# Feasibility Study for Hydroelectric Refurbishment on the Quaboag River, West Warren, MA


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# Notice and Acknowledgements

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# Abstract and Keywords

This feasibility study analyzes three installation options of “run-of-river” hydroelectric generators on two dams (one existing – “lower dam”, one breached – “upper dam”) located on the Quaboag River adjacent to the Wm. Wright Co. (Wrights) historic mill complex in West Warren, Massachusetts.

**Keywords:**

Wrights
West Warren
Quaboag River
Refurbishment
Hydroelectricity
Wetlands
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Massachusetts Environmental Policy Act (MEPA)
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Energy Facility Siting Board (EFSB)
Anadromous fish
Rare and Endangered Species

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# Executive Summary

This feasibility study analyzes three options for the installation of "run of river" hydroelectric generators on two dams, one existing ("lower dam"), one breached ("upper dam") located on the Quaboag River adjacent to the Wm. Wright Co. (Wrights) historic mill complex in West Warren, Massachusetts. The mill was founded in the early 1900's and has continuously operated at this location. Wrights manufactures woven fabric ribbons and currently employs over 500 workers. Hardwick Knitted Fabrics, a separate company, is located within the same mill complex. Run-of-river hydroelectric projects involve no or little water impoundment and the natural river flow is utilized and maintained with no seasonal regulation.

Three scenarios for repowering the dams to provide economic benefits to the mill were examined, (1) refurbishing the lower dam only with a Francis turbine (2) refurbishing lower dam only with a new Kaplan turbine and a new powerhouse and (2) repairing the upper dam and power canal in combination with the lower dam. The upper dam refurbishment will involve constructing a penstock from the end of the power canal to a new powerhouse located downstream of the lower dam. Supplemental low cost renewable energy for Wrights will assist in anchoring well paying jobs in Central Massachusetts provided by Wrights' operations.

The following table lists the potential power output from the three scenarios:

**Table 0-1**
**Refurbishment Scenarios and Estimated Output**

| Refurbishment Scenario | kW | Annual kWh |
|---|---|---|
| 1 - Lower Only Francis Turbine | 265 | 983,072 |
| 2 - Lower Only Kaplan Turbine | 830 | 1,595,255 |
| 3 - Lower + Upper | 1850 | 3,551,656 |

Conclusions and highlights are as follows:

**Summary Conclusions**

- Significant state regulatory permitting requirements are triggered if the upper dam is rebuilt. These permitting processes impose a high degree of regulatory uncertainty concerning the ability to receive all the necessary approvals to repower the upper dam in a cost-effective and timely manner.

- The most financially viable scenario is for the lower dam and to refurbish it using existing infrastructure, a Francis turbine, and used equipment to the greatest extent possible. Additional analysis following review of the draft feasibility study produced an IRR-10 of 31%; NPV-10 of $56,364 and IRR-20 37% NPV $306,450 and six years to cash flow positive.
- After review of the draft feasibility study, the additional analysis and consultation with Wrights management, it is their opinion that the current predicted financials are not strong enough to warrant proceeding on the hydroelectric refurbishment project at this time due to possible restructuring of their distribution operation. Wrights is willing to consider third party investment for this project in conjunction with a long term power purchase agreement with Wrights.

**Site Evaluation and Layout**

- The site has sufficient real estate necessary for equipment staging, upper dam repair, the construction of penstock and for a new power house.

- Additional well suited property most likely exists for the creation of new wetlands to mitigate for lost bordering wetlands from the refurbishment of the upper dam.

**Energy Use & Consumption**

- In 2004 Wrights consumed 3,683,478 kWh and Hardwick Knitted Fabrics consumed 2,695,600 kWh. Wrights electricity consumption is consistent with its operations; a one-shift operation, with significant off-shift consumption.

**Environmental Resource Assessment**

- Portions of the project site are situated in a Massachusetts Natural Heritage & Endangered Species Program designated “supporting natural landscape”. According to a Massachusetts Division of Fisheries and Wildlife Natural Heritage Program review letter relating to the project site area, threatened or endangered specie were identified.
- Over 5,000 $ft^2$ of bordering wetlands (roughly estimated to be between 1.5 and 2 acres, or around 80,000 square feet) would be flooded by the reconstruction of

the upper dam triggering mandatory Environmental Impact Report (EIR) under the Massachusetts Environmental Policy Act (MEPA) (see below).

**Permitting**

- No new permits for power generation for new dams or those associated with repairs to fully breached dams have been issued through the EFSB facilitation process in at least 20 years in Massachusetts.
- Approximately 40 permits were issued through the EFSB facilitation process for dam refurbishment and approximately half of these were constructed during the past 20 years.
- Lengthy permitting processes exist for all options including: FERC exemption (3 – 4 years), MEPA review, and EFSB process. MEPA EIR would be triggered with upper dam refurbishment; it would not be triggered if only the lower dam was repowered.
- Significant permitting process cost and uncertainty exists for the breached upper dam refurbishment option, especially in terms of its wetland impact. Obtaining wetland permit approvals would require additional research and scoping during the design phase.
    - The capital costs of wetland delineation, mitigation design and construction, and permitting may be prohibitive (estimated to be ~$250,000).
    - Wetlands can be replicated on Wrights property to replace bordering wetlands most likely at a minimum replacement ratio of 2:1 that would be flooded if the upper dam is reconstructed. However, high-valued bordering wetlands are difficult to replicate and additional acreage may be required for mitigation.
    - The construction of the penstock, and power house is not expected to impact wetlands but will affect riverbank.
    - The construction of the service road for the upper dam would most likely impact additional areas of wetland.
    - Uncertainty regarding the potential for historic sediment contamination and remediation.

- Threatened and endangered specie review indicated the project exists within the habitat of three state-protected species. The presence of these species will require an additional state permit approval, a Conservation and Management Permit.
- There are existing regulatory initiatives in Massachusetts for the removal of dams versus their refurbishment or construction. These types of programs create additional institutional barriers for hydro power development or refurbishment in the Commonwealth.
- Massachusetts Fisheries and Wildlife's programs to protect and promote anadromous fish trigger the installation of eel ladders at both upper and lower dams. This requirement is independent of the fact that there are no migrating eels in the Quaboag but their need would be argued as necessary in case dams located downstream of Wrights were removed or eel passages were installed in the future on existing downstream dams.

**Engineering and Interconnection Requirements**

- The physical lower dam and power canal infrastructure can support refurbishment.
- Existing utilities and water uses can be maintained for Wrights and Hardwick Knitted Fabrics.
- The proposed hydroelectric generator may be interconnected to the Wrights existing 600 volt electrical system by multiple sets of 600 volt cables or by one (1) 4.16 kV, three phase, interconnection circuit.
- Interconnection paths for the proposed hydro-electric generator can be established to one or both of the Wrights existing 600 volt supply substations;
- Interlocking circuitry and protective relays should be installed to prevent both circuits from being connected to the generator at any one time.
- The simultaneous interconnection of the proposed hydroelectric generator to both Wrights and Hardwick Knitted Fabrics could cause real and reactive power flows between their respective electrical systems. Therefore, an interconnection circuit to Hardwick Knitted Fabrics is not recommended for consideration at this time.
- The lowest cost electrical interconnection alternative is a single 600 kV interconnection circuit from the hydro-electric generator station to Wrights

Courtyard substations associated with installing the 265kW generator in Building 9.

