in FERC's records, is 1,166.80 MW.

2.2 Operation During Adverse, Mean, and High Water Years

Under the current FERC license, to provide the storage capacity for pumped storage operations of the Northfield Mountain Pumped Storage Development, the water level of the TFI can vary from a minimum elevation of 176.0 feet to a maximum operating elevation of 185.0 feet as measured at the Turners Falls Dam. Also under the current FERC license, FirstLight is required to release a continuous minimum flow

of 1,433 cfs or inflow, whichever is less below the Turners Falls Development. Below is a summary of how the Turners Falls Development and Northfield Mountain Pumped Storage Development operate over a range of flow conditions.

Turners Falls Development and Northfield Mountain Pumped Storage Development Operations when Naturally Routed Flows are < 1,433 cfs (Minimum Flow)

When naturally routed flows are very low, i.e. less than 1,433 cfs (current minimum flow), FirstLight generally maintains the TFI elevation between 180.5 and 182.0 feet to create sufficient hydraulic head to pass flow through the gatehouse.

At flows less than 1,433 cfs, Cabot Station does not operate and Station No. 1 operates as a run-of-river facility. Station No. 1 generally operates over two flow ranges as follows: a) at low flows (too low to operate one turbine at Cabot); and b) at flows exceeding Cabot's hydraulic capacity of approximately 13,728 cfs.

Bypass flows are provided at Turners Falls Dam as required for fishery needs during certain periods of the year. If bypass flows are required, they are provided by bascule gate No. 1 closest to the gatehouse.

At these low flows (less than 1,433 cfs), the Northfield Mountain Pumped Storage Development may operate during peak hours of the day or when the price of power is high, while pumping back typically at night or when the price of power is less. The number of turbines operating and the magnitude of generation flow will vary depending on demand.

Turners Falls Development and Northfield Mountain Pumped Storage Development Operations when Naturally Routed Flows are between 1,433 cfs and 13,728 cfs (Cabot Capacity)

Under moderate flow conditions, i.e., naturally routed flows are between 1,433 cfs and 13,728 cfs (river flow exceeds 13,728 cfs approximately 34% of the time), the TFI elevation is typically managed around elevation 180.5 feet, but fluctuates under these inflow conditions due to Vernon peaking operations, Cabot peaking operations, and the pumping/generating cycle at the Northfield Mountain Pumped Storage Development. Under most circumstances, the TFI elevation fluctuates between 180.5 and 184.0 feet under these inflow conditions. The target elevation in the power canal at the Cabot forebay remains at 173.5 feet.

When naturally routed flows are between 1,433 cfs and 13,728 cfs (the approximate hydraulic capacity of Cabot Station), FirstLight will typically operate Cabot Station, while Station No. 1 remains idle. Depending on the inflow, electrical demand or energy pricing, Cabot Station may be operated as a peaking facility, with the number of peaks per day varying with electrical demand and / or price. If demand and / or price are high, such as in the summer and winter, Cabot may be peaked twice a day, in the morning and late afternoon. Outside of these hours, Cabot's generation is typically curtailed to base load needs, by reducing the flow through the gatehouse. Excess inflow to Turners Falls Dam is stored within the TFI. If inflow is consistently in the 13,728 cfs range, Cabot will operate continuously at full capacity.

In the summer and winter seasons, the Northfield Mountain Pumped Storage Development typically peaks twice a day- in the morning and late afternoon. During other months, commonly called shoulder months, the Northfield Mountain Pumped Storage Development may be peaked one to two times a day, pending electrical demand and / or price. In both cases, water is typically pumped back to the Upper Reservoir during the night or during low energy priced hours.

Turners Falls Development and Northfield Mountain Pumped Storage Development Operations when Naturally Routed Flows are between 13,728 cfs and 15,937 cfs (full capacity of Station No. 1 and Cabot)

Under these flow conditions, operations are similar to above; however, Cabot is typically operated at full hydraulic capacity, while the remaining flow is passed through Station No. 1. On an annual basis, river flow exceeds 15,937 cfs approximately 28% of the time.

Turners Falls Development and Northfield Mountain Pumped Storage Development Operations when Naturally Routed Flows are between 15,937 cfs and 30,000 cfs

Under normal to somewhat high flows, as the naturally routed inflow to the TFI exceeds the hydraulic capacity of Cabot and Station No. 1, both facilities operate at full capacity. Per the agreement with the United States Army Corps of Engineer (USACE) as required by Article 32 of the Turners Falls Project license (May 5, 1980 FERC License), and Article 43 of the Northfield Mountain Project license, the maximum TFI elevation during inflows of this magnitude is 186.5 feet, although FirstLight typically opens the bascule gates at the Turners Falls Dam, as needed, to maintain the TFI elevation closer to 180-182 feet. On an annual basis, river flow exceeds 30,000 cfs approximately 11% of the time.

Per the USACE agreement, FirstLight must release water through Cabot and Station No.1 and via the Turners Falls Dam gates so that at the start of the Northfield pumping, there is enough water stored in the TFI to restore the Upper Reservoir to its full capacity.

Turners Falls Development and Northfield Mountain Pumped Storage Development Operations when Naturally Routed Flows are between 30,000 cfs and 65,000 cfs

When flows are in this high range, Turners Falls Development and Northfield Mountain Pumped Storage Development operations are generally the same as above, with one exception: the USACE requires that FirstLight draw the TFI elevation down as far as possible, but not below elevation 176.0 feet. In drawing the TFI down, discharges cannot be increased by more than 10,000 cfs per hour above the naturally routed flows. The TFI elevation is maintained down until the naturally routed flow drops below 30,000 cfs or the actual discharge exceeds 65,000 cfs. When the actual discharge past Turners Falls Dam rises to 65,000 cfs (river flow exceeds 65,000 cfs approximately 1% of the time), the discharge is maintained at 65,000 cfs until the TFI elevation has fallen to 176.0 feet or the TFI begins to rise, at which point a constant TFI elevation is maintained.

Turners Falls Development and Northfield Mountain Pumped Storage Development Operations when Naturally Routed Flows are between 65,000 cfs and 126,000 cfs

Per the USACE agreement, when the naturally routed flow exceeds 65,000 cfs, but is expected to be less than 126,000 cfs (this flow is very rarely exceeded), the outflow at Turners Falls should be regulated according to the operating schedule of the Northfield Mountain Pumped Storage Development. If the Northfield Mountain Pumped Storage Development is operating, it is required to keep the combined useable volume of the Upper Reservoir and TFI constant. If the Northfield Mountain Pumped Storage Development is not operating, it is required to keep the TFI elevation constant until the spillway gates are wide open.

Turners Falls Development and Northfield Mountain Pumped Storage Development Operations when Naturally Routed Flows exceed 126,000 cfs

When the naturally routed flow is expected to be greater than 126,000 cfs, the operating rules continue to require the following: if the Northfield Mountain Pumped Storage Development has not been operating in the previous hour, it is required to maintain a constant TFI elevation. If the Northfield Mountain Pumped Storage Development has been operating in the previous hour, it is required to maintain a constant combined useable storage volume.

2.3 HEC-ResSim Operations Model

FirstLight developed an operations model to better understand how operational changes at the three[1] TransCanada hydroelectric projects and FirstLight's Northfield Project affect the timing of river flows and energy generation. The model takes into account each Project's engineering data and operational constraints, such as current FERC licensed water level fluctuations and minimum flow requirements. The model outputs include hourly flow and generation from the TransCanada and FirstLight hydroelectric facilities.

The model calibration procedure involved adjusting several model parameters and constraints to reasonably match historic (2002-2003) Project data (flow, stage, generation). The calibrated model was subsequently updated to reflect today's equipment; this model is termed the baseline model. The baseline model was subsequently used to predict the impact of Project operations on generation over a longer-term period (1960-2013).

Some sections of this license application, including Exhibit D and Exhibit E-Developmental Analysis, utilize the Baseline model outputs. Sections using model outputs will explicitly state when model results (as opposed to actual data) are presented.

3 DEPENDABLE CAPACITY AND AVERAGE ANNUAL GENERATION

3.1 Estimate of Dependable Capacity and Average Annual Generation

The net dependable capacity of the Turners Falls Development is 67.699 MW (62.016 MW at Cabot and 5.683 MW at Station No. 1).

The net dependable capacity of the Northfield Mountain Pumped Storage Development is 1,166.8.

Average annual generation of the Turners Falls Development for the period 2000-2014 was 328,022 MWh. The monthly and annual generation at the Turners Falls Development for the period 2000-2014 is provided in Table 3.1-1.

Average annual net generation at the Northfield Mountain Pumped Storage Development for the period 2000-2014 (excluding 2010) was 1,053,891 MWh. Average annual pumping generation use by the Northfield Mountain Pumped Storage Development for the same time period was 1,437,464 MWh. The monthly and annual net generation and pumping energy use for the period 2000-2014 is provided in Table 3.1-2 and Table 3.1-3, respectively.

3.2 Streamflow

FirstLight estimates the total instantaneous inflow to the TFI – referred to as the naturally routed flow-- as the sum of the Vernon Hydroelectric Project discharge and inflow from two larger tributaries equipped with United States Geological Survey (USGS) gages – the Ashuelot and Millers Rivers. The drainage areas at the Vernon Dam and Turners Falls Dam are 6,266 square miles (mi^2) and 7,163 mi^2, respectively, a difference of 897 mi^2. Thus, 87% of the inflow to the TFI is controlled by the Vernon Hydroelectric Project. Information on the Ashuelot and Millers Rivers is shown in Table 3.2-1.

[1] TransCanada is in the process of relicensing three projects in series on the Connecticut River located immediately upstream of the Turners Falls Development and having the same license expiration date of April 30, 2018 as the FirstLight Projects. They included in upstream to downstream order: Wilder Hydroelectric Project (FERC No. 1892), Bellows Falls Hydroelectric Project (FERC No. 1855) and the Vernon Hydroelectric Project (FERC No. 1904).

Table 3.2-1: USGS Gages on Tributaries to the Turners Falls Impoundment

Gage No.	Gage Name	Period of Record	Drainage Area	Regulation
01161000	Ashuelot River at Hinsdale, NH	1907-current	420 mi^2	Regulated by Corps Storage Reservoir- Surry Dam since 1941.
01166500	Millers River at Erving, MA	1915-current	372 mi^2	Regulated by Corps Storage Reservoirs- Tully Dam and Birch Hill Dams since 1949 and 1941, respectively.

