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September 6, 2007

Coopers Mills Dam Hydro Study Group
c/o Steve McCormick, First Selectman
Town of Whitefield
P.O. Box 58
Whitefield, ME 04353

Emailed on September 6, 2007 to: Steve McCormick (whitefield@roadrunner.com), Lou Sell (LSell52354@aol.com), Jed Wright (jed_wright@fws.gov)

Re: Pre-Feasibility Study Letter Report for Coopers Mills Dam

Dear Mr. McCormick:

Please find enclosed the pre-feasibility study letter report for the Cooper Mills Project. The report includes generation estimates at the project for a range of head and flow conditions. Using the estimated average annual generation (MWH/year), along with energy pricing ($/MWH), the average annual revenue potential from the project was estimated.

In addition, as discussed with the Hydro Group on August 22, 2007, we have provided costs for comparable hydropower development projects with similar head and flow conditions as Coopers Mills Dam. Within the past three years we have conducted more detailed feasibility studies that evaluated the potential for hydropower development at an existing dam- these sites are comparable in size to Coopers Mills. It should be noted that a site-specific estimate for developing hydropower at Coopers Mills Dam was not part of our scope. However, the order of magnitude costs should provide the Hydro Group with a sense of what hydropower development could cost.

Please note that although I am sending this via email, one hard copy will be sent to the Town of Whitefield at the address above. I hope this letter report addresses your needs. If you have any questions regarding the enclosed, please feel free to give me a call at 603-529-4400.

Sincerely,

Mark Wamser, PE
Water Resource Engineer

1.0 Background

The Coopers Mills Dam, located on the Sheepscot River, is owned by the Town of Whitefield. The dam has been abandoned for approximately 30 years and was historically used to provide hydro mechanical power for sawmills. The dam is approximately 10 feet high and 150 feet wide, with a 43 foot wide spillway. The dam retains a small impoundment that extends approximately 750 feet upstream, and is located immediately upstream of the South Main Street Bridge as shown in Figure 1. A concrete Denil fishway, owned by the State of Maine, has historically provided fish passage for alewife and Atlantic salmon at the dam. The dam impoundment is equipped with a dry hydrant used by the Coopers Mills and Whitefield volunteer fire departments, as well as by surrounding towns, as a source of water for fire control. This is the only source of water that allows for direct pumping for fires in the Coopers Mills village, and its presence is critical for fire protection.

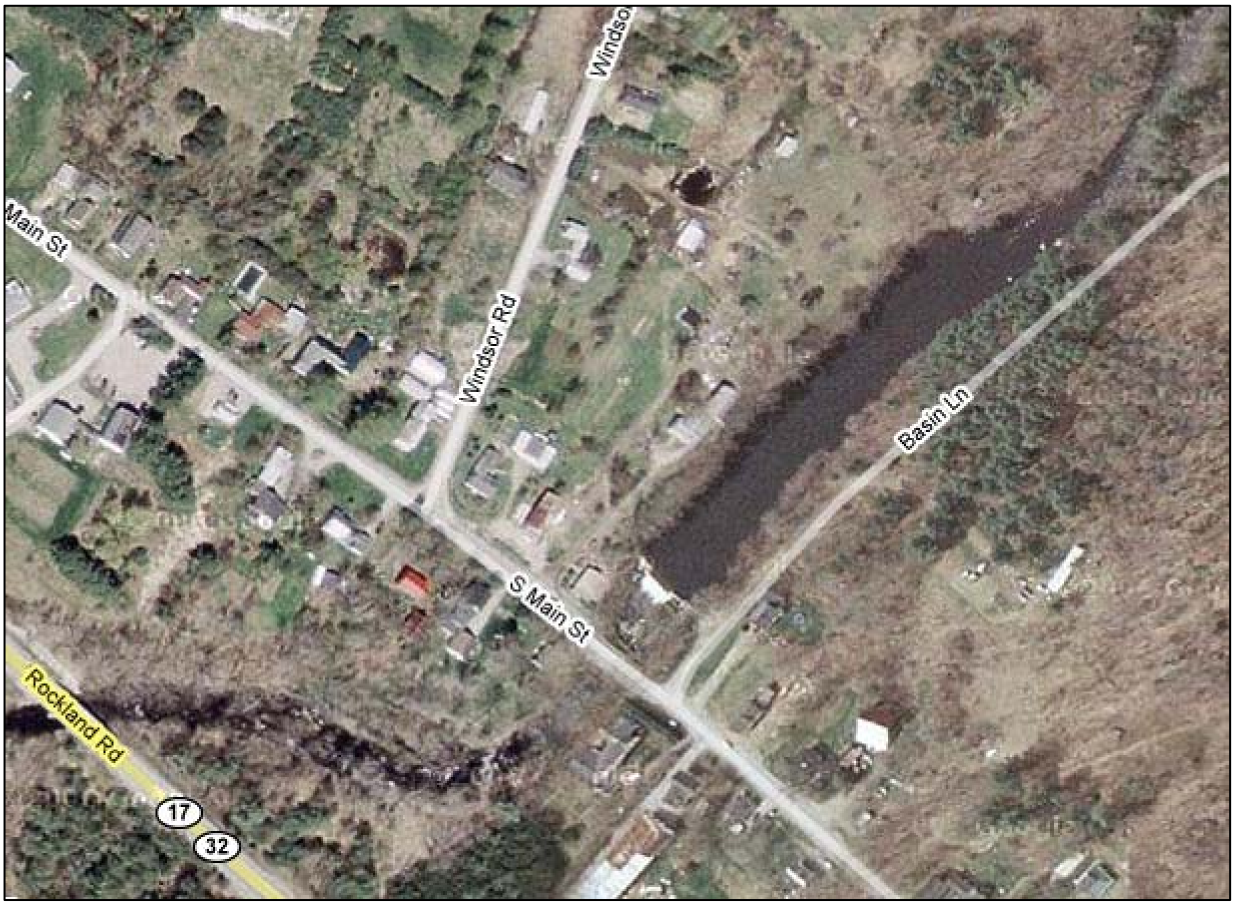

Figure 1: Aerial View of Coopers Mill Dam

According to Kleinschmidt Associates[1] (KA) the dam and Denil fishway are in significant disrepair and would require upgrades to properly function. KA reported that the dam leaks considerably resulting in the impoundment's water level dropping below the dam's spillway crest during low flow periods. When water levels drop, the intake for the Denil fishway becomes perched, rendering the fishway inoperable. Because there is no flow over the spillway during these periods, downstream fish passage is blocked. In addition, under some low flow conditions, the water level renders the dry hydrant inoperable, and in some cases completely dewaters it.

[1] Kleinschmidt Associates, Coopers Mills Dam, Sheepscot River Engineering Evaluation, October 2005

Because the dam is failing and diadromous fish can migrate to the dam, three alternatives for removing the dam and maintaining fire supply have been evaluated. The three alternatives involving dam removal have included:

- Dam removal with hydrant downstream
- Dam removal with pumphouse downstream
- Dam removal with hydrant upstream

In addition to dam removal, two other alternatives have been investigated including status quo, and dam/fish ladder repair. More recently, another alterative is being consider, which calls for rehabilitating the dam, ladder and installing a hydropower facility at the project to produce power.

Gomez and Sullivan Engineers, P.C. (Gomez and Sullivan) was requested by the Coopers Mills Dam Hydro Study Group ("Hydro Group") to conduct a very preliminary feasibility study to examine if hydropower development is a viable alternative. As discussed in a conference call with the members of the Hydro Group on August 24, 2007, this letter report includes estimates of the average annual hydropower generation (in megawatt hours per year, MWH/yr) at Coopers Mills under various head and flow conditions. In addition, cost estimates for installing hydropower based on comparable sites in New England are provided; it should be clearly noted that the cost estimates are not specific to Coopers Mills and thus the cost could vary. These order of magnitude costs could be compared to the estimated generation/revenue from Coopers Mills to determine if hydropower is economically viable.

2.0 Hydropower Generation

2.1 Hydropower Generation Potential

The amount of generation (in kilowatts, kW) at a given hydropower project is a directly related to three variables as explained in the formula below:

$$P=\frac{Q*H*E_s}{11.8}$$

Where:

- P=Power (units- kilowatt, kW)

- Q=Turbine Discharge (units- cubic feet per second, cfs). The higher the turbine flow the greater the generation.

- H=Net Head (units- feet). The higher the head the greater the generation. There is a difference between gross head and net head. Gross head refers to the vertical distance between the impoundment water level and the tailrace[2] elevation as shown in the Figure 2 below. Net head is less than the gross head. Net head accounts for headlosses between the powerhouse intake and the tailrace. Headlosses are associated with the trashracks, elbows, contractions, expansions, friction losses in penstocks, etc.

- E_s=Turbine/Generator Efficiency (%). The higher the turbine efficiency the greater the generation. It should be noted that turbines have a range of efficiencies that vary with the magnitude of flow passing through the turbine as well as the net head. Typically, a

[2] The tailrace is located immediately below where the turbines discharge back into the river.

hydropower turbine has an optimal setting where the efficiency is highest- this is commonly referred to as "best gate". Efficiencies above and below best gates will be less.