**Economic Feasibility Analysis**

- If a hydroelectric facility were in place today, then for every kWh produced it on average would avoid 9.0 ¢/kWh in billed costs (approximately as large as $30,000 per month or 90% of Wrights monthly bill).
- In addition Wrights could earn 3.0 ¢/kWh or more selling renewable energy certificates from a run-of-river hydroelectric project.
- Project costs ranged from $0.8 million to $4.5 million installed.
- Paybacks for the no grant scenarios and the $650,000 grant scenarios were very long (over 15 years).
- Scenarios of economic payback were run assuming no grants, $650,000 grants, and 50% project costs scenarios. A summary of results follows.

**Table 0-2**
**Twenty Year Internal Rate of Return for Various Scenarios**

| Scenario | No Grant | $650,000 Grant | 50% Grant |
|---|---|---|---|
| Scenario #1 | n/a | n/a | 11% |
| Scenario #2 | n/a | n/a | 1% |
| Scenario #3 | n/a | 5% | 13% |

# 1 Technical Feasibility Analysis

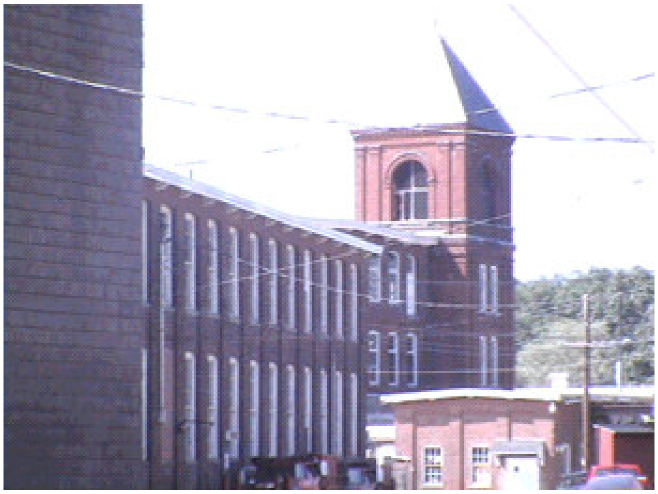
## *1.1 History*

Wm. Wright Co. (Wrights) is located in a historic mill complex in West Warren, Massachusetts on the Quaboag River where it was originally sited to take advantage of its water resources. The company was founded in 1897, originally in New York, then moved to West Warren in the 1930's and was operated by three generations of Wright family members until it was sold in 1985. Wrights currently employs over 500 workers.

The mill complex buildings include 600,000 $ft^2$ of area on approximately 114 acres of land. The West Warren mill site was originally constructed in the late 1800's and was used as a cotton mill. Wrights played a manufacturing role during the World War II by converting some of its manufacturing space to make parachutes for our troops. Currently, Wrights manufactures woven ribbon fabrics in varying widths of up to 4" wide. These strips are used primarily in the garment and craft industries for binding, seaming, window dressings, etc.

Two dams exist on the Quaboag River that originally provided the mill complex power, cooling and fire protection water. Currently, the lower dam's impoundment provides only non-contact cooling water and water for fire protection; the upper dam slightly upstream from the mill has fallen into disrepair and is not utilized. It was breached during a flood in the mid 1950's along its northern terminus with the shoreline. Approximately 80% of the stone and concrete structure remains intact though it has not been maintained. The upper dam is connected to Wrights via a canal paralleling the Quaboag River that while overgrown, still retains water in its course.

The mill possesses excellent unutilized hydroelectric resources. The average annual flow at the plant is 147 cfs with flow ranging from 7 to 12,800 cfs, and more than adequate electricity consumption (> 3,800,000 kWh / year) to make the installation of turbines a viable project. There are no remaining hydroelectric turbines at the site.



Wrights Mill Complex – West Warren, Massachusetts

## 1.2 Site Evaluation

### 1.2.1 Site Layout

The Wright complex consists of approximately 10 brick and concrete block mill buildings of various stories constructed during separate periods beginning approximately 100 years ago. In total, approximately 1,000,000 $ft^2$ of industrial buildings are owned by Wrights not all of which are currently being utilized. Additional expansion at Wrights into existing vacant structures is possible if favorable electricity rates would be available at the site through the refurbishment project.

The complex forms a rough square with the exception of one large mill building owned and occupied by Hardwick Knitters to the west of the main Wright structures. The site is bordered by the Quaboag River and the lower dam to the north. Continuing north, on the opposite bank of the Quaboag, runs a Conrail railroad easement and Main St (Massachusetts State Route #67). The west of the site is bordered by South Street and the Quaboag River. Polaski St is located to the South and Otis Lane to the East. Beyond the developed areas of the property to the east approximately 2025 feet upstream on the Quaboag River is the breached upper dam.