The total drainage area of these two gages is 792 mi^2, which represents 88% (792/897) of the remaining drainage area.

TransCanada reports the Vernon Hydroelectric Project discharge to FirstLight, including flow through the Vernon turbines (total station hydraulic capacity of 17,130 cfs) plus any spill via the gates. Spill at Vernon is estimated via rating curves for the various gates.

FirstLight sums the reported Vernon Hydroelectric Project instantaneous discharge plus the flow contributions from the Millers and Ashuelot Rivers as measured at the USGS gages and then adjusts it based on the travel time required to reach the Turners Falls Dam. FirstLight refers to the adjusted flow on its log sheets as the "natural routed flow". Note that the electronically available data is only available for the period 2000-2014. Thus, to estimate the inflow to Turners Falls Dam over a long period of record a different method was used to estimate inflow as described below.

The Connecticut River flow at the Turners Falls Dam was estimated using two USGS gages as listed in Table 3.2-2.

Table 3.2-2: USGS Gages to Estimate inflow to Turners Falls Dam

Gage No.	Gage Name	Period of Record	Drainage Area	Regulation
01170500	Connecticut River at Montague City, MA	1904-current	7,860 mi^2	Regulated seasonally by dams on the CT River (and other major tributaries): First and Second CT Lakes, Moore Reservoir and Comerford Reservoir.
0117000	Deerfield River at West Deerfield, MA	1940-current	557 mi^2	Regulated seasonally by dams on the Deerfield River: Somerset and Harriman Reservoirs.

The Montague USGS gage is located approximately 4,500 feet downstream of the Cabot Powerhouse. It represents the total flow on the Connecticut River including flow from the Deerfield River. The Deerfield River USGS gage is located further upstream from its confluence with the Connecticut River. As noted above, the drainage area of the Connecticut River at the Turners Falls Dam is 7,163 mi^2. The additional drainage area at the Montague USGS gage compared to the Turners Falls Dam is 697 mi^2, of which the bulk of the increase is attributable to the Deerfield River (557 mi^2 as measured at the USGS gage and 665 mi^2 as measured at its confluence with the Connecticut River). The Deerfield River gage flow was prorated by a factor of 1.25 (697/557) to represent the additional flow from the 697 mi^2 drainage area. This prorated flow was then subtracted from the corresponding flow measured at the Montague USGS Gage to estimate the flow at Turners Falls Dam. The following equation was applied to estimate the flow at Turners Falls Dam:

$Q_{Turners\ Falls\ Dam} = Q_{Montague\ USGS\ Gage} - 1.25(Q_{Deerfield\ USGS\ Gage})$, where

$Q_{Turners\ Falls\ Dam}$=	calculated approximate inflow to Turners Falls Dam (cfs)
$Q_{Montague\ USGS\ Gage}$=	flow recorded at the Montague USGS Gage (cfs)
1.25 =	ratio of the drainage areas (697/557)
$Q_{DeerfieldUSGS\ Gage=}$	flow recorded at the Deerfield USGS gage (cfs)

The annual and monthly mean and median flows, and flow per square mile of drainage area at the Turners Falls Dam was calculated for the period 1940-2013 as shown in Table 3.2-3.

Table 3.2-3: Estimated Connecticut River at Turners Falls Dam Drainage Area= 7,163 mi^2, Period of Record Oct 1941-Dec 2013 (cfs)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean	10,153	9,753	18,889	33,399	19,513	11,848	8,207	7,447	6,328	11,701	13,940	14,504	14,008
Mean/ mi^2	1.42	1.36	2.64	4.66	2.72	1.65	1.15	1.04	0.88	1.63	1.95	2.02	1.96
Median	7,862	7,699	13,450	30,163	17,200	8,893	4,908	4,104	4,072	6,038	9,883	9,525	8,464
Median/ mi^2	1.10	1.07	1.88	4.21	2.40	1.24	0.69	0.57	0.57	0.84	1.38	1.33	1.18

Figures 3.2-1 through 3.2-5 show the annual and monthly flow duration curves representing calculated Turners Falls Dam average daily flows, respectively.

3.3 Area Capacity Curve

The TFI stage versus storage curve is shown in Table 3.3-1 and plotted in Figure 3.3-1. The TFI licensed operating range is between 185 feet and 176 feet, a 9 foot fluctuation providing a total usable storage of approximately 16,150 acre-ft. The TFI has a surface area of approximately 2,110 acre at elevation 185 ft.

The Upper Reservoir stage versus storage curves is shown in Table 3.3-2 and plotted in Figure 3.3-2. The Upper Reservoir licensed operating range is between 1000.5 and 938 ft, a 62.5 foot fluctuation providing a total usable storage of 12,318 acre-feet. As noted earlier, FirstLight is proposing to increase the Upper Reservoir storage operating limits to be between 1004.5 ft and 920 ft, a 84.5 foot fluctuation providing a total usable storage of 15,327 acre-ft. The Upper Reservoir has a surface area of approximately 278 acres at elevation 1000.5 ft.

Combined Useable Storage Volume in the Northfield Mountain Pumped Storage Development System

The combined useable volume in the Northfield Mountain Pumped Storage Development is the sum of useable water volumes in the Upper Reservoir and the TFI. At any given time, a comparison of the actual combined useable storage volume and the useable storage in the full Upper Reservoir (12,318 acre-feet) provides an indication of whether the TFI useable storage volume is adequate for filling the deficit in the Upper Reservoir. The useable volume in the Upper Reservoir plus the useable volume in the TFI equals 12,318 acre-feet when the system is balanced. At any given time three situations are possible as follows:

- *Combined Useable Storage = 12,318 acre-feet*. This indicates a balanced condition, where the total storage in the TFI and Upper Reservoir is 12,318 acre-feet.

- *Combined Useable Storage < 12,318 acre-feet*. This indicates there is insufficient water available in the TFI to refill the Upper Reservoir. During periods of low flow, this deficiency can be rectified by curtailing generation at Cabot or Station No. 1 to allow the TFI to fill.

- *Combined Useable Storage > 12,318 acre-feet*. This indicates there is more than enough water available in the TFI to refill the Upper Reservoir.

In general, FirstLight strives to maintain a near balanced condition or a positive imbalance where the combined useable storage is close to 12,318 acre-feet.

3.4 Hydraulic Capacity

The Turners Falls Hydroelectric Development includes two facilities – Station No. 1 and Cabot Station located on the power canal. Unit hydraulic capacities of Station No. 1 are shown in Table 3.4-1. At Station No. 1, only five (5) of the seven (7) turbines are operational. The total hydraulic capacity of Station No. 1 is 2,210 cfs.

Table 3.4-1 Station No. 1 Hydraulic Capacity

Unit No.	Hydraulic Capacity (cfs)
1	560
2*	140
3	500
4	--
5	490
6	--
7	520
Total	2,210

*Unit No. 2 is directly connected to a 1600 amp, 257 rpm, 115 volt exciter.

Cabot Station has six identical turbines for a total hydraulic capacity of 13,728 cfs or approximately 2,288 cfs/turbine.

The Northfield Mountain Pumped Storage Development includes four reversible pump turbines. The hydraulic capacity of the Northfield Mountain Pumped Storage Development when in a pumping and generating mode is approximately 15,200 cfs (3,800 cfs/pump) and 20,000 cfs (5,000 cfs/turbine), respectively.

3.5 Tailwater Rating Curve

Station No. 1 discharges into the Turners Falls bypass reach further upstream than Cabot Station. The Station No. 1 tailwater rating curve is shown in Figure 3.5-1.

Cabot Station discharges into the end of the Turners Falls bypass reach. The Cabot Station tailwater rating curve is shown in Figure 3.5-2.

The Northfield Mountain Pumped Storage Development uses the TFI as its lower reservoir. TFI elevations reflect multiple influences, including operations of the Vernon Hydroelectric Project, Northfield Mountain Pumped Storage Development, and Turners Falls Development. Therefore, Northfield Mountain Pumped Storage Development hourly operations do not necessarily correlate with TFI elevations, such that a traditional tailwater elevation versus plant discharge relationship can be produced. However, FirstLight maintains a long-term water logger in the Northfield Mountain tailrace and hourly TFI elevations at the tailrace are electronically available for the period 2000-2014. An elevation duration curve was developed at the Northfield Mountain tailrace as shown in Figure 3.5-3. The tailrace elevation generally ranges from 181.1 ft (90% exceedance elevation) to 184.9 ft (10% exceedance elevation).

3.6 Powerplant Capability versus Head Curve

Head (feet) versus generation capacity (kW) curves for Station No. 1 and Cabot Station are shown in Figure 3.6-1 and 3.6-2, respectively.

Head versus generation capacity curves for the Northfield Mountain Pumped Storage Development is shown in Figure 3.6-3.

4 UTILIZATION OF PROJECT POWER

The primary purpose of the Project is to supply energy, capacity, regulation and other ancillary services to the New England ISO Interconnection, a regional transmission organization that coordinates the movement of wholesale electricity.

The Northfield Mountain Pumped Storage Development typically pumps water to the Upper Reservoir during the low cost hours of the night, when the power demand is low and generates during the higher priced hours of the day when power demand is high. The Northfield Mountain Pumped Storage Development provides critical energy, operating reserves and operational flexibility to ISO-NE system operation. The fact that ISO-NE, as part of its daily operational planning processes, can rely on the Northfield Mountain Project to supply these operational flexibilities from a certain fuel supply is of high value to ISO-NE and the New England region. In many periods, this significant supply of operational flexibility has avoided the commitment of many other less flexible resources to provide for a more efficient system dispatch. This peak load ability provides rapid response power resources to the grid to prevent regional blackouts.

Storage provides other important reliability benefits to the system. These include helping to manage light load, or excess generation conditions during off peak periods and the ability to respond very quickly to energy and operating reserve needs on the power system during any time of the day or year. New England is deficient in flexible, quick-start capacity today and will remain so for at least the near future.

In the future, if wind and solar energy were to expand considerably in the Northeast, it is possible there could be surplus power from these sources on the grid during the daytime. If these conditions were to occur, it is possible that the Northfield Mountain Pumped Storage Development could pump water to the Upper Reservoir during low demand daytime hours when the price of power is low.