- 11.8=Constant for English/Metric conversion

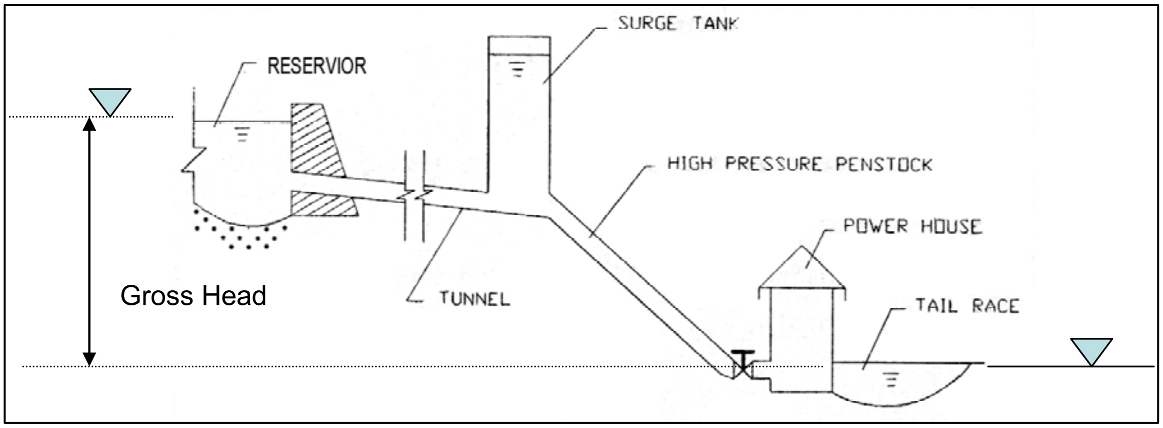

Figure 2: Schematic showing gross head at a hydropower station

2.2 Hydropower Operation

Most hydropower facilities typically operate as either "peaking" or "run-of-river" facilities. A peaking hydropower project normally has significant reservoir storage; the storage is used along with available inflow to generate at full turbine capacity during periods when the price of power is high. Peaking operations typically result in lowering the reservoir water level during periods of high energy prices. Water levels are lowered as the available inflow as well as reservoir storage is used to operate the turbine(s) at best gate. Best gate refers to the most efficient setting of the turbine. When the price of power is less, the turbine discharge is reduced allowing the inflow to refill the reservoir until the next peak cycle.

Alternatively, a run-of-river project does not utilize reservoir storage to supplement inflow for generation. Instead the hydropower facility relies solely on the available inflow to generate electricity. Under run-of-river operations the impoundment water level is not purposely fluctuated.

It is important to understand the distinction between peaking and run-of-river facilities as they are designed differently and have different environmental impacts. Peaking projects have greater environmental impacts due to the fluctuation of reservoir water levels and turbine discharges below the hydropower facility. In contrast, run-of-river facilities maintain relatively constant reservoir levels and the discharges below the hydropower facility match the inflow to the dam. For purposes of estimating the generation potential at the Cooper Mills project, it is assumed that the facility would be operated as run-of-river.

2.2 Factors Impacting Hydropower Generation

As noted in the formula above, there are two factors can influence generation - flow and net head. Below is a description of flows that will not be available for generation and how the head can be increased.

Flow

Hydropower facilities operate over a range of flows; not all of the inflow from the Sheepscot River will be available for generation. When the Sheepscot inflows to Coopers Mills Dam exceeds the maximum hydraulic capacity of the turbine, or is less than the minimum hydraulic capacity of the turbine, the water is spilled and is not available for generation. For example, say the maximum and minimum hydraulic range of a fictitious turbine were 400 and 160 cfs, respectively. If inflow was 500 cfs, then 100 cfs would be spilled, while 400 cfs would be used to generate. Alternatively, if inflow were 150 cfs, then all 150 cfs would be spilled and no generation would occur.

Other flows that would not be available for generation include minimum flows below the dam for the protection of aquatic resources. The state and federal agencies will require the hydropower owner to release minimum flows throughout the year. Minimum flows are typically required in what is called a "bypass" reach, which is the area of the river bed that becomes dry when the available inflow is passed through the powerhouse as shown in Figure 3. It should be noted that minimum flows would take higher priority than flows used for generation. For example, if inflow to Coopers Mills Dam was 400 cfs and the minimum flow required in the bypass reach was 40 cfs, the minimum flow of 40 cfs would be provided first and the remaining 360 cfs could be used for generation.

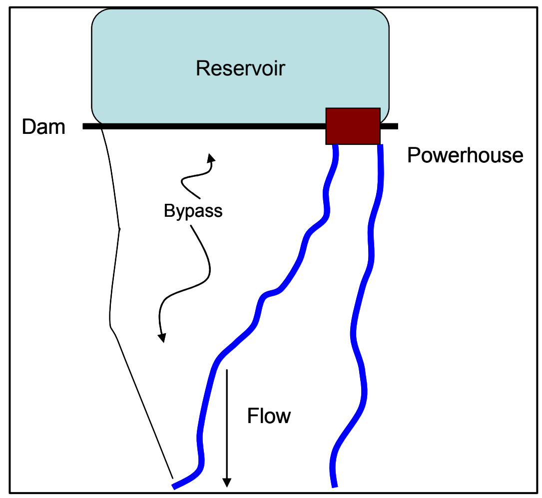

Figure 3: Schematic of Powerhouse and Bypass channel

In addition to minimum flows, the upstream fish passage facility at Coopers Mills would be operated during the migration season, as described later. In order to pass fish through the ladder, flow is required to "attract" fish to the entrance and to provide sufficient depths in the ladder to permit fish passage. Again, the flow required in the ladder would be unavailable for generation- and it would take higher priority than generation.

Head

As noted above, more head translates to greater generation. The options to increase head at the Cooper Mills site would include increasing the impoundment water level, and/or locating the powerhouse further downstream.

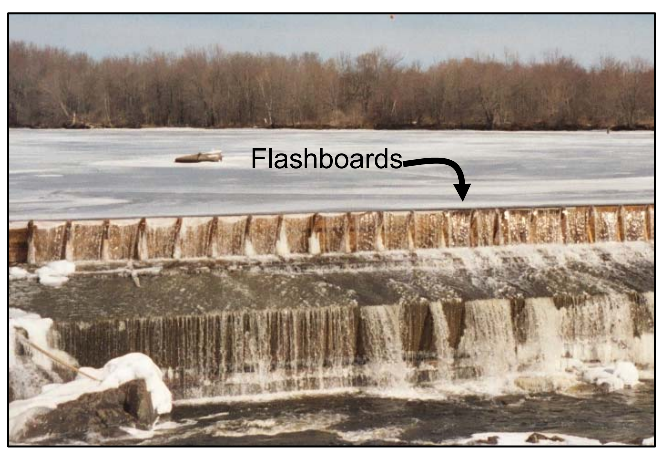

Figure 4: Example of Dam with Flashboards

To increase the water level of the impoundment, flashboards could be added to the dam as shown in Figure 4. Flashboards heights can vary, but typically two feet are commonly added to the spillway crest elevation to increase the available head. Affixing 2-foot flashboards will increase the water level upstream and thus inundate additional lands. The Hydro Study Group would need to determine if the dam owner has flowage rights to these lands. Also, flashboards could contribute to flooding, however, the boards are designed to fail when the water level atop the boards typically reaches two feet. In lieu of flashboards, rubber dams- consisting of a bladder that is filled with air-- can be affixed to the spillway crest to also raise the water level. The bladders are designed to deflate to pass higher flows.

Besides raising the impoundment water level, another method to increase the head at Coopers Mills is by locating the powerhouse further downstream. Powerhouses are typically located integral to the dam (see Figure 5) or are located further downstream to take advantage of the natural drop in topography (see Figure 6).

As shown in Figure 6, the bypass consists of riffles as the river gradient is steep. By diverting water at the dam and conveying it to the powerhouse, additional head can be gained by the natural drop in topography.

As described later we investigated placing the Coopers Mills powerhouse further downstream to determine if additional head could be gained. If the powerhouse were located further downstream, the flow must be conveyed via a penstock or canal.

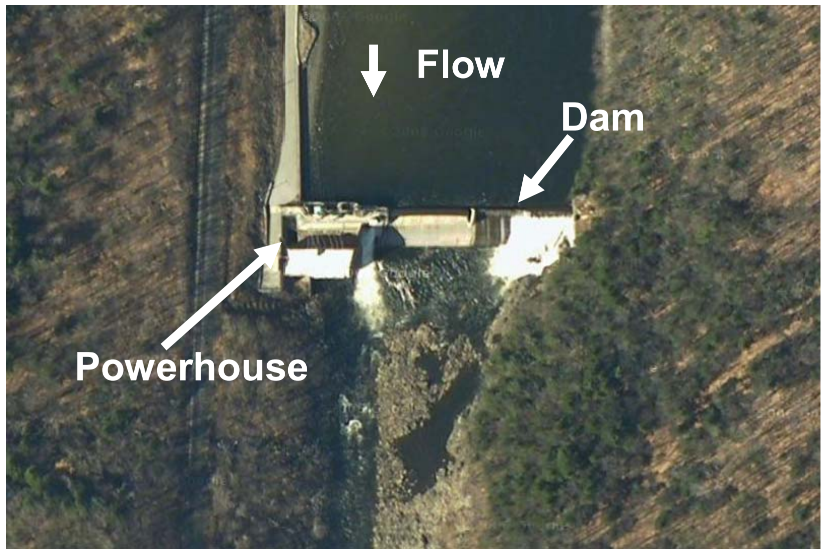

Figure 5: Example of Powerhouse Integral to the Dam

3.0 Hydropower Potential at Coopers Mills

Sheepscot River Hydrology

The drainage area at the Coopers Mills Dam is reported to be 81 square miles. Located further downstream of the dam is a United States Geological Survey (USGS) gage that records streamflow on the Sheepscot River. The gage has a drainage area of 145 square miles. To estimate flows at the Coopers Mills Dam, flows at the USGS gage were adjusted by a ratio of drainage areas (81/145 or 0.56). The USGS gage has been active since 1938, thus there are 60+ years of flow data.