**Figure 1-1**
**Current Site Plan**

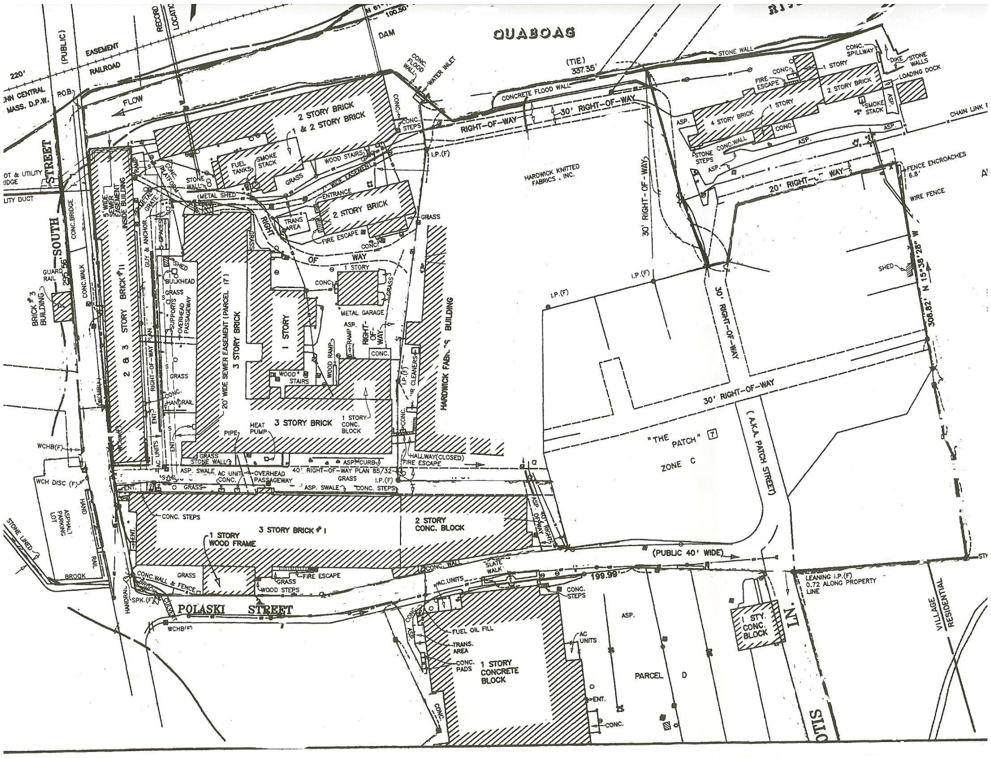
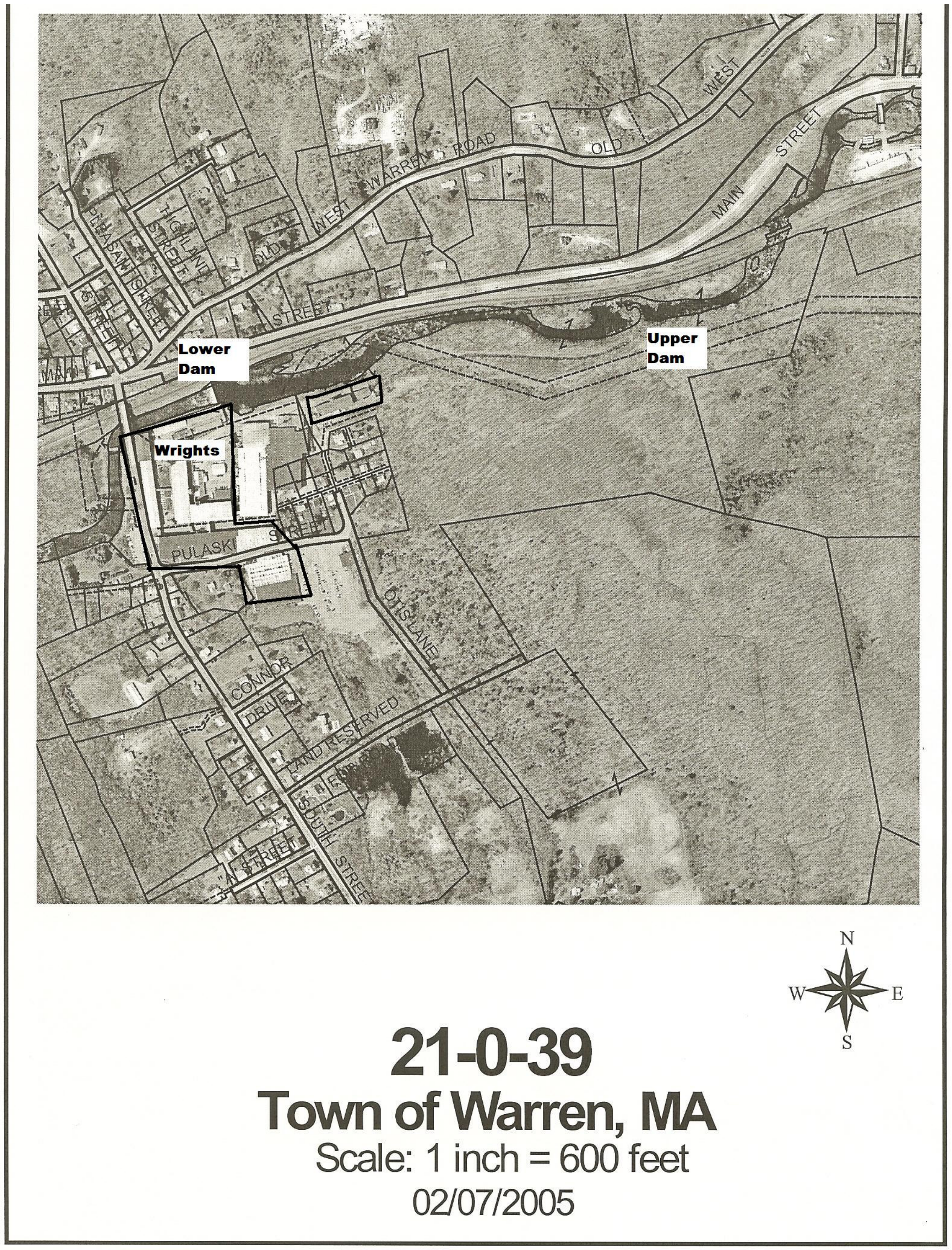


**Figure 1-2**
**Site Aerial Photo - Town of Warren**



### *1.2.2 Property Boundaries, Topography*

The Wright property consists of eight parcels, totaling approximately 114 acres one of which, Parcel F, is located approximately 1000 ft southeast of with the mill. The site is situated on level ground adjacent to the Quaboag River in what is otherwise, wooded and rural surroundings. Both upstream and downstream of Wrights the Quaboag River flows in numerous bends through steeper banked wooded terrain typical of New England river systems. Marks Mountain, rising to approximately 300 ft elevation is a large undeveloped tract lies east of the site and contains “core habitat” and “supporting natural landscape” as identified by the Natural Heritage and Endangered Species program’s Biomap.