5 PLANS FOR FUTURE DEVELOPMENT

There are no plans for future development of the Project. Pending the magnitude of any future minimum flow releases from the Turners Falls Dam, FirstLight may evaluate installing a minimum flow turbine-generator in the future.

Table 3.1-1.Turners Falls Development- Summary of Monthly and Annual Generation (MWH) for 2000 to 2014

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2000	28,432	18,654	38,145	34,688	39,156	26,144	13,313	22,643	10,714	15,350	23,739	23,573	294,551
2001	21,281	19,462	21,789	23,905	27,295	16,773	6,504	1,875	2,766	4,012	9,147	13,482	168,291
2002	12,713	19,935	31,642	38,169	38,051	28,866	13,579	6,776	7,017	11,432	22,380	22,830	253,390
2003	18,684	14,809	24,167	41,200	40,239	21,315	7,551	19,320	15,825	25,252	26,701	26,774	281,837
2004	25,901	15,833	26,903	33,799	35,155	20,759	13,250	22,084	28,301	16,303	23,364	39,848	301,500
2005	34,623	21,565	25,497	39,151	42,809	36,913	20,571	10,860	13,190	27,190	34,807	35,016	342,192
2006	37,182	35,423	31,076	42,935	38,360	41,285	27,079	26,590	12,804	32,698	43,538	43,658	412,628
2007	26,814	17,662	31,725	39,604	41,986	22,144	21,251	10,740	6,579	22,768	36,026	33,569	310,868
2008	38,050	39,282	43,283	37,361	32,209	27,491	28,503	37,856	16,278	23,966	36,272	42,953	403,504
2009	31,690	23,968	44,716	43,861	39,277	29,916	42,117	33,954	10,548	29,548	39,309	40,310	409,214
2010	31,416	27,633	41,142	43,506	32,466	20,856	14,012	13,797	7,541	37,047	38,314	35,832	343,562
2011	26,269	19,431	39,341	39,448	45,213	34,294	14,704	18,156	25,336	38,674	35,033	44,346	380,245
2012	34,633	25,227	40,104	30,139	42,125	29,565	11,983	8,349	9,577	24,229	24,868	33,528	314,327
2013	27,118	26,881	33,500	44,208	33,628	40,650	40,622	18,168	21,957	13,963	25,577	30,104	356,376
2014	35,353	22,059	23,709	38,911	45,584	28,200	32,620	23,501	9,183	21,757	25,366	41,609	347,852
Average	28,677	23,188	33,116	38,059	38,237	28,345	20,511	18,311	13,174	22,946	29,629	33,829	328,022

Table 3.1-2 Northfield Mountain Pumped Storage Development- Summary of Net Monthly and Annual Generation (MWH) for 2000 to 2014

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2000	109,864	93,567	92,126	89,140	109,320	100,727	137,576	153,957	131,579	123,193	98,718	113,447	1,353,214
2001	101,351	77,503	107,797	121,528	117,901	123,672	137,954	149,880	145,696	138,503	114,467	119,844	1,456,096
2002	95,850	78,303	97,810	103,238	108,275	92,970	111,514	132,978	145,309	125,227	121,123	119,287	1,331,884
2003	95,056	92,116	81,976	65,973	71,618	94,434	96,930	85,811	99,356	61,691	86,925	102,546	1,034,432
2004	99,038	68,077	83,489	75,299	81,302	91,938	89,748	91,846	104,555	87,248	90,696	93,304	1,056,540
2005	81,856	47,618	60,445	58,132	60,958	92,404	104,355	95,351	73,493	77,921	76,339	81,201	910,073
2006	79,856	58,120	76,698	81,847	86,519	79,207	101,082	102,527	91,914	80,443	96,297	100,885	1,035,395
2007	93,798	54,954	43,704	46,464	60,212	87,499	107,016	142,983	139,486	122,630	98,251	103,570	1,100,567
2008	90,188	91,888	101,507	99,094	95,346	116,186	153,354	102,877	82,032	77,478	85,450	84,183	1,179,583
2009	66,037	52,512	61,739	68,409	60,943	79,981	97,749	124,674	93,964	92,274	77,584	96,730	972,596
[1]2010	86,164	73,981	78,598	52,630	672	0	0	0	0	0	18,440	62,204	372,689
2011	65,671	64,477	46,452	42,301	50,058	56,290	103,392	79,772	67,771	76,893	52,454	51,629	757,160
2012	45,074	26,698	52,722	68,596	74,068	55,938	98,932	110,138	61,517	59,794	72,925	55,424	781,826
2013	66,781	65,362	57,176	51,085	61,099	60,465	109,059	76,220	57,764	60,570	64,130	79,232	808,943
2014	68,726	64,673	67,949	58,571	81,431	74,821	98,883	101,214	99,761	82,828	89,316	87,993	976,166
[2]Average	82,796	66,848	73,685	73,548	79,932	86,181	110,539	110,731	99,586	90,478	87,477	92,091	1,053,891

[1]The Northfield Mountain Pumped Storage Development was out of operation for much of 2010.
[2]The average does not include 2010, given this year was an anomaly due to the Northfield Mountain Pumped Storage Development extended outage.

Table 3.1-3 Northfield Mountain Pumped Storage Development- Summary of Net Monthly and Annual Generation (MWH) Consumption in Pumping Mode for 2000 to 2014

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2000	157,351	131,094	125,737	129,019	144,954	139,323	190,031	205,477	184,650	167,439	139,645	155,752	1,870,472
2001	138,633	105,502	150,565	164,074	160,922	172,880	187,517	203,549	201,358	191,469	153,844	168,665	1,998,978
2002	136,523	103,437	141,198	133,679	146,994	132,568	146,600	185,188	196,329	174,822	168,801	167,005	1,833,144
2003	130,126	124,585	112,260	98,449	89,020	133,009	134,548	119,934	134,217	84355	116,700	139,201	1,416,404
2004	141,351	90,200	112,840	103,857	112,097	125,896	112,995	128,896	136,736	119,890	122,353	128,224	1,435,335
2005	110,358	61,864	87,156	74,377	86,454	125,696	138,225	126,601	98027	109,068	104,009	109,238	1,231,073
2006	109,578	82,360	98,692	107,359	118,492	110,219	133,915	139,214	120,725	113,678	125,271	139,147	1,398,650
2007	132,605	76,064	54,029	62,831	82,046	118,986	146,089	194,557	195,152	165,484	133,335	141,776	1,502,954
2008	127,655	128,575	138,742	141,327	127,381	160,269	212,444	146,638	111,357	104,468	120,801	118,252	1,637,909
2009	90,332	82,182	76,542	97,149	86,154	107,715	135,735	176,610	131,289	126,293	106,205	133,929	1,350,135
[1]2010	126,198	99,201	109,006	71,612	83	0	0	0	0	0	32,244	89,887	528,231
2011	96,439	82,752	72,367	55,866	69,610	81,690	142,141	106,248	93,523	110,491	71,918	69,741	1,052,786
2012	57,045	38,936	65,705	93,555	99,673	77,037	132,357	140,865	86,191	74,027	99,027	77,183	1,041,601
2013	88,692	85,026	71,356	68,421	83,307	81,206	144,181	94,930	80,654	76,997	84,133	110,535	1,069,438
2014	85,727	87,745	87,358	84,204	105,758	100,985	129,180	129,100	128,599	113,603	119,270	114,094	1,285,623
Average[2]	114,458	91,452	99,611	101,012	108,062	119,106	148,997	149,843	135,629	123,720	118,951	126,624	1,437,464

[1]The Northfield Mountain Pumped Storage Development was out of operation for much of 2010.

[2]The average does not include 2010, given this year was an anomaly due to the Northfield Mountain Pumped Storage Development extended outage.