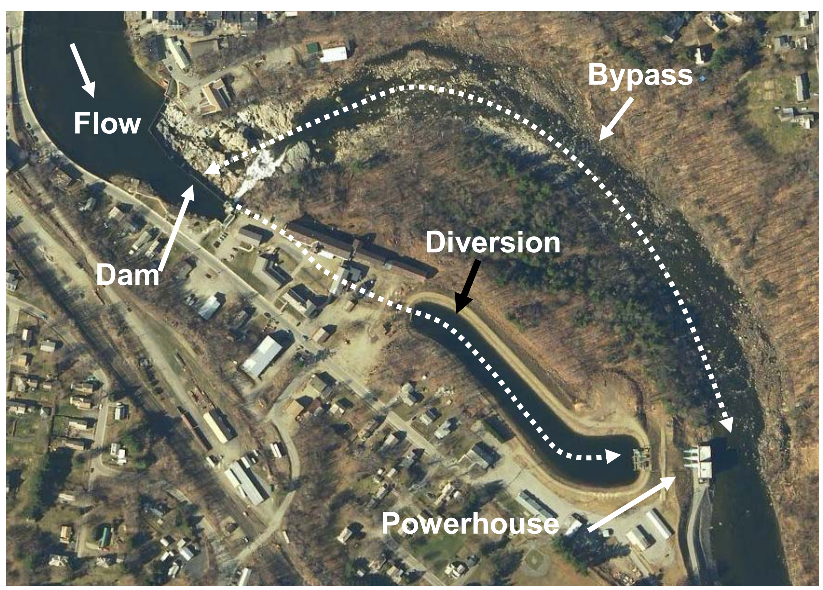

Figure 6: Example of Powerhouse located further downstream- takes advantage of natural drop in topography

Using the estimated daily flows at the Coopers Mills Dam, a flow duration analysis was conducted. A flow duration analysis provides the percentage of time a given flow has been equaled or exceeded for the period of available streamflow. A flow duration curve is developed by ranking all the daily flow data of record according to discharge. The percentage of the daily flow equal to or greater than a measured flow, termed the "percent exceedence", is calculated. Shown in Figure 7 is the annual flow duration curve at the Coopers Mills Dam. For example, a flow of 100 cfs is equaled or exceeded 41% of the time in the Sheepscot River at the Coopers Mills Dam. As a side note, KA had already developed an annual flow duration curve. As part of this study, we confirmed their findings and used the same annual flow duration curve in our energy analysis.

Sizing of Facility Capacity

For purposes of this analysis we have assumed that a Kaplan type turbine would be installed at the project, which allows the turbine to operate under a wider range of flows. An exceedance value of 20% to 25% is often used to size generating equipment to assess the feasibility of run-of-river hydro projects. For the Coopers Mills Project, we sized the turbine for a maximum capacity of 220 cfs, which represents the 20% exceedence interval (see Figure 7). For a Kaplan unit the lowest hydraulic capacity to operate the turbine is typically 25% of the maximum turbine capacity. In this case, the minimum turbine capacity was set to 55 cfs (25% of 220 cfs). For purposes of this analysis, the operational range of the turbine is 55 cfs to 220 cfs. If inflow to the Cooper Mills Dam is less than 55 cfs, this flow would be spilled. Similarly, if inflow to the Coopers Mills Dam was 300 cfs, the turbine would operate at maximum capacity – 220 cfs- while the remainder (80 cfs) would be spilled.

Minimum Flows

The location of the Coopers Mills Powerhouse may govern what, if any, minimum flow would be required below the dam. If the powerhouse is integral to the dam, and the facility is operated as run-of-river, it is unknown if the agencies will require a continuous year-round minimum flow. If the powerhouse was located further downstream to gain additional head, a bypass would be created. The bypass would extend from the base of the dam to the location where the powerhouse discharges back to the river. Based on our experience in licensing hydropower projects, a minimum continuous flow will be required below the dam to ensure the protection of aquatic resources in the bypass reach.

What minimum flow is needed to ensure that aquatic resources are protected? The hydropower owner typically has two options- the owner can accept a default minimum flow or conduct a site-specific field study in the bypass reach. The US Fish and Wildlife Service (USFWS) developed the New England Regional Flow Policy[3] which states that absent a site-specific[4] study to determine minimum flows needed for the protection of aquatic resources, a minimum flow equivalent to the Aquatic Base Flow (ABF) should be provided. In the Policy, the USFWS defines the ABF as equivalent to 0.5 times the drainage area. The drainage area at the Coopers Mills dam is 81 square miles, thus the ABF – or the continuous minimum flow- would be equivalent to 40.5 cfs year-round. However, the Policy also notes that if a long-term USGS gage is located near the site of interest, the median (50% exceedence flow) August flow at the Coopers Mill Dam could serve as the continuous minimum flow. The median August flow at Coopers Mills Dam, based on the prorating the USGS gage flows, is 18 cfs. Thus, a case could be made for maintaining a continuous year-round minimum flow of 18 cfs (0.21 cfs per square mile). It should be noted that the policy also states that flows higher than the median August flow may be required for spawning and incubation. Thus, if spawning and incubation occurs below the dam, the agencies may require higher minimum flows during periods of spawning and incubation.

[3] Included in Appendix A is a copy of the New England Regional Flow Policy.
[4] Site-specific studies require field data collection and analysis to determine what flows are needed for the target species of interest. The site-specific study could result in a flow lower or higher than the ABF.

Based on our experience with other river systems in New England the August median flow per square mile of drainage area of 0.21 is low. As noted above, the owner can opt to conduct a site specific field study in the bypass reach that results in a relationship between flow and fish habitat. The site-specific field study could result in a flow higher or lower than 18 cfs. Given that a) the median August flow of 18 cfs is considered low, b) the cost of a site-specific field studies could range from $20,000-$40,000, and c) there is no guarantee that the site-specific study would yield a flow less than 18 cfs, it would be prudent to accept a minimum flow of 18 cfs year round.

It should be noted that although minimum flows are typically provided to support aquatic resources, flows may also be required for aesthetic or water quality purposes. In some cases, the state or federal agencies have requested a hydropower owner to pass water over the spillway for aesthetic (sights and sounds) purposes. Also, if the project is having an impact on water quality, water passed over the spillway could serve to aerate the flow and increase dissolved oxygen levels. In summary, in the energy analysis described below, we assumed the following range of bypass flows: 0, 10, 18, 30, and 40.5. Again, these bypass flows would be unavailable for generation.

Fish Passage Flows

The Sheepscot River supports diadromous fish including salmon. In fact, Atlantic salmon were listed as an Endangered species by the US Fish and Wildlife Service in 2000. Thus, fish passage and any work in or near the river would be highly scrutinized by the agencies.

As noted above, the dam is already affixed with a non-functioning fish ladder to pass fish upstream. The typical season for upstream passage of salmon adults is from approximately May 1 to October 31 (Ref: USFWS). Thus, during the upstream passage period flow is needed in the ladder to facilitate passage and to provide attraction flow at the ladder's entrance. Again, water passing through the ladder would be unavailable for generation. The fish ladder at Coopers Mills Dam is designed to pass between 10 and 14 cfs (Ref: Ben Rizzo, USFWS).

In addition to upstream passage, after spawning and incubation occurs, smolts[5] move downstream on their journey back to the ocean. In Maine, smolts typically move downstream from April 15 to June 15 (Ref: USFWS). Kelts[6] would require passage from April 15 to June 15 and from October 15 to December 15 (Ref: USFWS). Smolts are surface oriented, meaning they swim close to the water surface. Passing smolts or kelts through the turbine(s) will be unacceptable to the agencies as they could be struck by the turbine blades and killed. To pass smolts, the agencies commonly request passage over the spillway, through a notch within the spillway or through the ladder.

For purposes of estimating generation at the Coopers Mills Dam, it was assumed that fish passage flows would be included in the bypass flow requirements. Thus, if the bypass flow was 18 cfs, we assumed that during the passage (upstream and downstream) season 10-14 cfs of the 18 cfs would be used for the fish ladder.

Leakage

As documented in photographs, there is considerable leakage at the dam—obviously leakage flows would be unavailable for generation. For purposes of our energy analysis, we assumed that the dam would be repaired resulting in negligible leakage.

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[5] A smolt is a young salmon that has assumed the silvery color of the adult and is ready to migrate to the sea.
[6] A kelt is a spawned out or spent salmonid such as salmon.

Available Head

According to KA's report (see Figure 8), the spillway crest elevation of the dam is 165.8 ft. As noted earlier, from the base of the dam to the spillway crest is approximately 10 feet. If the powerhouse was positioned integral to the dam the gross head would be roughly 10 feet. With the addition of 2-foot flashboards, the gross head would increase to 12 feet. There has also been discussion about potentially locating the powerhouse further downstream to take advantage of the natural drop in topography. Shown in Figure 9 is a topographic map; the contour lines traversing the river are marked. It should be noted that contour maps at this scale are not always highly accurate. If the project were to proceed, a detailed survey would be required below the dam to more accurately quantify topographic relief. For purposes of this analysis we assumed a flashboard crest elevation of 167.8 feet and then locating the powerhouse at the 150 ft, 140 ft and 130 ft contour intervals. The following gross heads were used in our analysis:

- 10 feet- powerhouse integral to dam, no flashboards, spillway crest elevation= 165.8 ft
- 12 feet- powerhouse integral to dam, 2-foot flashboards, flashboard crest elevation= 167.8 ft
- 17.8 feet- powerhouse located downstream at 150 ft contour line, flashboard crest elevation= 167.8 ft
- 27.8 feet- powerhouse located downstream at 140 ft contour line, flashboard crest elevation= 167.8 ft
- 37.8 feet- powerhouse located downstream at 130 ft contour line, flashboard crest elevation= 167.8 ft

It is important to note that locating the powerhouse below the dam will result in having to traverse South Main Street, and potentially Rockland Road (Rte 17/32). To convey water to the powerhouse would also require installing a penstock or canal system. Not only would the penstock/canal have to traverse roadways, but it would require excavation as well—which can be costly. If the powerhouse were located at contour intervals 150 ft, 140 ft and 130 ft, it would be roughly 150 ft, 1,150 ft and 1,900 ft below the dam, respectively.

The flow of water through a penstock will result in headlosses, which subsequently reduces the net head available for generation. Headlosses in penstocks are a function of many variables including the penstock length and diameter, and velocity. The longer the penstock and/or the higher velocity will result in greater penstock headlosses. Alternatively, the larger the penstock diameter, the less headlosses, however, larger diameter penstocks are more expensive. It is beyond the scope of this project to estimate headlosses. The energy results discussed later overestimate generation as the gross head— not the net head—was used in the energy calculations.