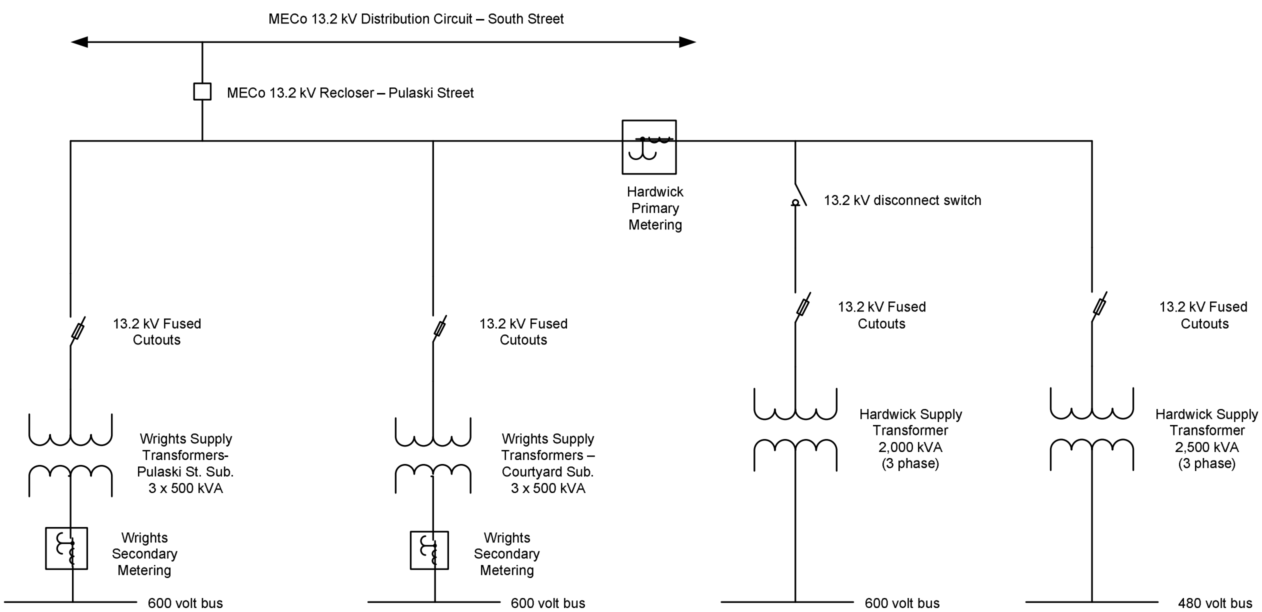
### *1.2.3 Abutters*

Wrights’ multiple parcels border numerous neighbors though most are separated by distance, Conrail’s Right of Way, easement or the river. Hardwick Knitted Fabrics owns approximately 4 acres within the Wright mill complex. This is relevant for an easement would be required from Hardwick for the penstock from the upper dam. However, Hardwick has shared their electric demand and billing information with Boreal for analysis and would benefit from the excess power generated from the refurbishment of the upper dam in times when Wrights is at reduced load. Hardwick has expressed interest in participating in the refurbishment design and construction planning in the future. In general, the abutters are required to be notified through state regulatory action concerning wetland permitting that would occur from either upper or lower dam refurbishment. An abutter’s list can be found in Appendix A.

## 1.3 Current Energy Infrastructure & Consumption

### 1.3.1 Infrastructure

**Figure 1-3**
**Wrights Existing Electrical Supply Diagram**




As shown in Figure 1-3, Wrights receives its electrical supply from a three phase, 13.2 kV , overhead distribution circuit on South Street that is part of Massachusetts Electric Company ("MECo") electrical distribution system in West Warren, MA. The electrical connection from the MECo distribution circuit on South Street to Wrights consists of overhead conductors supported on wood electric utility poles and is referred to as a "lateral circuit." The lateral circuit is connected to the MECO distribution circuit through a 13.2 kV circuit recloser that is located at the intersection of South Street and Pulaski Street. The 13.2 kV circuit recloser can isolate short circuits on the lateral circuit from the rest of the MECO distribution circuit.

The lateral circuit is supported on wood electric utility poles along Pulaski Street and within the Wrights complex, Electrical power is supplied to the Wrights complex at two locations; one at the 13.2 kV – 600 volt transformer bank on Pulaski Street and the other at the 13.2 kV – 600 volt transformer bank adjacent to Building #10 in the Courtyard within the Wrights complex. Each 13.2 kV – 600 volt transformer bank consists of three

(3) single phase transformers rated 500 kVA each that are connected to provide three phase, 600 volt electrical service to Wrights.   The energy usage and electrical demand of Wrights is metered by MECo at the secondary (600 volt) of each of the two transformer banks and it is totalized for billing purposes.

The same MECo 13.2 kV circuit that supplies electrical power to Wrights also supplies electrical power to another business within the Wrights complex that is known as Hardwick Knitted Fabrics.  The electrical supply to Hardwick Knitted Fabrics consists of two supply transformers: a three phase, 13.2 kV – 600 volt transformer that is located adjacent to the Hardwick Knitted Fabrics facility in the Courtyard and a 13.2 kV – 480 volt transformer installation inside the Hardwick Knitted Fabrics facility.  The energy usage and electrical demand of Hardwick Knitted Fabrics is metered by MECo at the primary (13.2 kV) of the supply transformer.

There are 13.2 kV fused cutout switches located at the primary of each of the Wrights supply transformers that are intended to provide overcurrent protection to the transformers.  The operation of one or two of the 13.2 kV fused cutout switches could cause a single phase supply condition to Wrights that could have an impact on the operation of the proposed hydro-electric generators and/or cause damage to electrical equipment within Wrights.

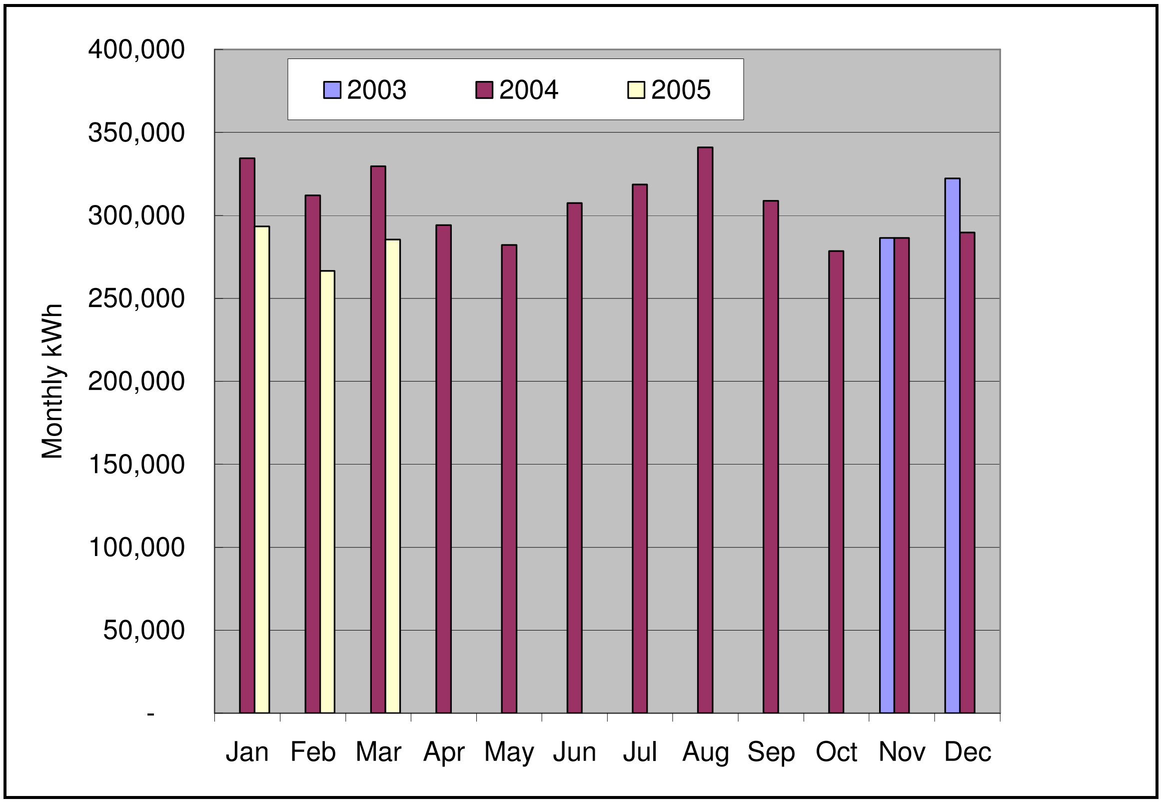
### *1.3.2 Wrights Electricity Consumption*

In 2004 Wrights consumed 3,683,478 kWhs.  Wrights consumption pattern was consistent with a single shift manufacturing facility with a relatively small amount of cooling and heating electricity consumption; high consumption during working hours, and much lower consumption during non-working hours, weekends and holidays.

#### *1.3.2.1 Annual and Monthly Patterns*

One hour Interval consumption data for a seventeen complete months (November 2003 through March 2005) are available for the Wrights site.  As can be seen in Figure 1-4, consumption is consistent month-to-month, averaging approximately 300,000 kWh.