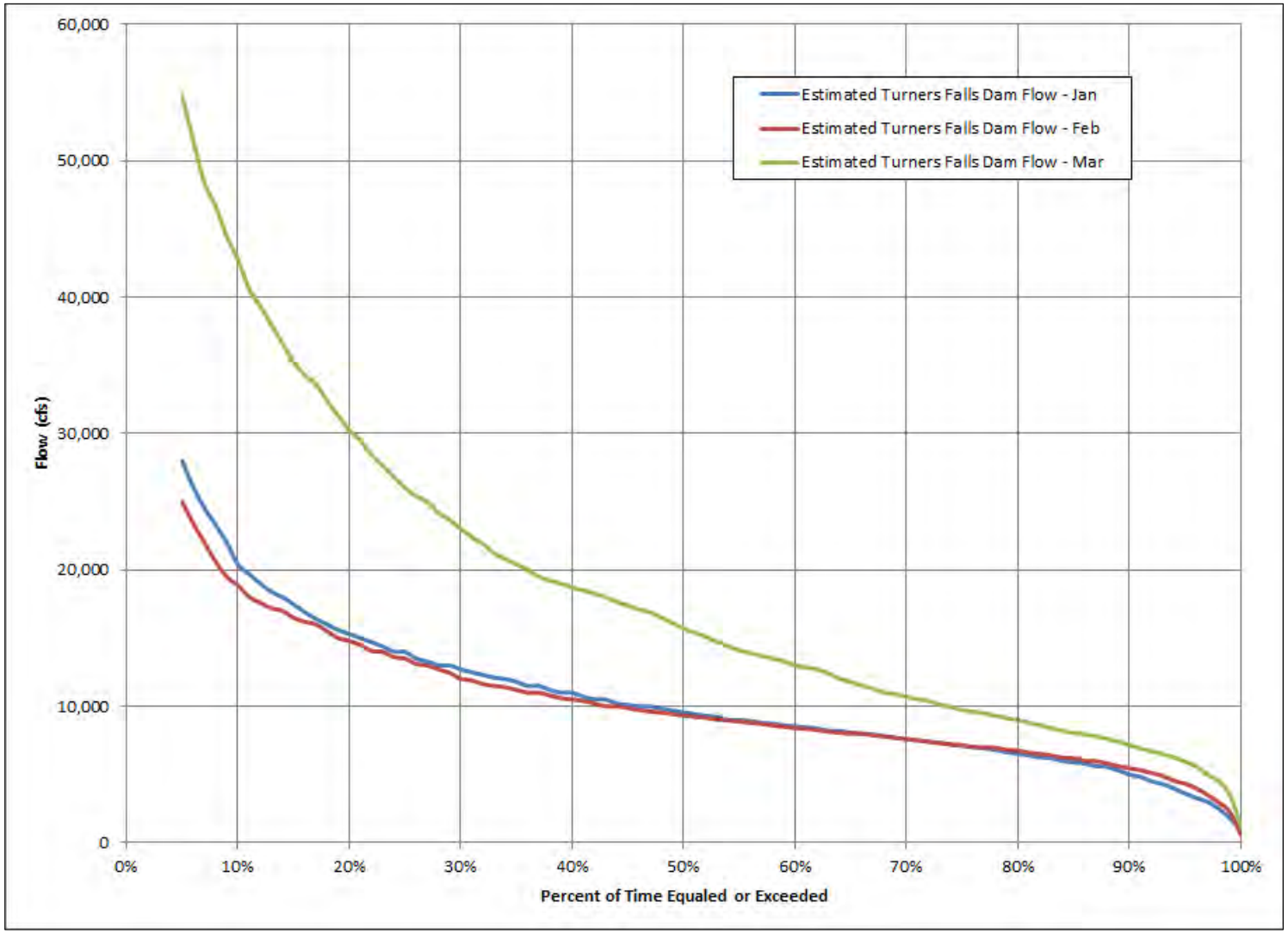

Figure 3.2-1. Connecticut River at Turners Falls Dam, Jan-Mar Flow Duration Curve, Oct 1940-Dec 2013, Drainage Area= 7,163 mi^2

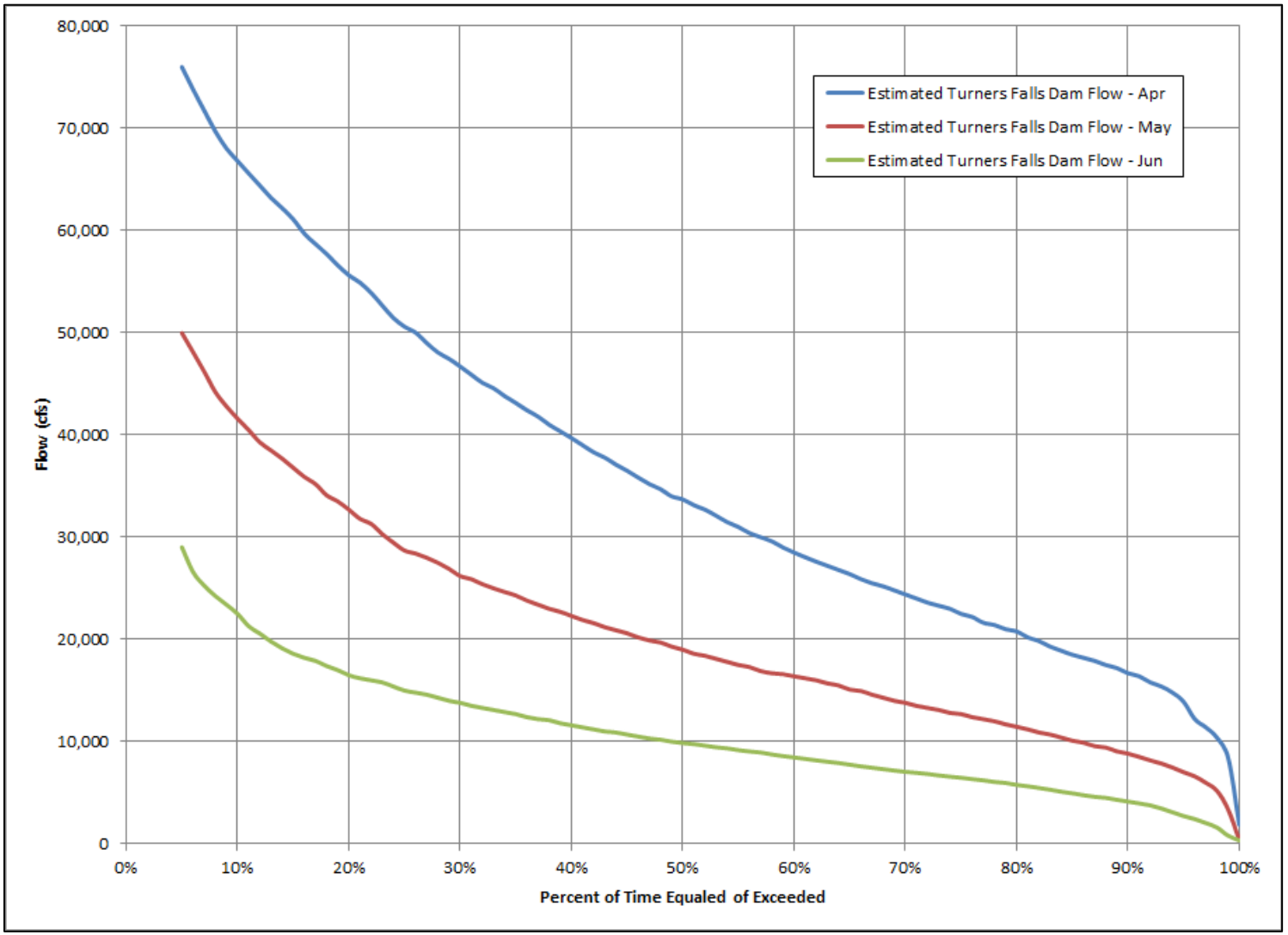

Figure 3.2-2. Connecticut River at Turners Falls Dam, Apr-Jun Flow Duration Curve, Oct 1940-Dec 2013, Drainage Area= 7,163 mi^2

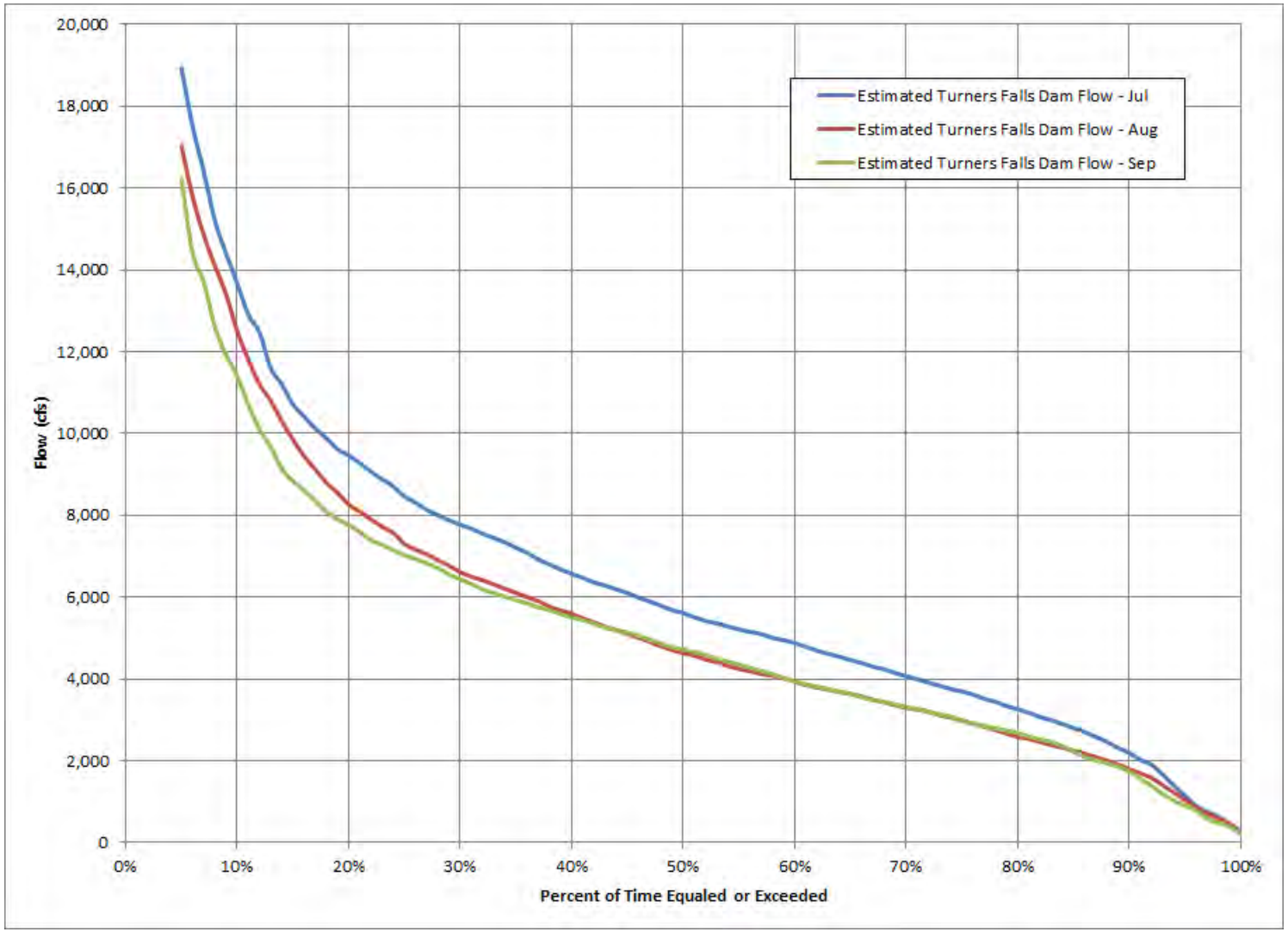

Figure 3.2-3. Connecticut River at Turners Falls Dam, Jul-Sep Flow Duration Curve, Oct 1940-Dec 2013, Drainage Area= 7,163 mi^2