Turbine Efficiency

As noted above turbine efficiencies vary with head and flow. For purposes of estimating generation, a constant turbine efficiency of 85% was used over the range of flows.

Average Annual Energy Generation

Based on the available <u>gross</u> head, available flow (less minimum flows), and turbine efficiency, the average annual generation was computed using the average annual flow duration curve data. Shown in Figure 10 is the average annual flow duration curve at Coopers Mills Dam showing the volume of water available for generation. Figure 10 shows the maximum and minimum turbine capacities, and- in this case- a continuous minimum flow of 18 cfs. The area in blue represents the flow available for generation.

The average annual generation was computed for a range of gross head conditions as noted above, and bypass minimum flow conditions - the results are shown in Figure 11. Hydropower facilities do not operate 24 hours/day, 7 days/week. Even when there is sufficient flow available, the turbine may be inoperable due to scheduled or unscheduled outages. Scheduled outages occur when repair work is required. It is common to assume that 8-10% of the time the turbine would be unavailable for generation. For purposes of this energy analysis an 8% downtime was applied to the average annual generation, which is reflected in Figure 11.

Average Annual Revenue

Using the average annual generation values above, a range of pricing ($/MWH) was used to estimate the revenue from the hydropower facility. Typically, hydropower generators sell electricity at wholesale prices. Information on wholesale pricing in Maine is available from ISO-New England (weblink: http://www.iso-ne.com/markets/index.html) or from the Federal Energy Regulatory Commission (weblink: http://www.ferc.gov/market-oversight/mkt-electric/new-england.asp#prices). Shown in Figure 12 are the January 2006 – July 2007 daily average day-ahead prices ($/MWH). Also shown in Figure 13 is more recent July 1-31, 2007 pricing. In looking at the two years of price data, the Maine Zone pricing varied from approximately $50.00/MWH to $75.00/MWH.

The average annual generation (in MWH) was subsequently multiplied by the cost of power ($50.00/MWH to $75.00/MWH) to estimate the range of revenue from the project. Shown in Figure 14 and Figure 15 is the average annual revenue based on a price of $50.00/MWH and $75.00/MWH, respectively. Again, the revenue numbers are based on generation using gross head conditions.

If the powerhouse was located integral to the dam with 2 foot flashboards and a continuous minimum flow of 18 cfs was provided year round the revenue could range from $27,140 ($50/MWH) to $40,710 ($75/MWH) annually. If the powerhouse were located further downstream, where the gross head is 38.7 feet, and a continuous minimum flow of 18 cfs was provided year round, the revenue could range from $80,900 ($50/MWH) to $121,400 ($75/MWH) annually.

4.0 Cost of Hydropower Development

As discussed with the Hydro Group, in lieu of a site-specific cost analysis for hydropower development at the Coopers Mill Dam, cost estimates from similarly sized hydropower sites in the general geographic region are provided. These order of magnitude costs of other hydropower developments, while not specific to this site, will provide perspective on the costs that could be expected should hydropower development at the Coopers Mill Dam proceed forward. This approach seems appropriate at this early juncture given that this particular study is preliminary in nature. If hydropower development at the site appears to have merit based on the study results, then it is expected that more detailed and site-specific cost estimates would be developed in subsequent analyses. These more refined costs could then be used to make a final decision on whether hydropower development at the site is to be pursued.

As shown in Table 1, the estimated cost from previously conducted feasibility studies at other projects averaged approximately $3.3 million. It should be noted that these costs are based on receiving quotes from turbine vendors for new equipment and estimating civil, mechanical and electrical works. As a side note, the cost of turbines has increased considerably over the few years as the price of steel has increased. The projects listed in Table 1 are located in the Northeast and the cost estimates were developed within the past 3 years. The proposed generation capacity and available head at each site is similar to the Coopers Mills site.

Although the specific engineering configuration at each project described in Table 1 varied depending on existing site conditions, each project required construction and installation of typical major hydropower components (e.g., powerhouse, turbine/generator, intake, and penstock) at an existing dam, and would likely be representative of the order of magnitude costs expected to be incurred at the Coopers Mill Dam site.

Table 1: Recent Cost Estimates for Hydropower Development at Select Sites in the Northeast

Project	Location	Available Head (ft)	Capacity (kW)	Estimated Cost
Project in MA		15	362	$3,000,000
Project in NY		9	500	$3,900,000
Project in VT		21	400	$2,960,000
Coopers Mills Project	Sheepscot River, ME	10-37.8 (gross head)	160-600 kW	

It should be noted that the estimates in Table 1 do not include other fees such as:

- Evaluation of water rights and property ownership
- Direct communication with regulatory agencies to determine project constraints
- Determination of any known threatened or endangered species at the site
- Determination of any known hazardous materials at the site
- Historic/Archeological investigations
- Electrical interconnection requirements- connection to the grid via transmission lines
- Detailed design or architectural drawings
- Detailed field survey
- Administration and Legal

To bring a hydropower project on-line, several regulatory reviews and permits are required as well. The primary permitting agency that needs to be consulted in order to obtain a federal hydropower license is the Federal Energy Regulatory Commission (FERC). In addition, the Maine Department of Inland Fisheries and Wildlife (MDFW), the Maine Department of Environmental Protection (MDEP), and the United States Fish and Wildlife Service (USFWS) will need to be consulted.

Costs associated with the FERC licensing of a new or existing project can be significant. Where a dam and hydropower project already exists, it typically takes a minimum of five years to relicense using the FERC Integrated Licensing Process[7] (ILP). Moreover, the licensing process of a new project that is not presently producing power would likely be subject to greater scrutiny from the federal and state regulators as the potential for adverse environmental impacts would be greater than for an existing facility. Significant rehabilitation or new construction may also trigger additional regulatory permitting requirements, which may lead to uncertainty with the necessary approvals needed to develop/rehabilitate a site in an economical manner.

For projects with smaller generation capacities, licensing costs and schedule can be reduced by applying for a FERC exemption from licensing. To qualify for exemption status, a conventional hydropower

[7] In July of 2003, FERC introduced the ILP as a new regulatory process for obtaining a hydropower license. The ILP is viewed as an enhancement over previous FERC licensing processes, since the ILP offers more opportunities for public participation while at the same time providing a more streamlined and predictable regulatory schedule. The ILP became FERC's default hydropower licensing process on July, 23 2005. Hydropower license applicants that wish to use FERC's pre-existing Traditional Licensing Process (TLP) or Alternative Licensing Process (ALP) must obtain permission from FERC.

project must have a capacity of 5 megawatts (MW) or less (which would be the case for Coopers Mills), and be built at an existing dam. However, for a FERC exemption the project would still be subject to any terms and conditions that federal and state fish and wildlife agencies determine are appropriate to protect environmental resources. The typical timeframe to complete a FERC exemption process for a conventional hydropower project is approximately 1-2 years, depending on the environmental issues and the complexity of any necessary construction/rehabilitation work associated with the project.

As part of a FERC license, a State 401 Water Quality Certificate is required from MDEP. Although licensing a project is a FERC process, the MDEP has a great deal of control in the process as the conditions they place on the 401 Water Quality Certificate have to be included in the FERC license. In addition, there are a variety of state and local permits that are typically required. In most cases, the environmental study and analysis contained in the FERC license or exemption application will provide the supporting basis for the remaining permit applications. Therefore, there is not duplication of study effort; however, each permit process has its own application procedures, timeframes, and fees.

Based on our experience with FERC relicensings and exemptions for similar projects in New England, we estimate that the cost could range from $150,000 to $450,000 for a relicensing, and $100,000 to $200,000 for an exemption. The low estimate assumes there is little controversy associated with the project, while the higher estimate reflects a more controversial project with larger issues. It should be noted that the cost of a FERC regulatory process is not directly related to the size of the facility; each project has its own sets of environmental issues and complexities.

Relative to relicensing, any work in the Sheepscot River would undergo serious scrutiny because Atlantic salmon were listed as an Endangered Species by the US Fish and Wildlife Service in 2000.

5.0 Economic Analysis

In addition to the capital costs associated with developing hydropower, the existing dam and fish ladder require renovation. KA estimated the cost of dam repair and fish ladder renovation as $218,000+. KA noted that the cost is considered to be a minimum cost, since the cost of one aspect of the repair—providing upstream passage for American eels—has not been determined in detail. However, KA estimated eel passage at the site could be as high as $20,000. In addition to the capital cost, there will be on-going operation and maintenance costs, which KA estimated as $6,000/year.

In summary order of magnitude capital costs for the project could include:

• Dam repair and renovation of fishway	$218,000
• Eel fish passage	$20,000
• Hydropower facility (comparables)	$3,000,000-$4,000,000
Total	$3,238,000-$4,328,000

Permitting/licensing costs could range depending on whether an exemption is sought; the range includes:

- FERC Licensing $100,000-$450,000

On the other side of the ledger is the revenue from the project. Based on the analysis conducted above, the annual revenue could range from:

• Range of Potential Revenue	$25,710/year	(0 cfs bypass flow, $55/MWH)-
	$121,400/year	(18 cfs bypass flow, $75/MWH)

Using the lower capital cost estimate of $3,238,000 and the highest project revenue of $121,400/year it would take over 26 years to recoup the capital investment, excluding annual operation and maintenance and licensing costs.