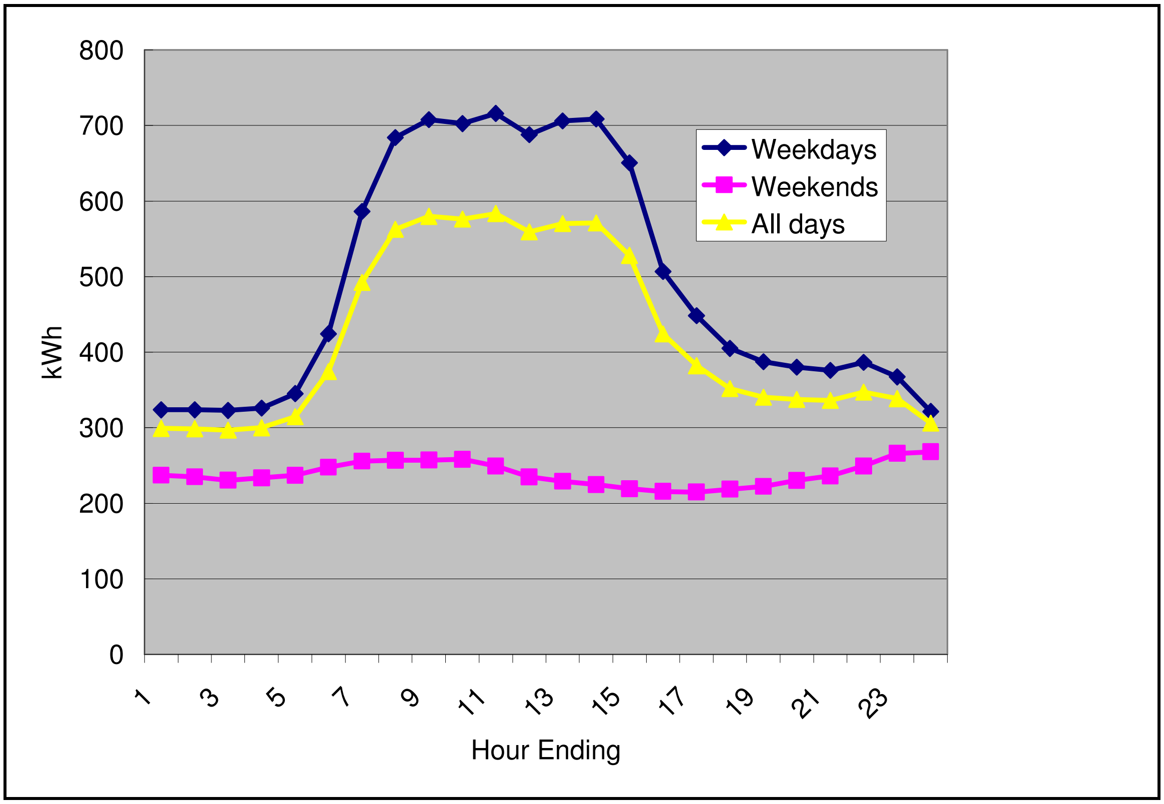
**Figure 1-4**
**Wrights' Historic Monthly Electricity Consumption (kWh)**




### 1.3.2.2 <u>Daily and Hourly Patterns</u>

Figure 1-5 shows Wrights average hourly consumption by weekend versus weekday. As can be seen the average consumption during working hours averages 700 kWh, while across all weekend hours averages 250 kWh.

**Figure 1-5**
**Wrights' Average 2004 Electricity Consumption (kWh) by Day Type**




The average weekday consumption for Wrights by hour and month is displayed in Figure 1-6. Wrights has some air conditioning load and consumption peaks during the summer months where consumption averages about 800 kWh during August. Figure 1-7 displays electricity consumption during weekend hours which generally ranges from 200 to 250 kWh. In January, February and March consumption is higher during the morning hours. Inspection of the underlying data shows this higher consumption to be associated with many of the Saturdays during those months. It is likely that partial shifts were working during those hours.