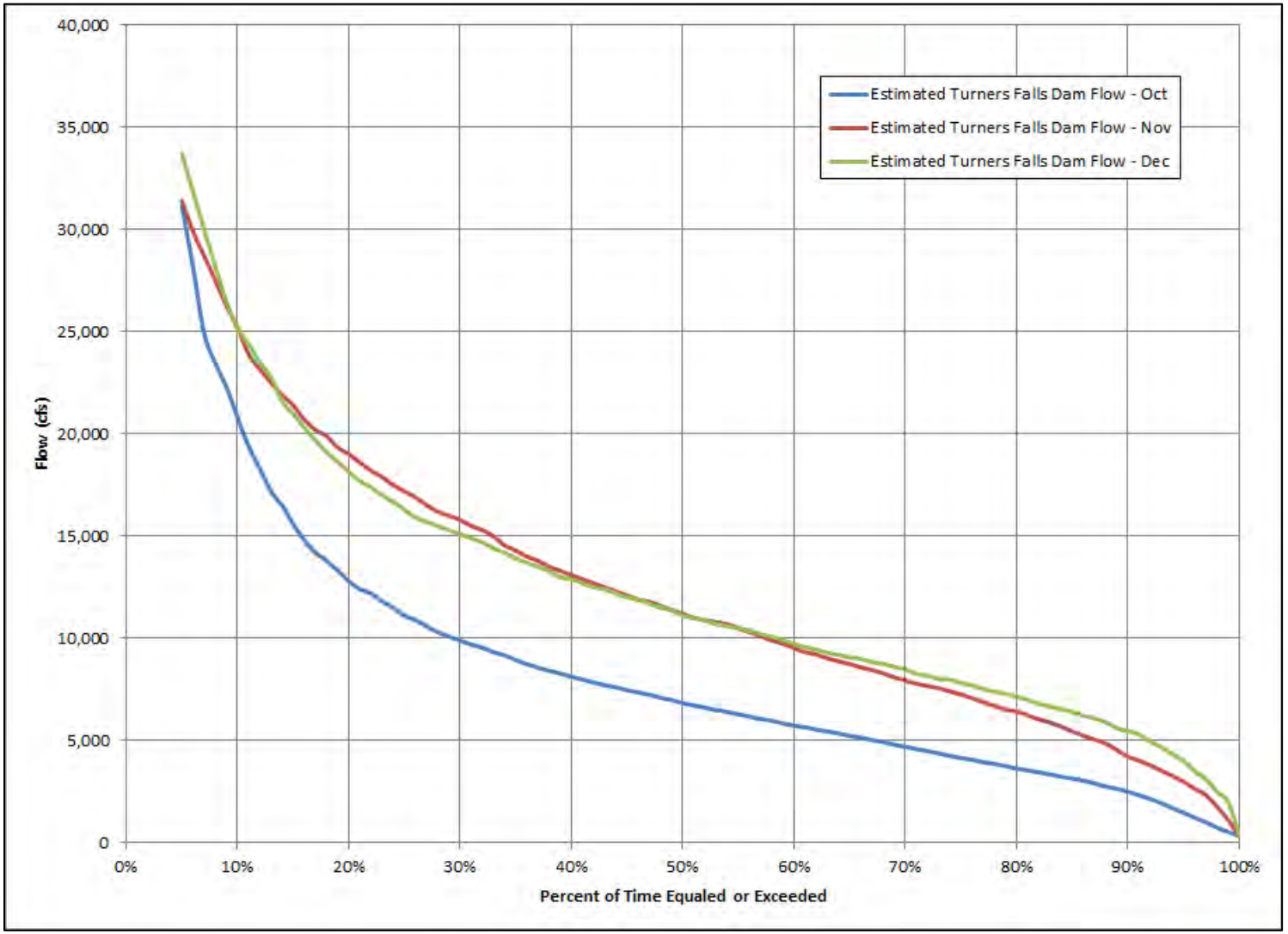

Figure 3.2-4. Connecticut River at Turners Falls Dam, Oct-Dec Flow Duration Curve, Oct 1940-Dec 2013, Drainage Area= 7,163 mi^2

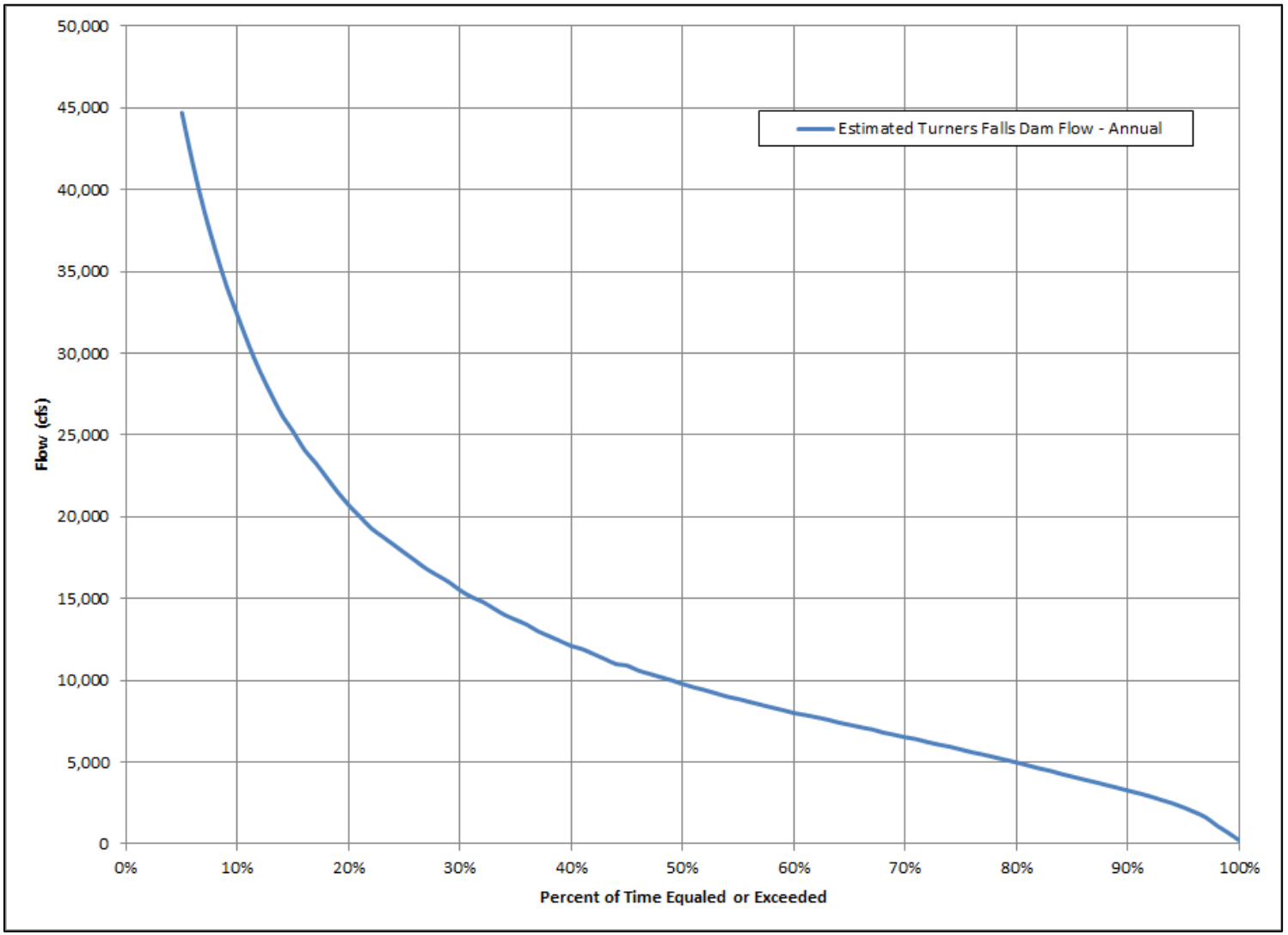

Figure 3.2-5. Connecticut River at Turners Falls Dam, Annual Flow Duration Curve, Oct 1940-Dec 2013, Drainage Area= 7,163 mi^2

Table 3.3-1: Turners Falls Impoundment Stage versus Storage Curve

Turners Falls Impoundment Elev (ft)	**Storage** (acre-ft)
172.26	0
176	4,150
177	5,600
178	7,500
179	9,200
180	11,100
181	13,000
182	14,750
183	16,600
184	18,450
185	20,300
186	22,100
186.5	23,000