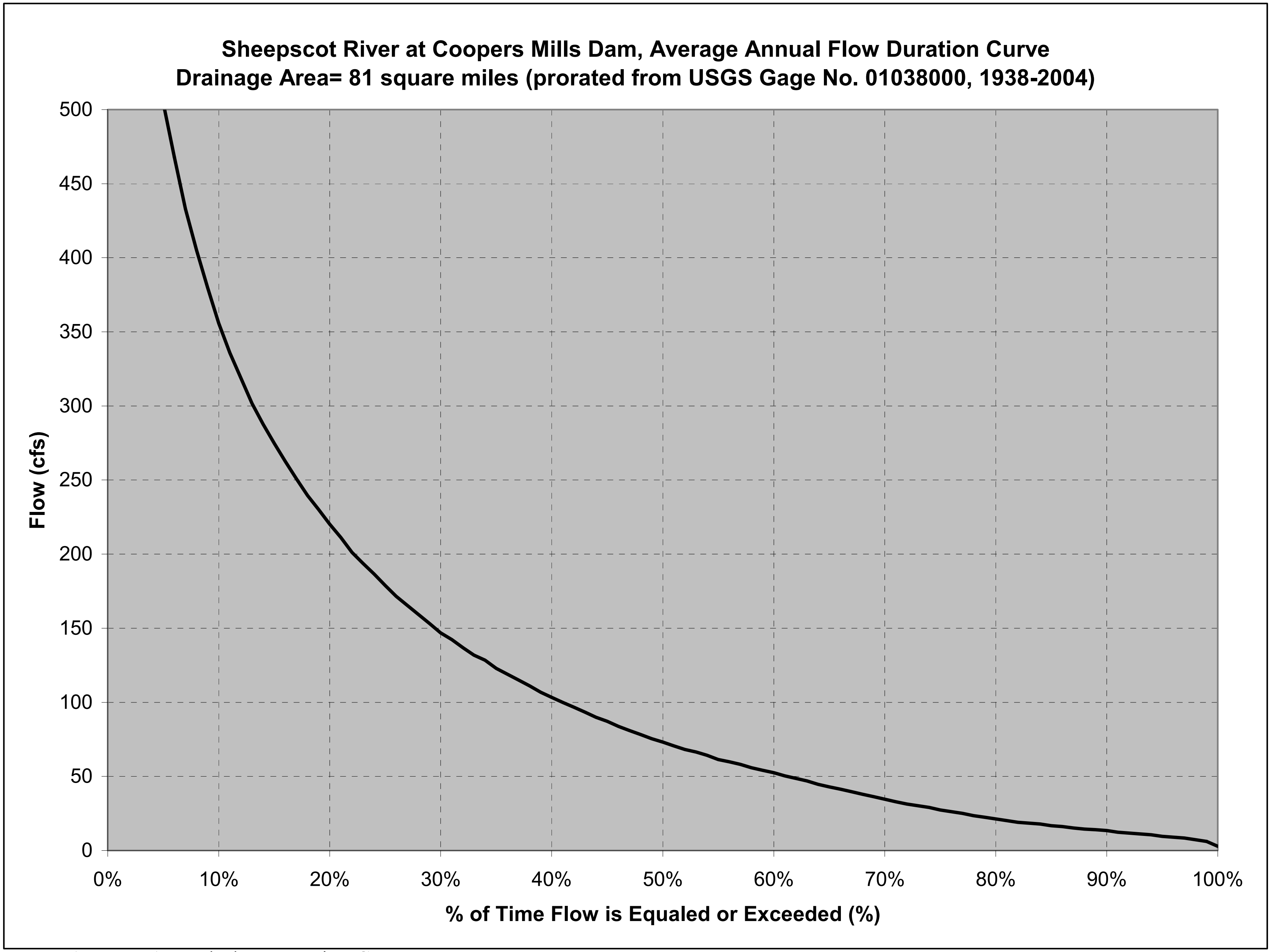

Figure 7: Average Annual Flow Duration Curve

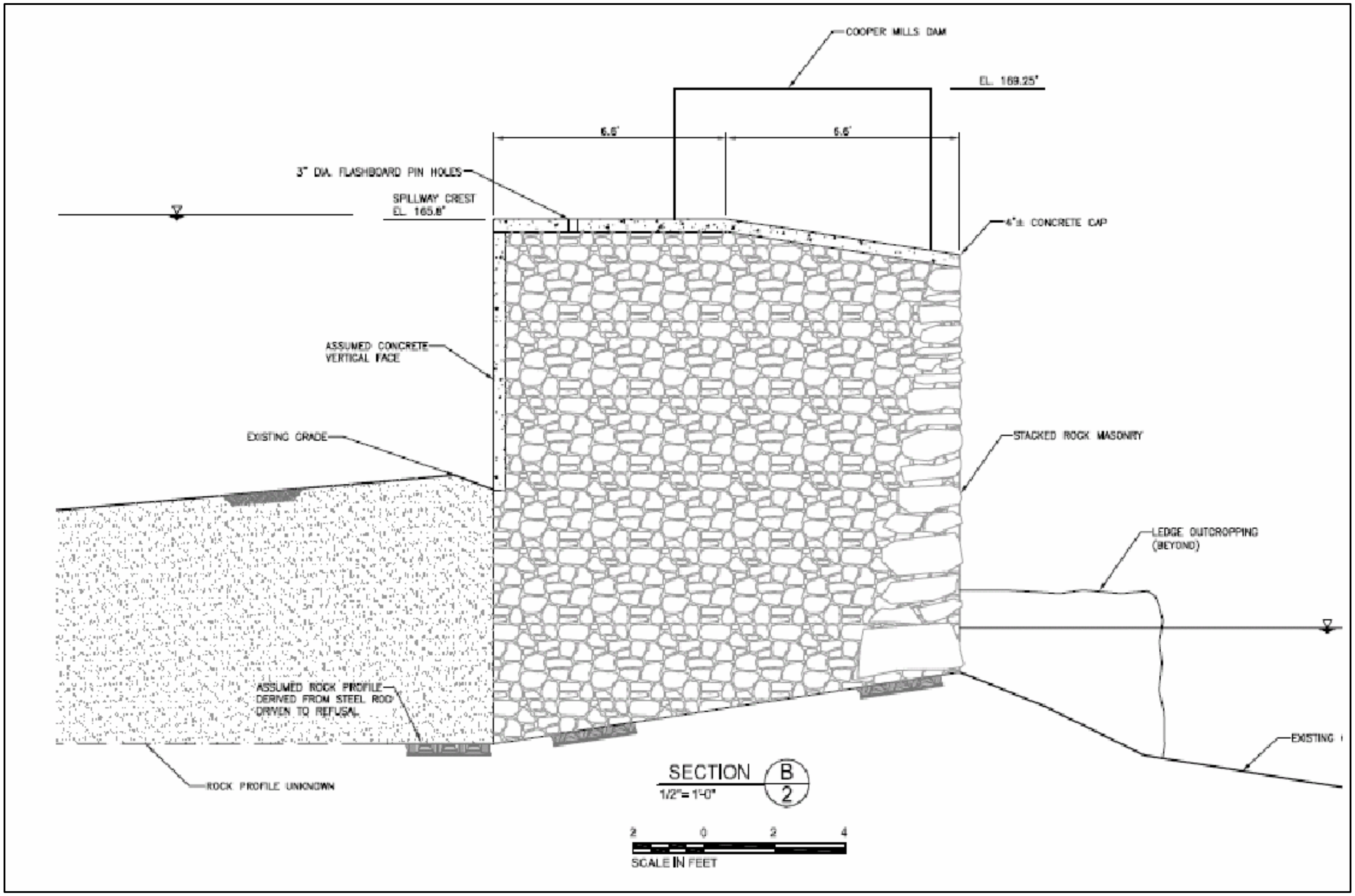

Figure 8: Cross-Section of Coopers Mills Dam (Source: Coopers Mills Dam, Sheepscot River, Engineering Evaluation, Kleinschmidt Associates, October 2005).