**Figure 1-6**
**Average 2004 Weekday Electricity Consumption (kWh) by Month & Hour**

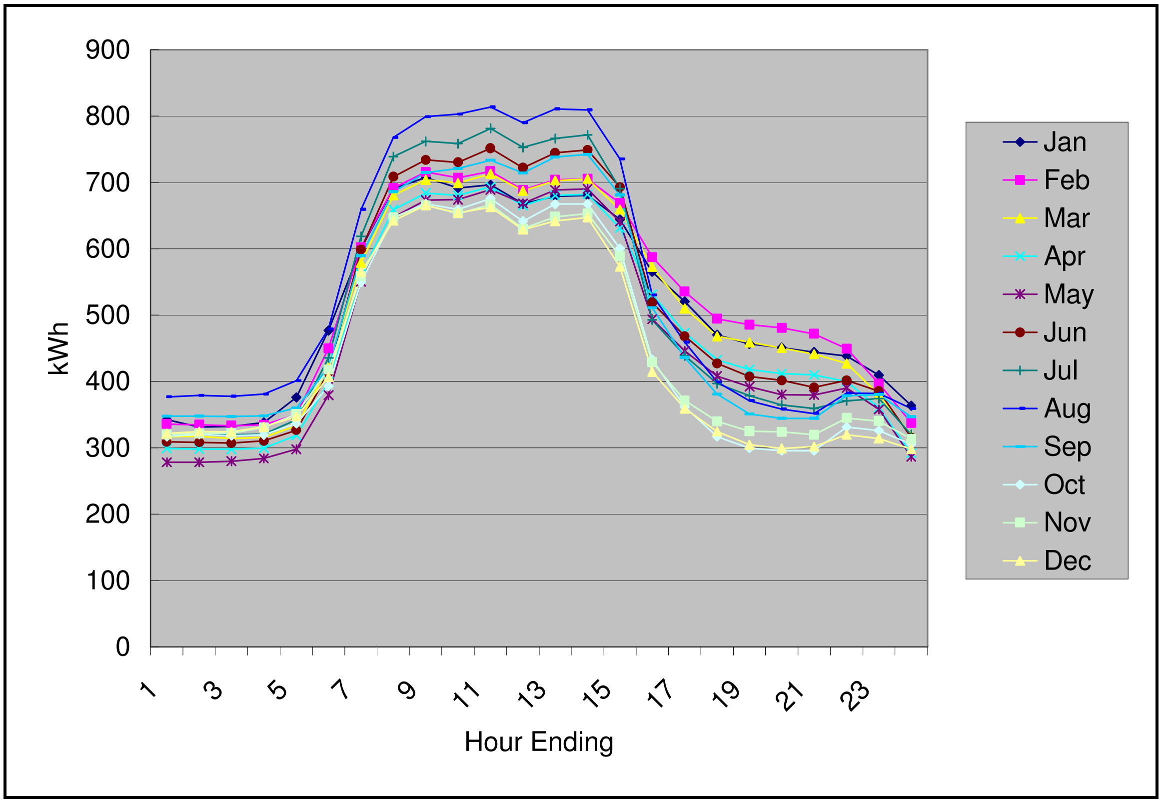
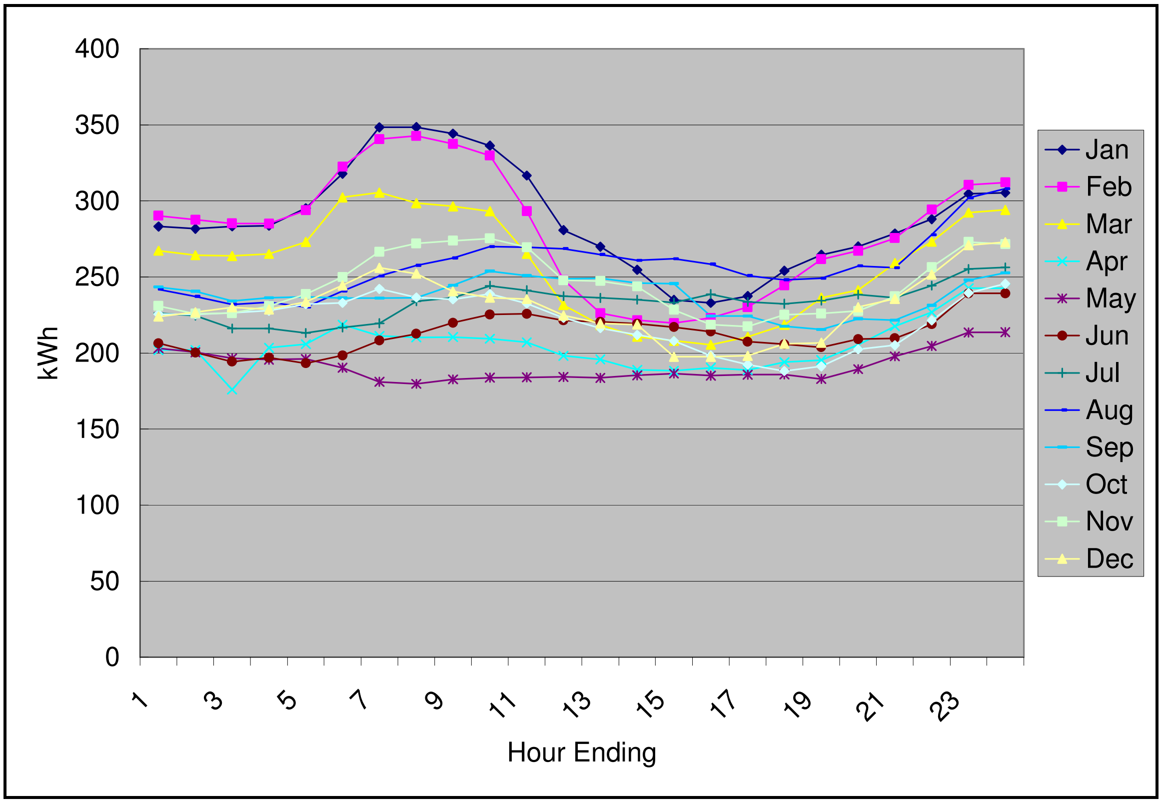


**Figure 1-7**
**Average 2004 Weekend Electricity Consumption (kWh) by Month & Hour**



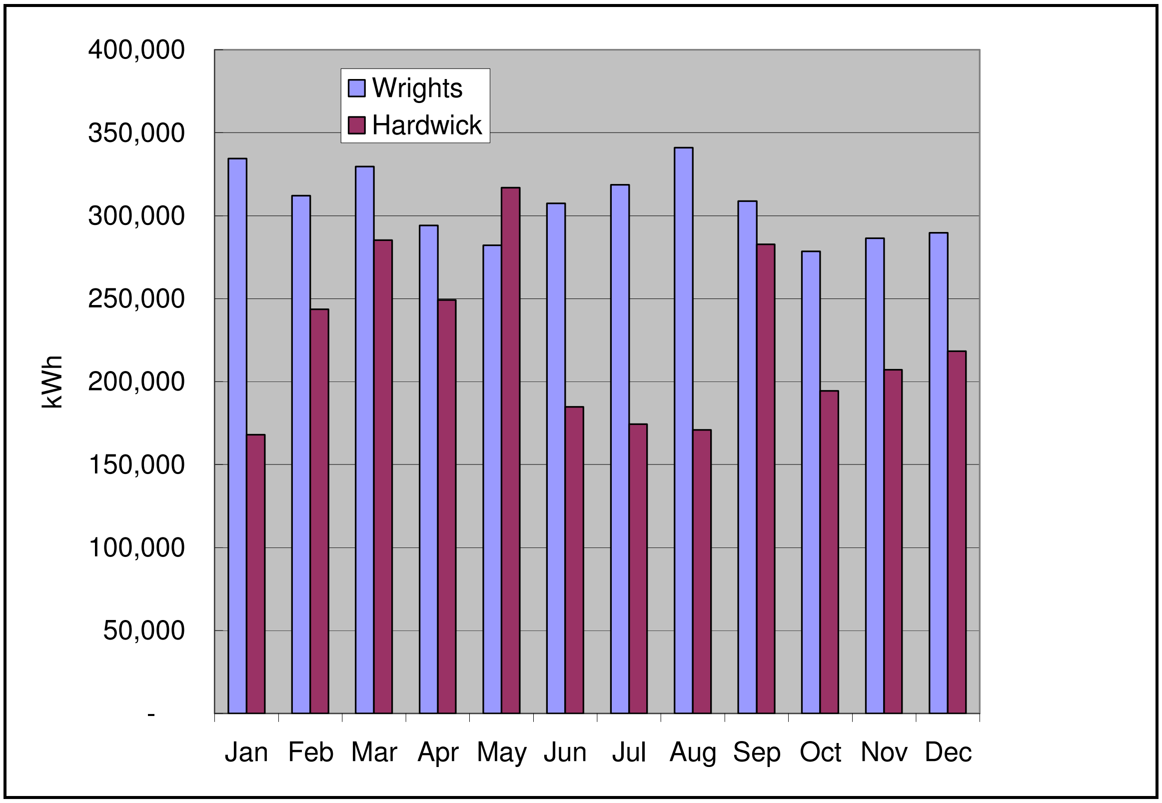

### *1.3.3 Hardwick Knitted Fabrics Electricity Consumption*

Hardwick Knitted Fabrics is an abutter to the Wrights and is interested in working with Wrights to installing the hydroelectric facility and sharing the electric output. Hardwick has significant electricity consumption: 2,695,600 kWh in 2004, which is 73% of Wrights 2004 consumption. Hourly consumption was not available for Hardwick, nonetheless analysis of a recent electric bill shows Hardwick consumption patterns are less consistent than Wrights (see Figure 1-8). Hardwick's annual load factor for monthly average peak demand is 36% as compared to Wrights' load factor of 49%[1]. From this we infer that in high usage months, Hardwick is being more process intensive (i.e., using

[1] Annual average load factor is defined as annual kWh consumption divided by the product of average peak kW draw multiplied by 8760 hours (the number of hours in a year). High load factor indicates consistent energy consumption across all hours, a low load factor indicates uneven energy consumption on an hourly basis.

more electricity) during peak hours and not increasing electricity proportionally during off-peak hours. Additionally, it is interesting to note that Hardwick's 2004 electric consumption varies much more closely with water resources (high in the spring, low in the summer).