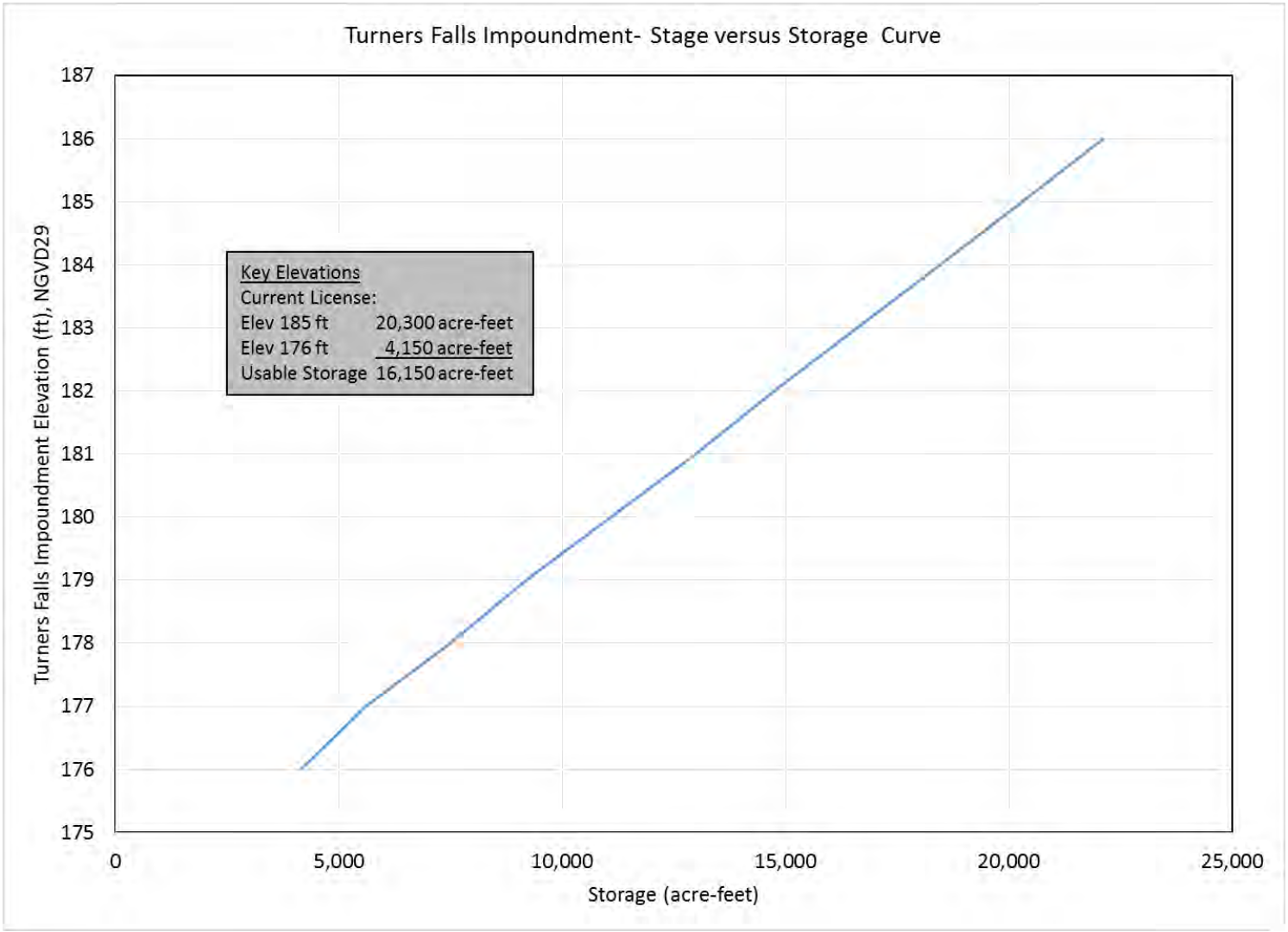

Figure 3.3-1: Turners Falls Impoundment Stage versus Storage Curve

Table 3.3-2: Upper Reservoir Stage versus Storage Curve

Upper Reservoir Elev (ft)	**Storage** (acre-ft)	**Upper Reservoir Elev** (ft)	**Storage** (acre-ft)
920	0	966	6,141
921	88	967	6,328
922	177	968	6,519
923	269	969	6,713
924	363	970	6,910
925	459	971	7,110
926	558	972	7,314
927	658	973	7,520
928	760	974	7,729
929	865	975	7,940
930	972	976	8,155
931	1,081	977	8,374
932	1,192	978	8,596
933	1,306	979	8,820
934	1,422	980	9,046
935	1,540	981	9,276
936	1,660	982	9,508
937	1,781	983	9,743
938	1,905	984	9,980
939	2,030	985	10,221
940	2,157	986	10,464
941	2,286	987	10,710
942	2,417	988	10,958
943	2,550	989	11,208
944	2,685	990	11,461
945	2,823	991	11,751
946	2,962	992	11,971
947	3,101	993	12,229
948	3,244	994	12,489
949	3,387	995	12,750
950	3,532	996	13,014
951	3,678	997	13,280
952	3,827	998	13,547
953	3,976	999	13,816
954	4,128	1000	14,087
955	4,281	1000.5	14,223
956	4,436	1001	14,360
957	4,593	1002	14,633
958	4,752	1003	14,969
959	4,912	1004	15,187
960	5,077	1004.5	15,327
961	5,248		
962	5,425		
963	5,597		
964	5,775		
965	5,956		