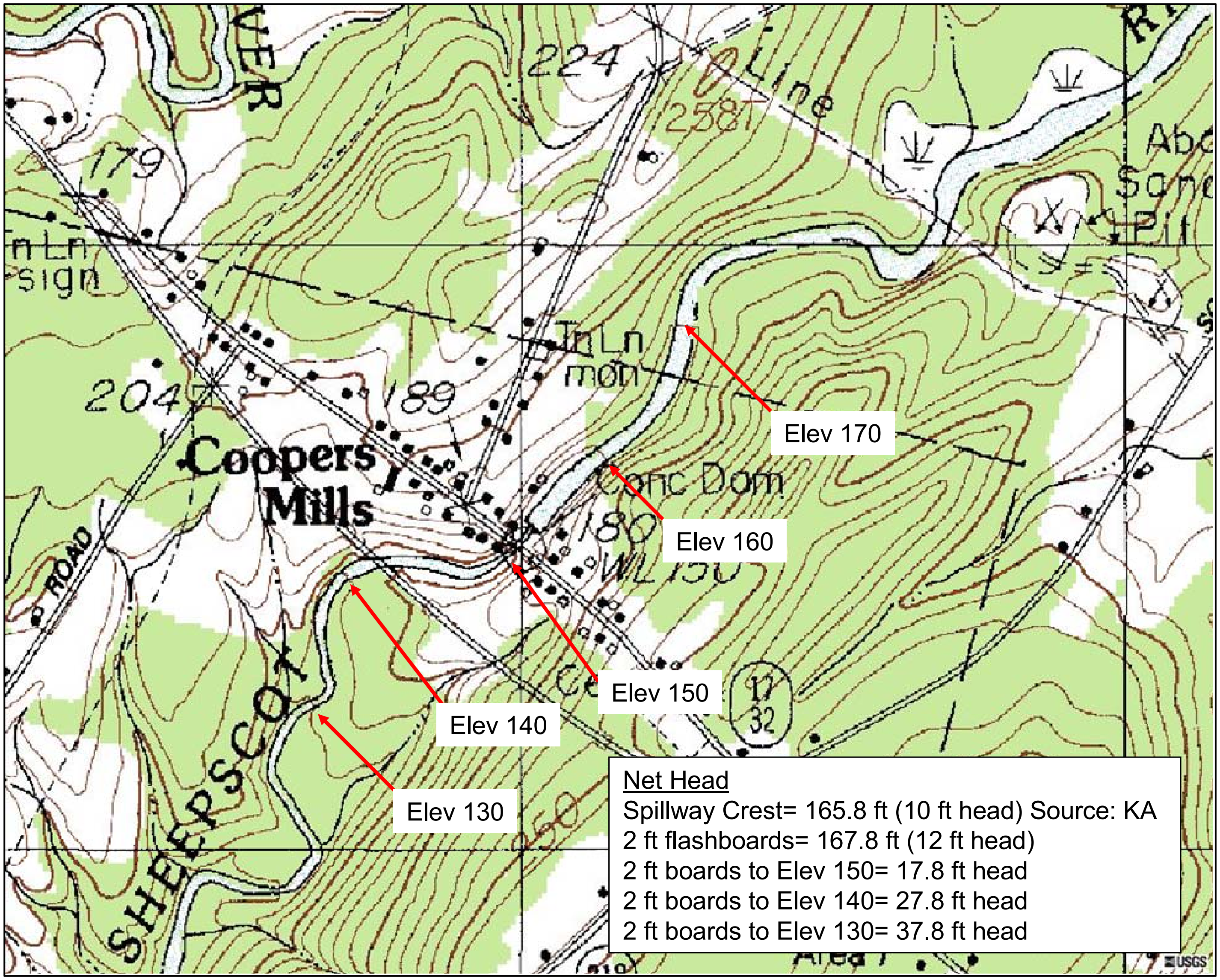

Figure 9: Topographic Map of Coopers Mills Dam

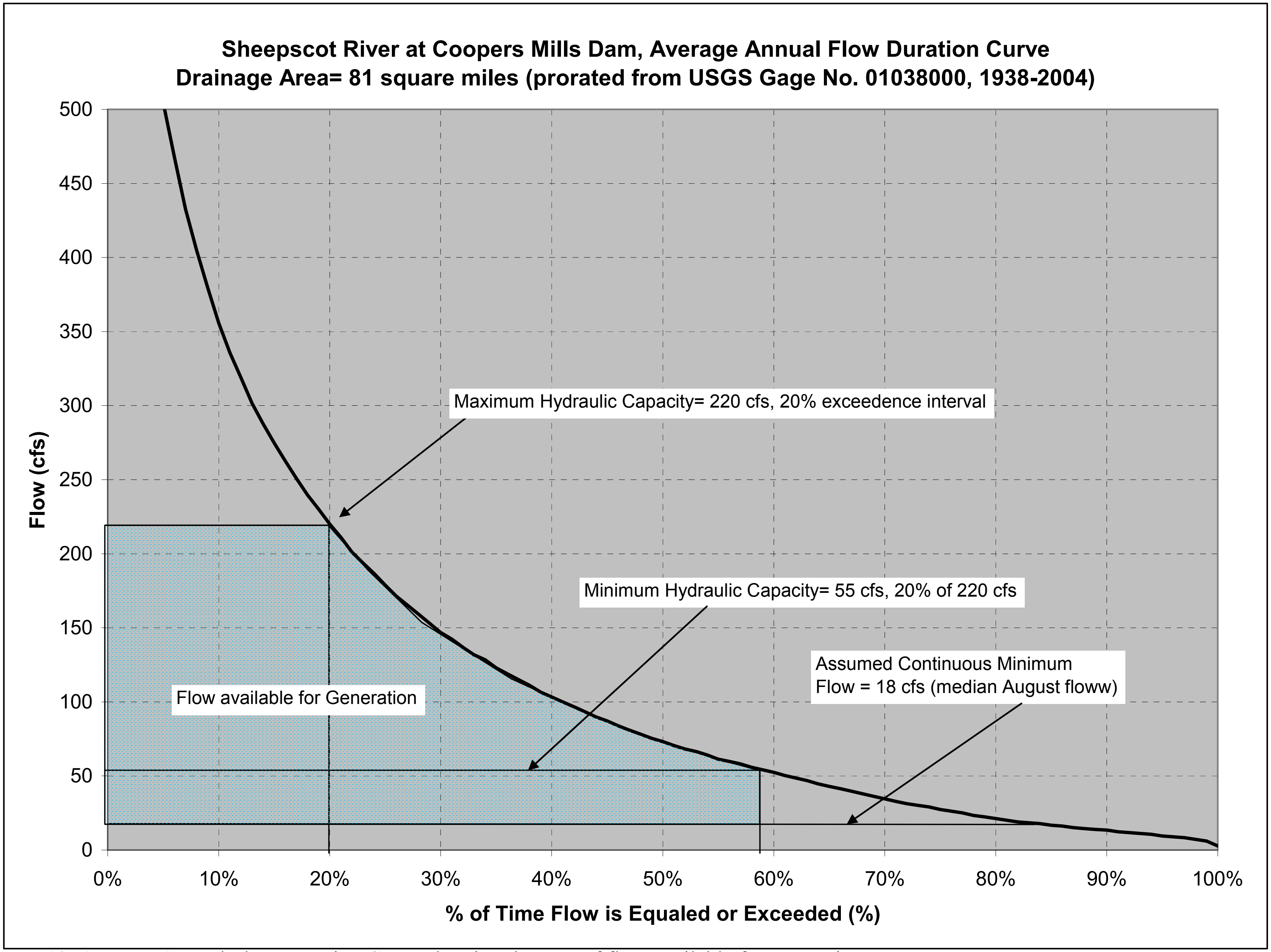

Figure 10: Average Annual Flow Duration Curve showing the area of flow available for generation

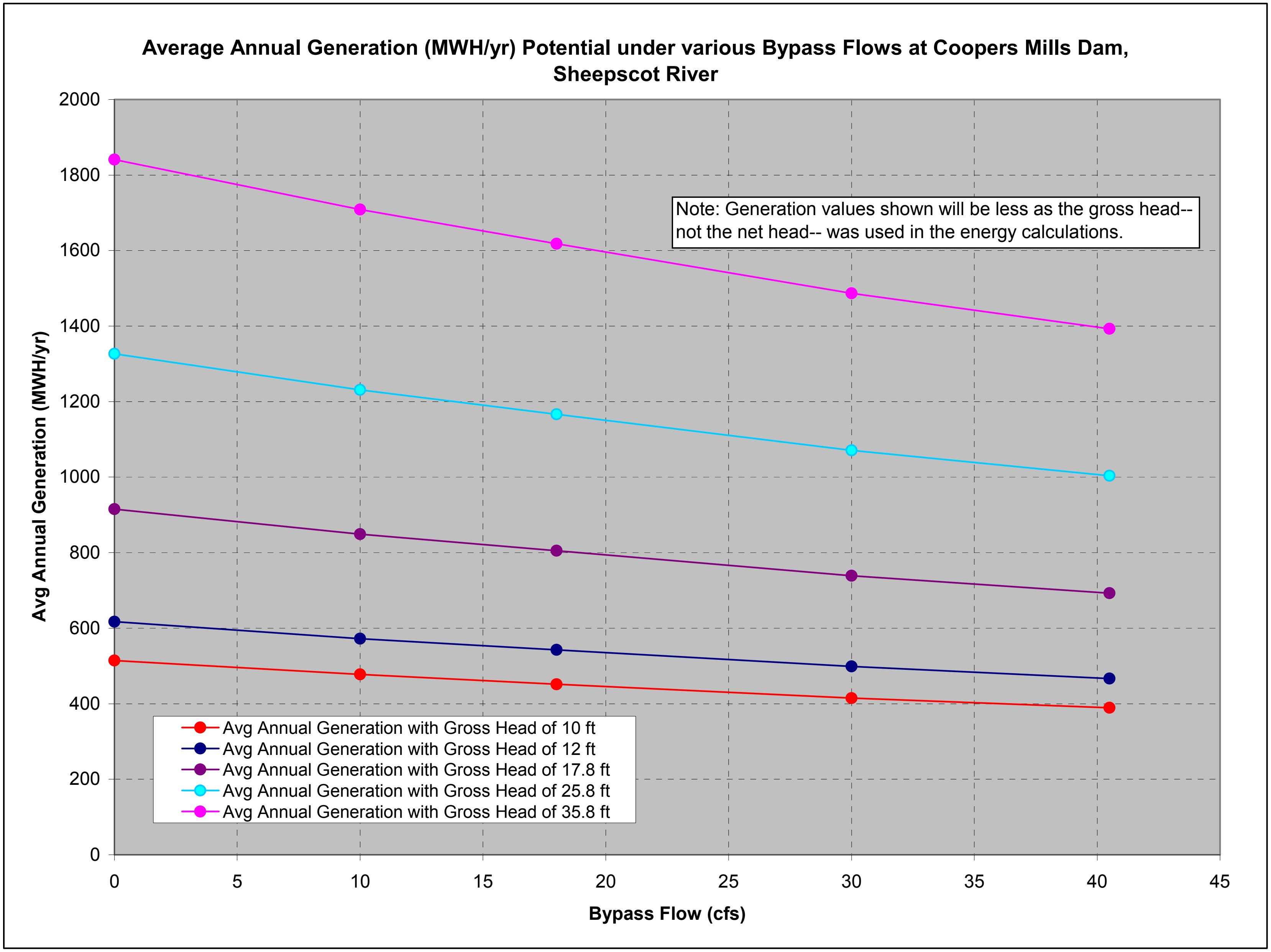

Figure 11: Average Annual Generation under various bypass flow and head conditions