**Figure 1-8**
**Compare Hardwick and Wrights 2004 Monthly Electricity Consumption (kWh)**




### *1.3.4 Inspections/Initial Dam Safety Survey*

According to U.S. Army Corps of Engineer (ACOE) Dam Safety Report of 1979 by the New England Regional office, the lower dam has a low hazard potential. A list of ACOE Hazard Potential Classification for Civil Works Projects and a copy of the Dam Safety Report for Wrights can be found in Appendix B. The test flood is the 50 to 100 year storm. Assuming a failure, with water at the top of dam 3444+/- cfs of water would be released. The improved downstream channel (by the ACOE in 1963) will adequately control this outflow. No adjacent mill buildings should be damaged. Homes are not located near the river channel, thus no damage should be expected. Below the mill complex, the flood flow should be dissipated within the river channel prior to reaching any improvements further downstream.

### ***1.3.5 Upper Dam and Power Canal***

The upper dam was breached in the 1950's and our research found very little information relating to its original design. The dam has a date stone of 1908 and is of typical construction for this period. The entire dam, including abutments, was constructed of cut granite. The original spillway is 115 feet in length. The embankment on the north riverbank opposite adjacent to the Conrail railroad was washed out, presumably in the flood of 1955. This section of breach is estimated to be 40 feet in width. The spillway is 12 feet high with 2 foot flashboards that allow about 14 foot total head.

Upper Dam 4-4-05 Spring Flows.

Breach on Upper Dam – 4-4-05 Spring Flows

Breach on Upper Dam – 9-04-04 – Fall Flows

**Power Canal**

A power canal runs from the upper dam parallel the southern bank of the Quaboag River and was used to convey water to the mill. The canal itself is primarily of earthen dike construction along the riverside with natural occurring elevations making up the southern bank of the canal. Today, while overgrown, it is observed to have sufficient integrity to allow reconstruction to receive the diverted flows from the upper dam. The head gate structure was rebuilt with concrete at some point after 1908 and is also in need of repair. The head gates themselves are intact which is convenient for reconstruction.

Existing Power Canal – Overgrown with small trees

### ***1.3.6 <u>Lower Dam</u>***

The lower dam is a gravity concrete and stone masonry run of the river dam. The masonry spillway has a length of 80 feet, a height of about 16 feet and a top width of 3 feet. The upstream area has concrete training walls on both sides. Two small outlet conduits are located along the left training wall. The lower dam is well maintained by Wrights and the Town of West Warren.

### ***1.3.7 <u>Environmental Resource Assessment</u>***

A brief site reconnaissance was conducted by Lee Carbonneau, a Wetland Scientist/Terrestrial Ecologist from Normandeau Associates Inc. and other members of the feasibility study team on April 4, 2005 to identify natural resources in the project area. Water levels were high at the time of the site reconnaissance.

### ***<u>Current Resources</u>***

#### *1.3.7.1 <u>Current Resources - Wetland</u>*

Following the breach of the upper dam, over the past 50 years, bordering wetlands have revegetated the banks of the Quaboag River. These wetlands extend primarily along the northern bank of the river along a triangular shaped area of over one acre in size. A wetland field delineation, boundary survey and functional assessment would be required to proceed with the permitting process.

The federal government has jurisdiction over navigable waters, tributaries and adjacent wetlands that meet criteria for hydrophytic vegetation, hydric soils, and wetlands hydrology defined in the *Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1*, (January 1987). The Massachusetts Department of Environmental Protection has jurisdiction over these resources and several others observed during the field reconnaissance, as described and defined below. These definitions correspond to specific regulatory requirements (see Table 1-4 below and 310 CMR 10.54 – 58) that are triggered by working within these areas all of which are likely to be impacted by the upper dam refurbishment and all but bordering wetland requirements by the lower dam construction activities.

Bank – The land between the mean annual low flow level and the first observable slope break or mean annual flood level for the Quaboag River and the power channel.

Bordering Vegetated Wetland – Areas with 50% or more hydrophytes (Facultative, Facultative-Wetland, and Obligate-Wetland species), or areas meeting wetland parameters for soils, hydrology, and vegetation. Emergent and shrub wetlands are located within the lower floodplain along the river channel and probably within the power channel.

Buffer Zone – Extends 100 feet inland from any Bordering Vegetated Wetland or Bank. The buffer zone is largely developed in the western part of the project area and forested in the east, with a railroad passing through.

Land Under Water bodies and Waterways – land below the mean annual low water elevation of the Quaboag River and possibly including the power channel. The river channel is 50 to 150 feet wide, and the power channel is approximately 15 to 20 feet wide, with a mineral soil substrate.

Bordering Land Subject to Flooding – the 100 year floodplain on FEMA maps, the maximum extent of flooding recorded, or as identified through calculations. The floodplain of the Quaboag River within the project area is approximately 200 feet wide, confined by a natural slope on the south bank and the railroad embankment on the north.

Riverfront Area – The land within 200 feet of the Mean annual high water line of the Quaboag River. This resource area overlaps with Bordering Vegetated Wetlands, Buffer Zone and Bordering Land Subject to Flooding.

In the vicinity of the mill, the Riverfront Area is developed with buildings, roads, parking areas, and landscaped yards. To the east of the mill, the Riverfront Area is a managed mixed hardwood-softwood forest.

#### *1.3.7.2 Aquatic and Benthic Communities*

Aquatic resources of this portion of the Quaboag River were not inventoried, but are likely to include aquatic macroinvertebrates, fish and aquatic vegetation. The composition of these communities is not currently known, but would be dominated by species common to warm water riffle and pool habitats.

According to Wright's personnel, trout are stocked upstream and downstream of the lower dam. The Massachusetts Stocked Trout Waters 2005 website indicates that the Quaboag River in Palmer (downstream of the project area) is stocked with trout in spring and fall. Protection of instream flows downstream of both dams will be a critical issue for the project. Anadromous and Catadromous fisheries are not present due to the presence of numerous dams downstream of the Wrights mill including those on the Ware River and Chicopee River.