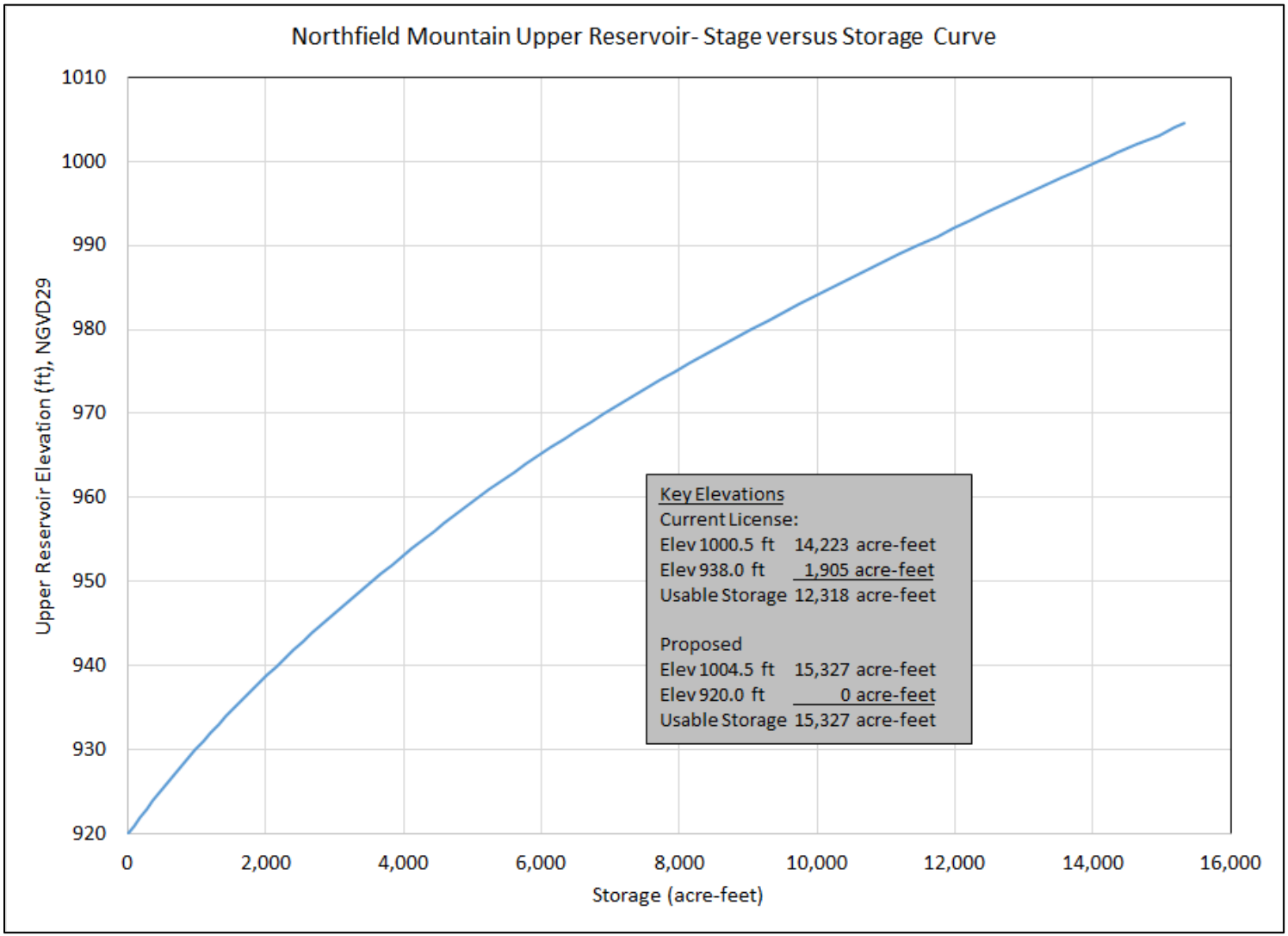

Figure 3.3-2: Northfield Mountain Upper Reservoir Stage versus Storage Curve

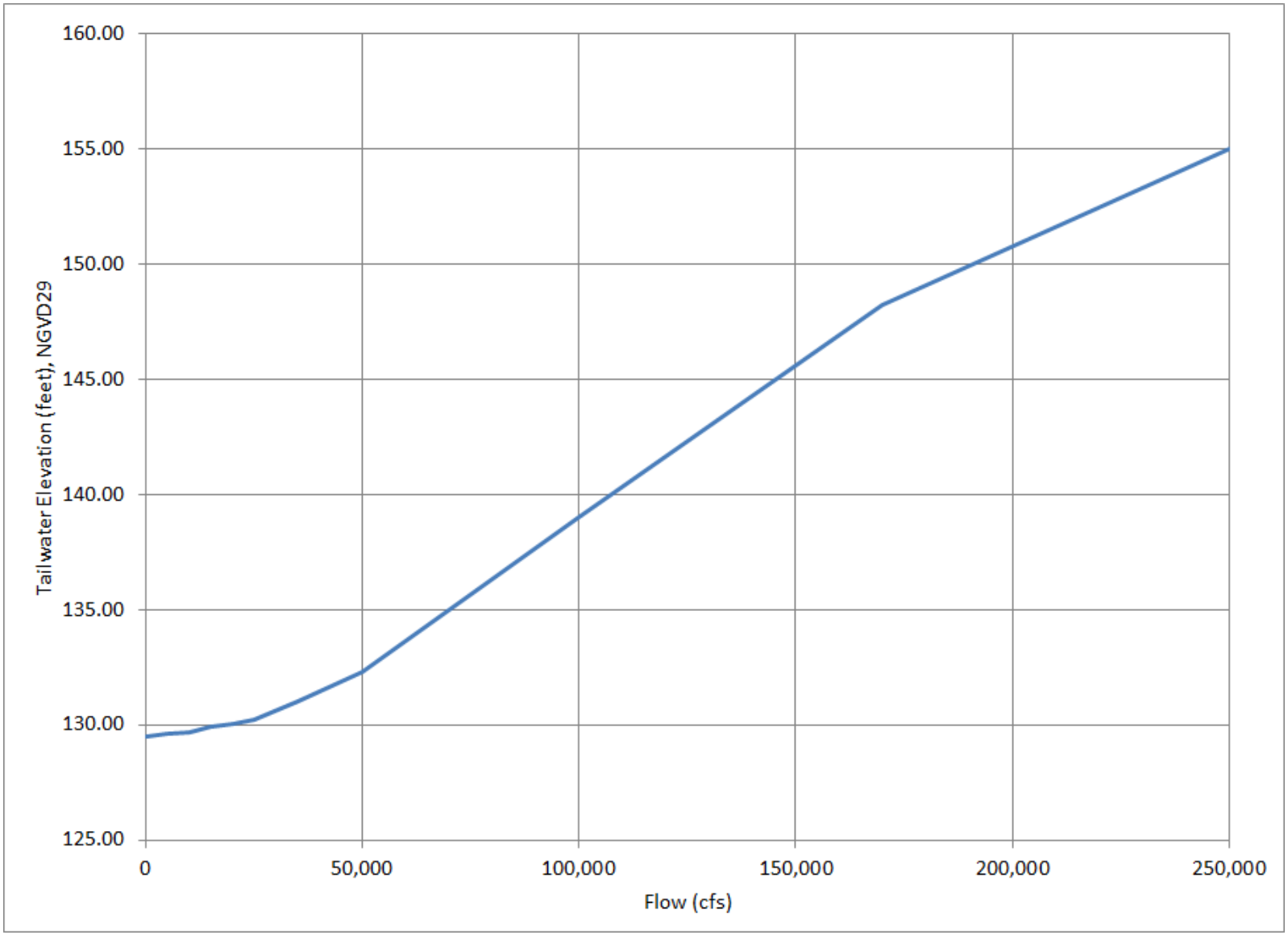

Figure 3.5-1: Station No. 1 Tailwater Rating Curve

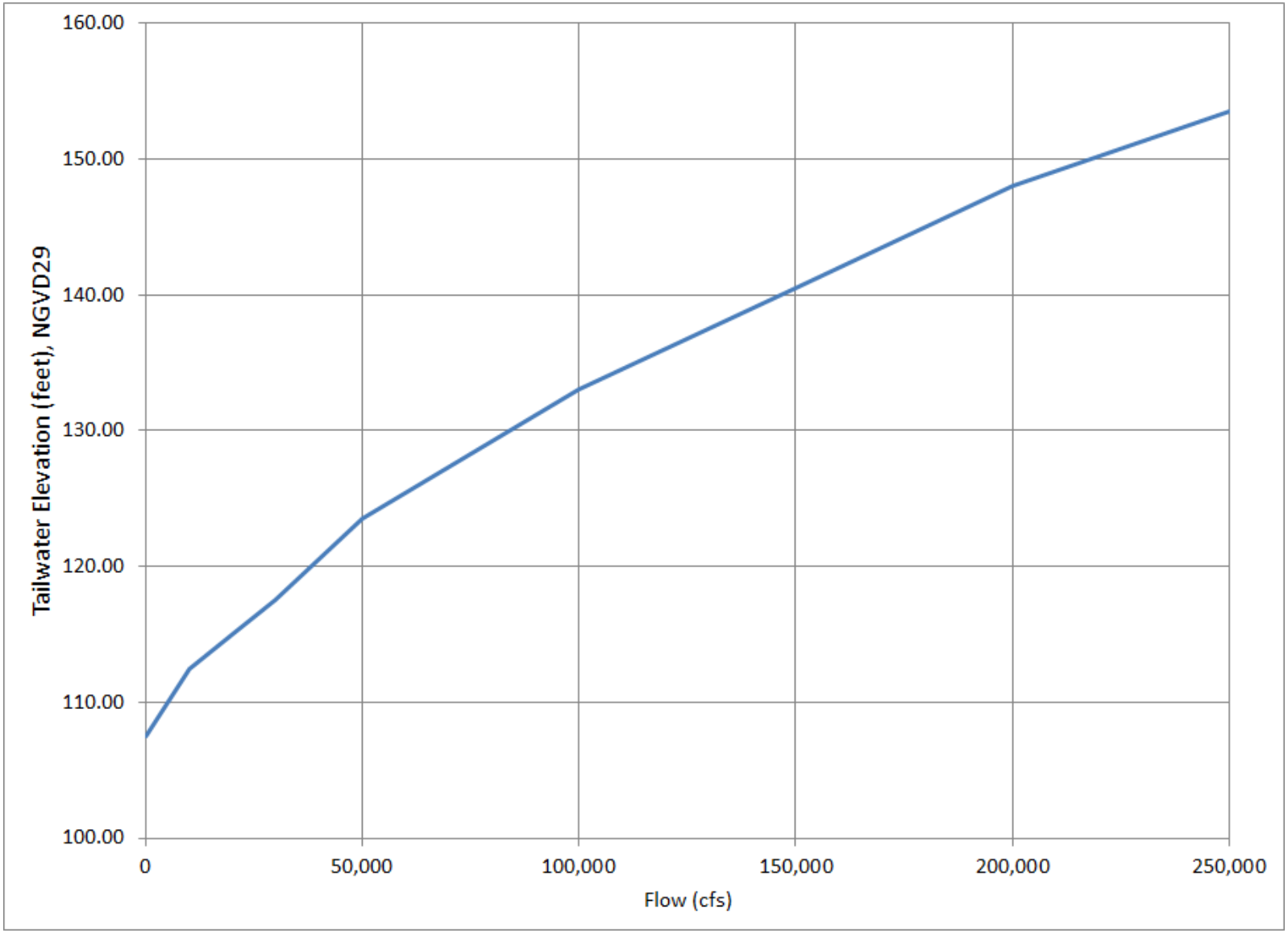

Figure 3.5-2: Cabot Station Tailwater Rating Curve

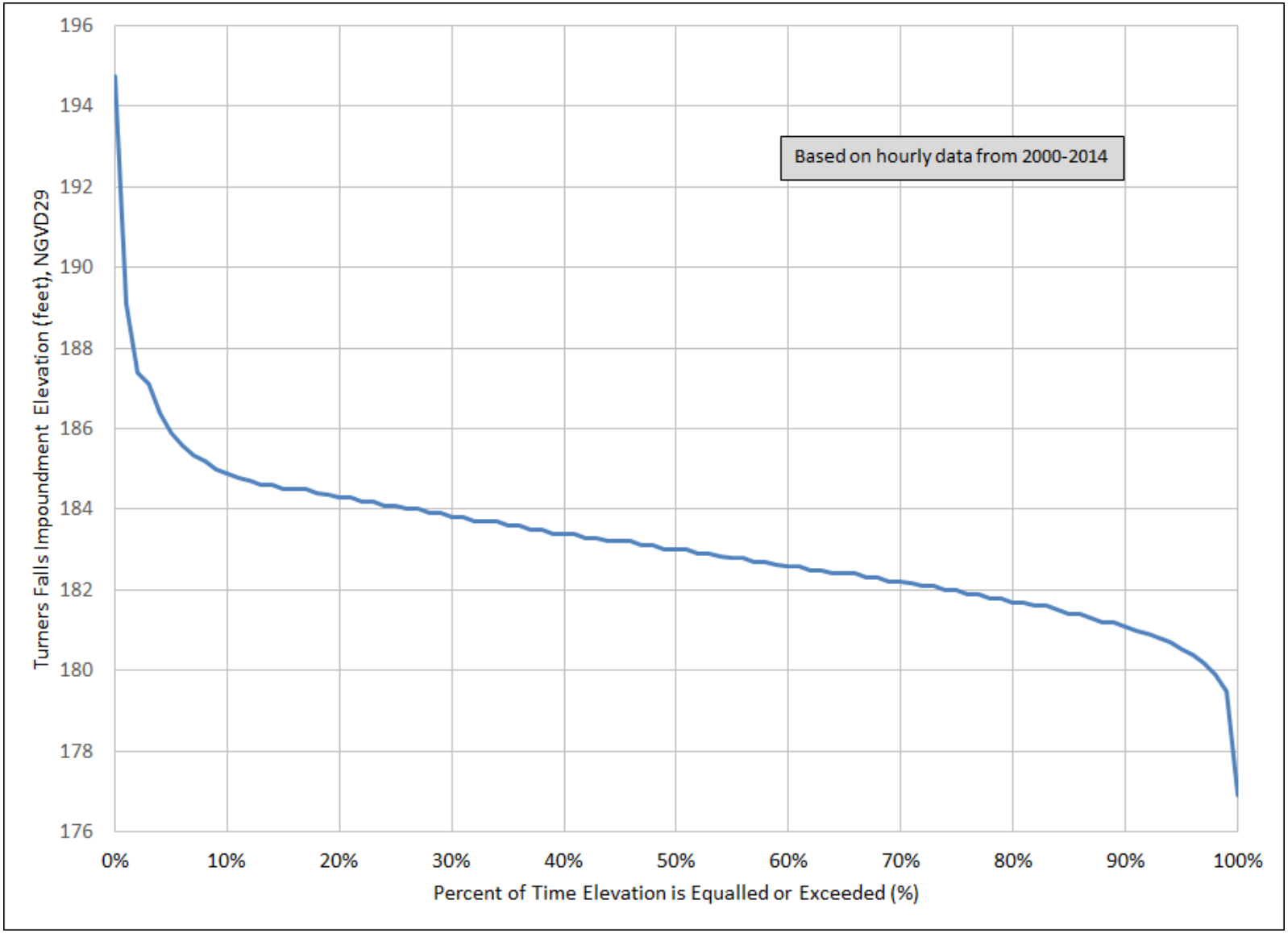

Figure 3.5-3: Turners Falls Impoundment- Elevation Duration Curve at Northfield Mountain Pumped Storage Development Tailrace
(based on hourly data from 2000-2014)