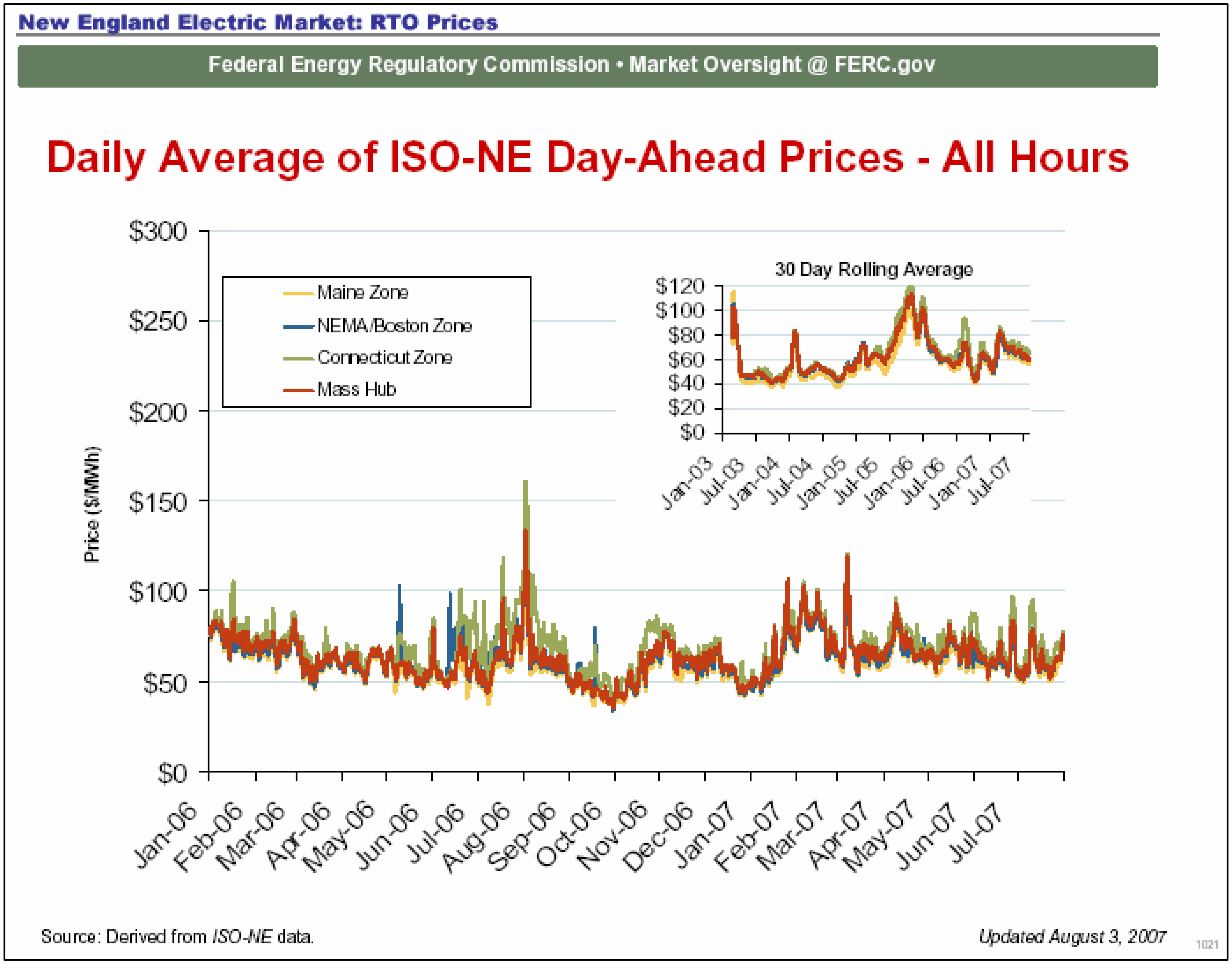

Figure 12: January 2006-July 2007 Daily Average ISO-New England Day-Ahead Prices- All Hours, Source: FERC

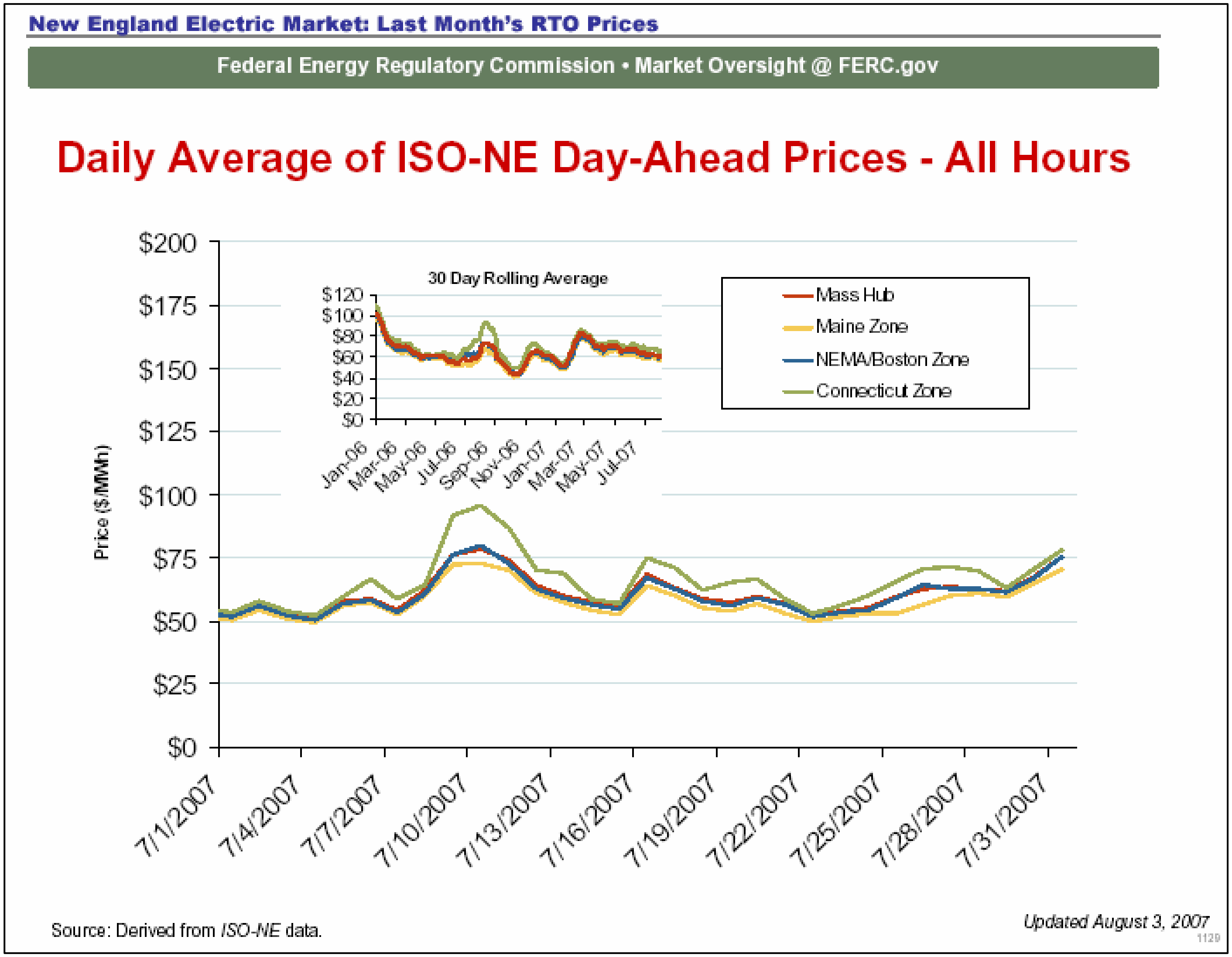

Figure 13: July 1-31, 2007 Daily Average ISO- New England Day-Ahead Prices, All Hours (Source: FERC)