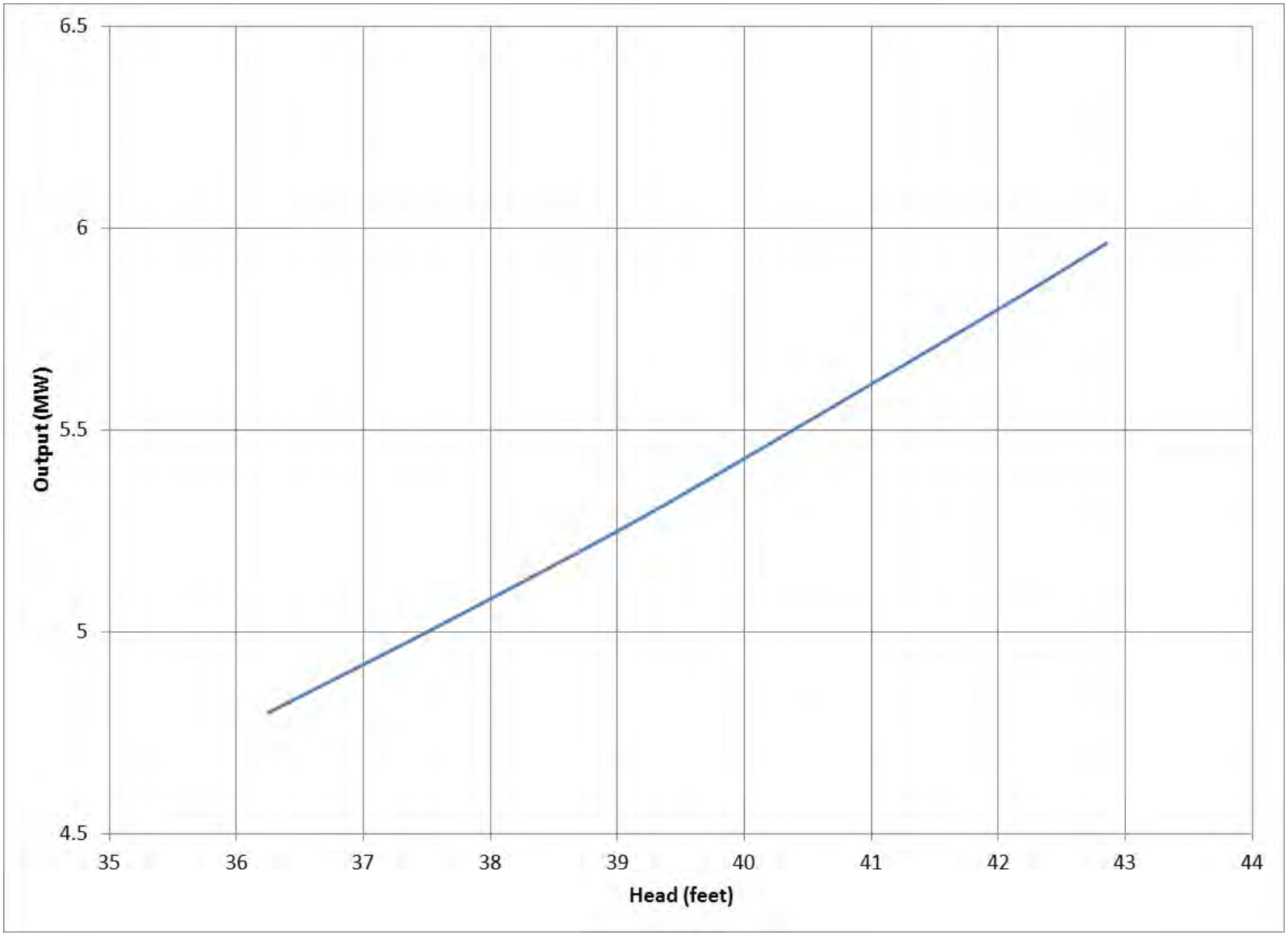

Figure 3.6-1. Station No. 1 - Plant Capability (MW) versus Head (ft) Curve

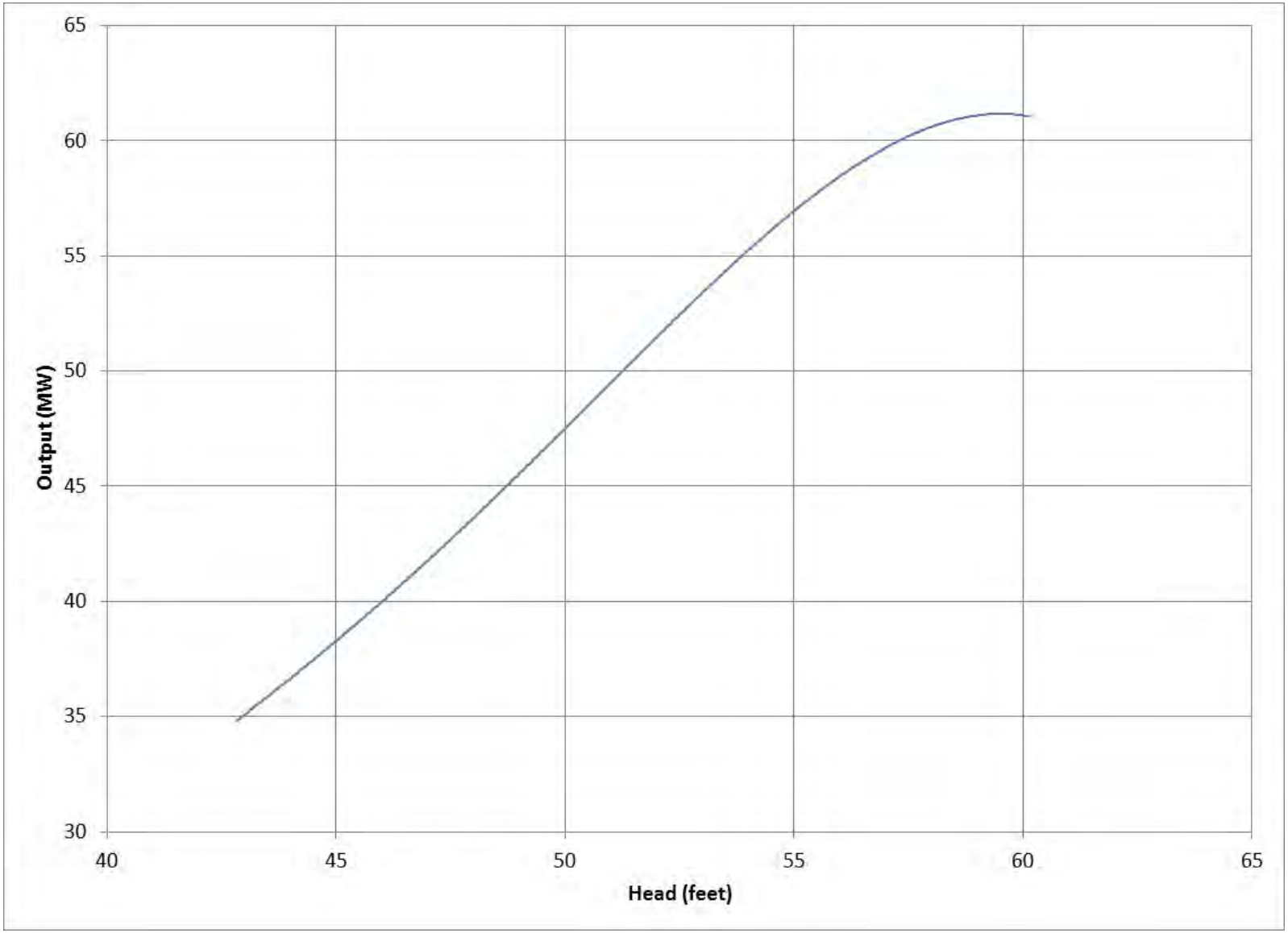

Figure 3.6-2. Cabot Station - Plant Capability (MW) versus Head (ft) Curve

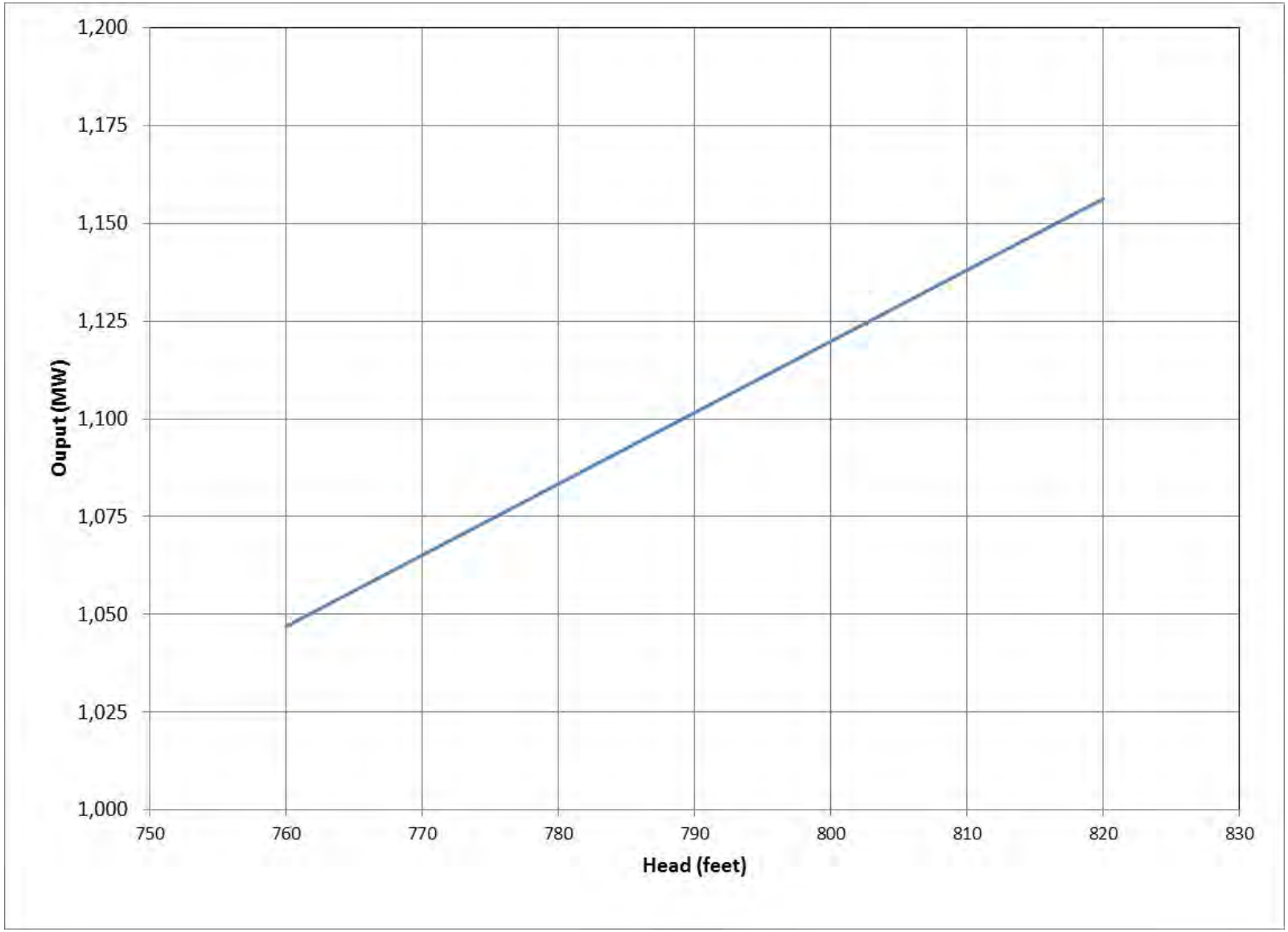

Figure 3.6-3. Northfield Mountain Pumped Storage Development - Plant Capability (MW) versus Head (ft) Curve