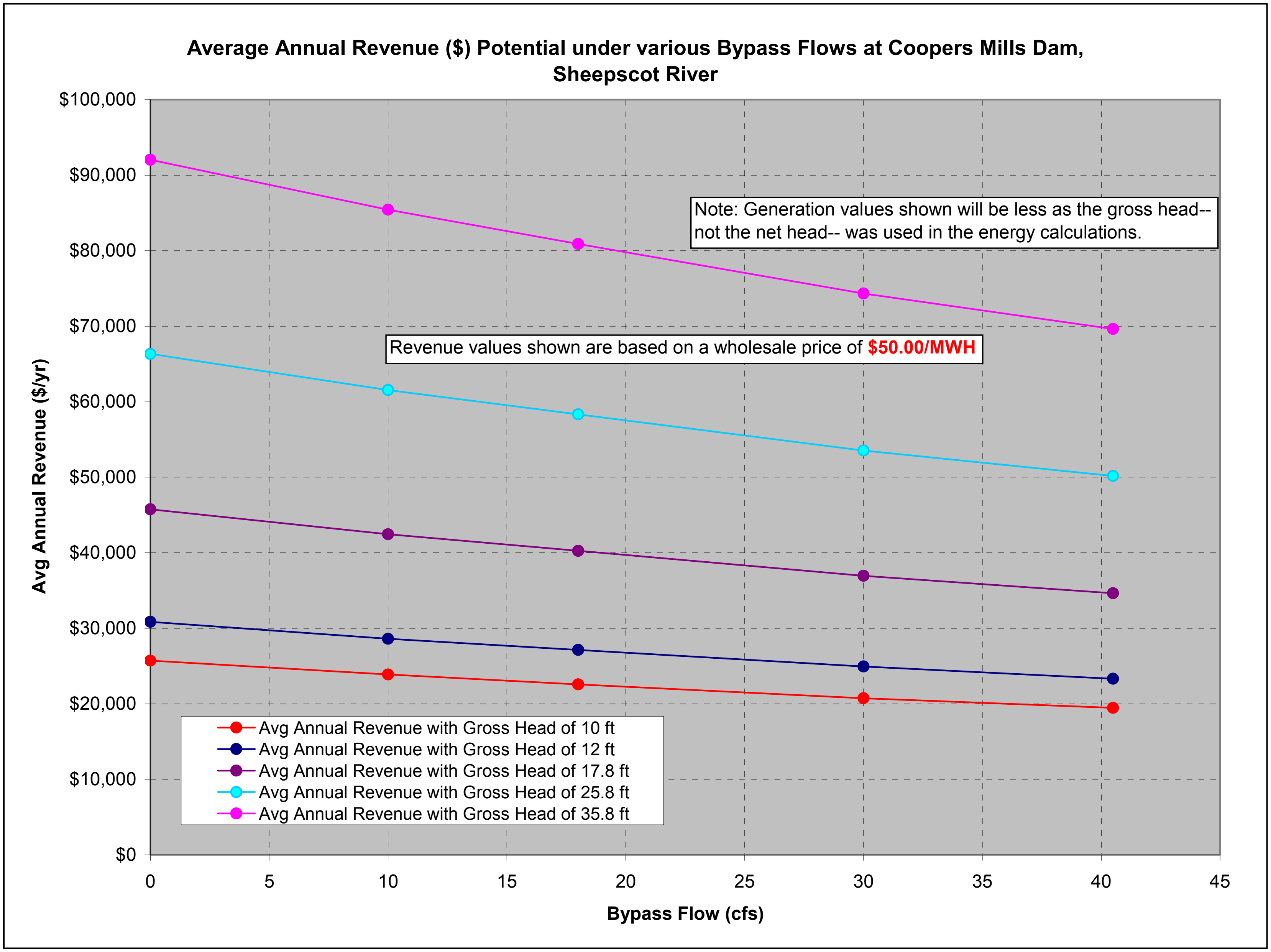

Figure 14: Average Annual Revenue based on the cost of power= $50/MWH

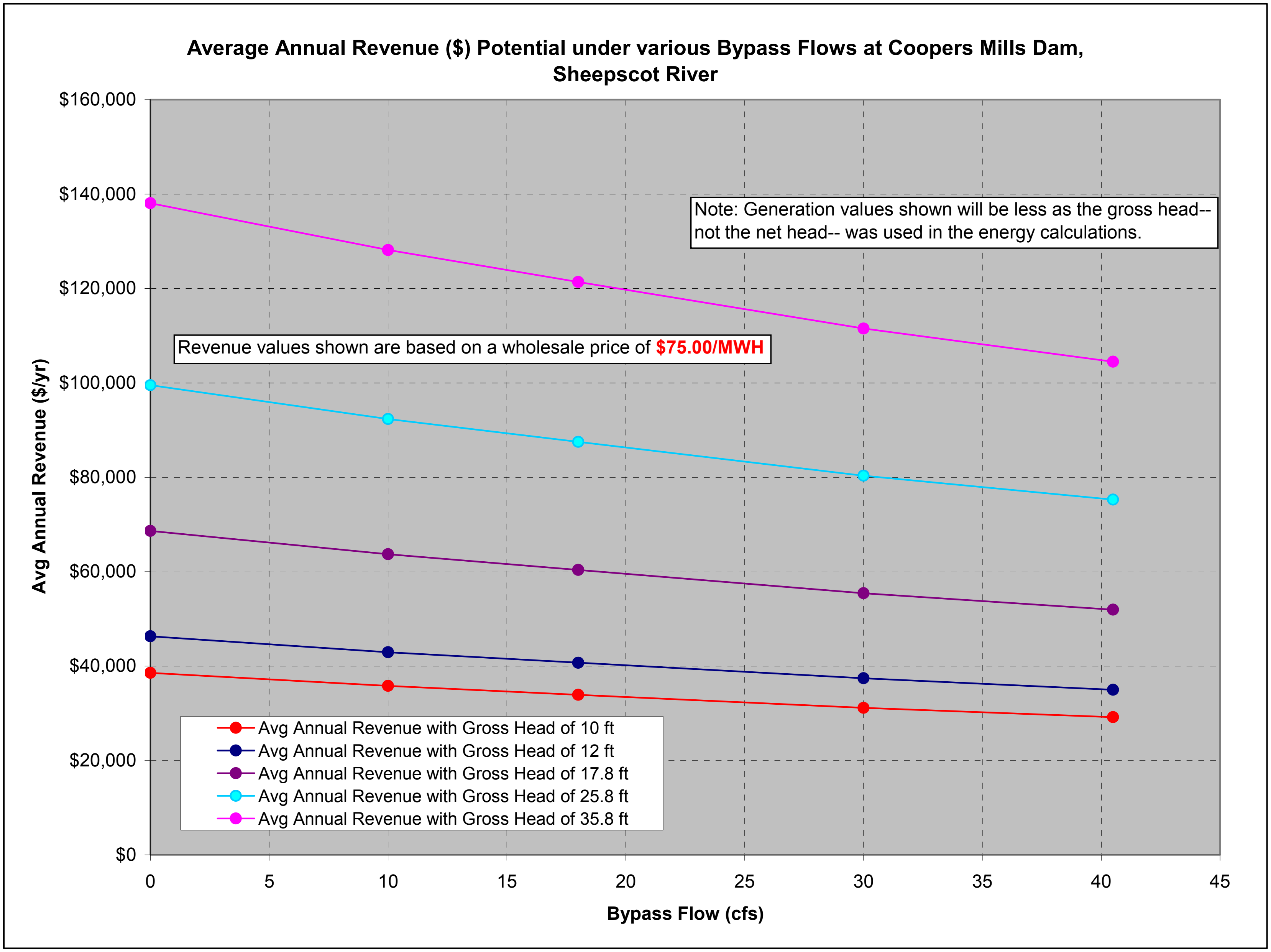

Figure 15: Average Annual Revenue based on the cost of power= $75.00/MWH

Appendix A

INTERIM
REGIONAL POLICY
FOR NEW ENGLAND STREAMS FLOW RECOMMENDATIONS

A. Purpose

The U.S. Fish and Wildlife Service (USFWS) recognizes that immediate development of alternative energy supplies is a high national priority. We further recognize that hydroelectric developments are among the most practical near-term alternatives and that environmental reviews may have delayed expeditious licensing of some environmentally sound projects. A purpose of this policy is to identify those projects that do not threaten nationally important aquatic resources so that permits or licenses for those projects can be expeditiously issued without expensive, protracted environmental investigations.

This directive establishes Northeast Regional (Regional 5) policy regarding USFWS flow recommendations at water projects in the New England Area. The policy is primarily for application to new or renewal hydroelectric projects but should also be used for water supply, flood control and other water development projects. The intent of this policy is to encourage releases that perpetuate indigenous aquatic organisms.

B. Background

The USFWS has used historical flow records for New England to describe stream flow conditions that will sustain and perpetuate indigenous aquatic fauna. Low flow conditions occurring in August typically result in the most metabolic stress to aquatic organisms, due to high water temperatures and diminished living space, dissolved oxygen, and food supply. Over the long term, stream flora and fauna have evolved to survive these periodic adversities without major populations changes. The USFWS has therefore designated the median flow for August as the Aquatic Base Flow (ABF)[8]. The USFWS has assumed that the ABF will be adequate throughout the year, unless additional flow releases are necessary for fish spawning and incubation. We have determined that flow releases equivalent to historical median flows during the spawning and incubation periods will protect critical reproductive functions.

C. Directive

1. USFWS personnel shall use this standard procedure when reviewing procedure, providing planning advice for and/or commenting on water development projects in New England Area.

[8] Aquatic Base Flow as used here should not be confused with the hydrologic base flow, which usually refers to the minimum discharge over a specified period.

USFWS personnel shall encourage applicants, project developers and action agencies to independently assess the flow releases needed by indigenous organisms on a case-by-case basis, and to present project-specific recommendations to the USFWS as early in the planning process as possible.

2. USFWS personnel shall recommend that the instantaneous flow releases for each water development project be sufficient to sustain indigenous aquatic organisms throughout the year. USFWS flow recommendations are to be based on historical stream gaging records as described below, unless Section 6 herein applies.

   - Where a minimum of 25 years of U.S. Geological Survey (USGS) gaging records exist at or near a project site on a river that is basically free-flowing, the USFWS shall recommend that the ABF release for all times of the year be equivalent to the median August flow for the period of record unless superceded by spawning and incubation flow recommendations. The USFWS shall recommend flow releases equivalent to the historical median stream flow throughout the applicable spawning and incubations periods.

   - For rivers where inadequate flow records exist or for rivers regulated by dams or upstream diversions, the USFWS shall recommend that the aquatic base flow (ABF) release be 0.5 cubic feet per second per square mile of drainage (cfsm), as derived from the average of the median August monthly records for representative New England streams[9]. This 0.5 cfsm recommendation shall apply to all times of the year, unless superceded by spawning and incubation flow recommendations. The USFWS shall recommend flow releases of 1.0 cfsm in the fall/winter and 4.0 cfsm in the spring for the entire applicable spawning and incubation periods.

3. The USFWS shall recommend that when inflow immediately upstream of a project falls below the flow release prescribed for that period, the outflow be made no less than the inflow, unless Section 6 herein applies.

4. The USFWS shall recommend that the prescribed instantaneous ABF be maintained at the base of the dam in the natural river channel, unless Section 6 herein applies.

5. The USFWS shall review alternative proposals for the flow release locations, schedules and supplies, provided such proposals are supported by biological justification. If such proposals are found by USFWS to afford adequate protection to aquatic biota, USFWS personnel may incorporate all or part of such proposals into their recommendations.

[9] The ABF criterion of 0.5 cfsm and the spawning and incubation flow criteria of 1.0 and 4.0 cfsm were derived from studies of 48 USGS gaging stations on basically unregulated rivers throughout New England. Each gaging station had a drainage area of at least 50 square miles, negligible effects from regulation, and a minimum of 25 years of good to excellent flow records. On the basis of 2,245 years of record, 0.5 cfsm was determined to be the average median August monthly flow. The flows of 1.0 and 4.0 cfsm represent the average of the median monthly flows during the fall-winter and spring spawning and incubation periods.

6. USFWS personnel shall forward their recommendations to the Regional Director for concurrence (prior to release) whenever such recommendations would differ from the median historical flow(s) otherwise computed in accordance with Sections 3a and 3b above. For projects with lengthy headraces, trailraces, penstocks, canals or other diversions, Regional Directors concurrence need not be obtained on flow recommendations applicable to the river segment between the dam and downstream point of confluence of the discharge with the initial watercourse.

- Exemptions

On projects where the USFWS has written agreements citing 0.2 cfsm as a minimum flow, the USFWS shall not recommend greater flows during the lifetime of the current project license. Three hydro-electric projects at Vernon, Bellow Falls and Wilder, Vermont, currently qualify in this regard.

- Previous Directives

The Regional Director's memorandum dated April 11, 1980 and attached New England Area Flow Regulation Policy are hereby rescinded.

Dated: 2/13/81

Signed: Howard N. Larsen,
Regional Director