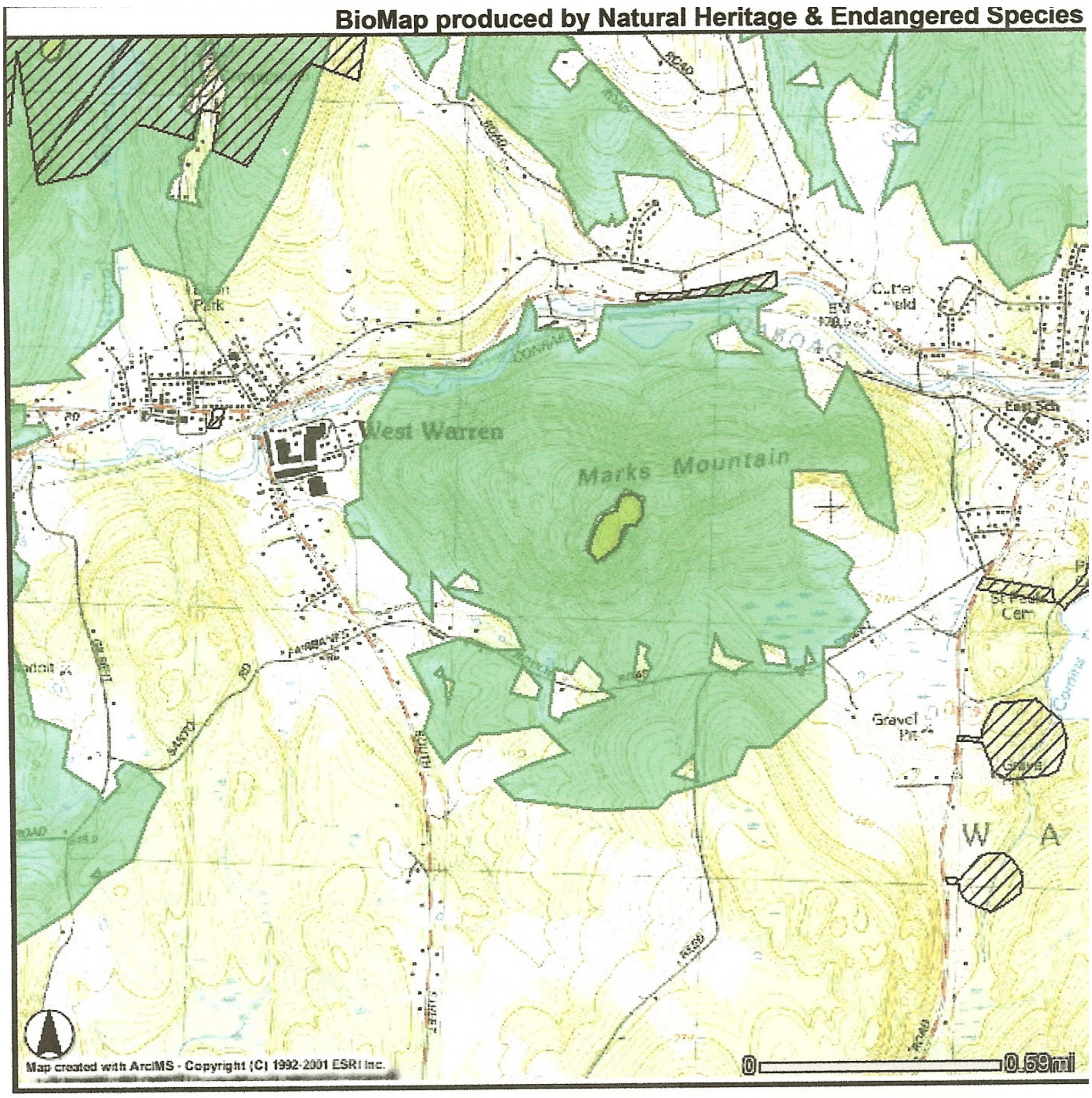
The Quaboag is most likely typical of benthic communities of warm water riffle & pool habitat. Additional research will be performed during design relating to sensitive, rare or endangered communities that may be present in the Quaboag.

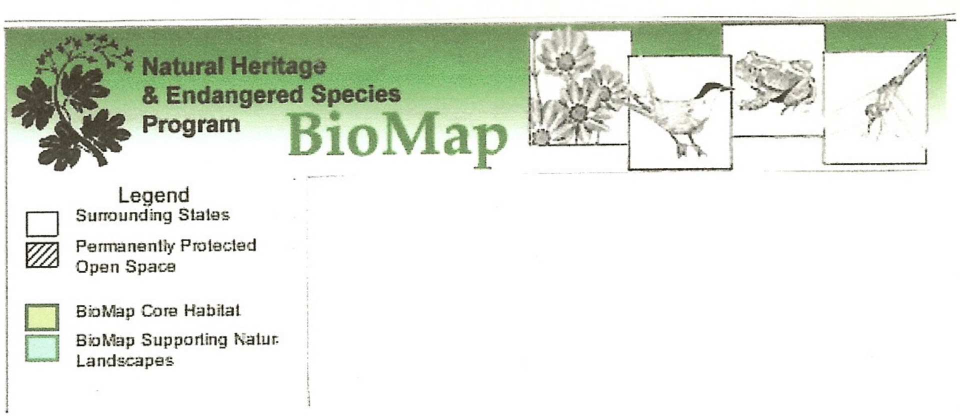
#### *1.3.7.3 Terrestrial*

The terrestrial landscape in the immediate vicinity of the mill is developed with roads, factory buildings, paved and gravel parking areas, landscaped lawn and planters, and small patches of native trees, shrubs, and forbs.

Rising just east of Wrights property is Marks Mountain that contains "core habitat" and "supporting natural landscape" as identified by the Natural Heritage and Endangered Species program's Biomap. The "supporting natural landscape" extends to the Quaboag

River in the vicinity and encompasses the upper dam. There are state-listed threatened or endangered species that have been identified at the project site and are discussed more fully in Section 1.5.4. The supporting Landscape designation indicates function as an undeveloped buffer for the core habitat, and possible value as a large block of naturally vegetated habitat (see Biomap Technical Report, 2001 below).


BioMap produced by Natural Heritage & Endangered Species
West Warren
Marks Mountain
Gravel Pit
W
A
Map created with ArcIMS - Copyright (C) 1992-2001 ESRI Inc.
0
0.59mi


Natural Heritage
& Endangered Species
Program
BioMap
Legend
Surrounding States
Permanently Protected
Open Space
BioMap Core Habitat
BioMap Supporting Natur
Landscapes

### *1.3.8 Reduced Regional Air Pollution from Hydro Power*

An estimate of regional emission reductions that would occur with the addition of Wrights, clean non-polluting hydroelectric energy is presented below. The energy supplements and displaces fossil fueled generation emissions based on the New England Power Pool's (NEPOOL's) aggregated air emissions from their fleet of power plants for the air pollutants sulfur dioxide ($SO_2$), nitrogen oxides ($NO_x$) and carbon dioxide ($CO_2$) for the calendar year 2003. NEPOOL provides average emission rates for these pollutants that represent the emissions from the last 500 MW of power added to the grid, known as the marginal unit. This power dispatched is typically from the least economic and most polluting units. Since the hydro turbine uses water to generate electrons versus the predominately fossil-fuel based generation capacity of the NEPOOL's system, each electron generated by a renewable energy system can be viewed as displacing from the grid an electron that would otherwise be created by the existing system's fossil fueled marginal power plant.

Table 1-1 provides the anticipated benefit to regional air emissions from the Wrights installation.

**Table 1-1**
**Annual Regional Air Emission Benefit**

| **Pollutant** | lbs/yr | Tons/yr |
|---|---|---|
| $CO_2$ | 4,186,629 | 2,093 |
| $SO_2$ | 7,031 | 4.0 |
| NOx | 259 | 0.13 |

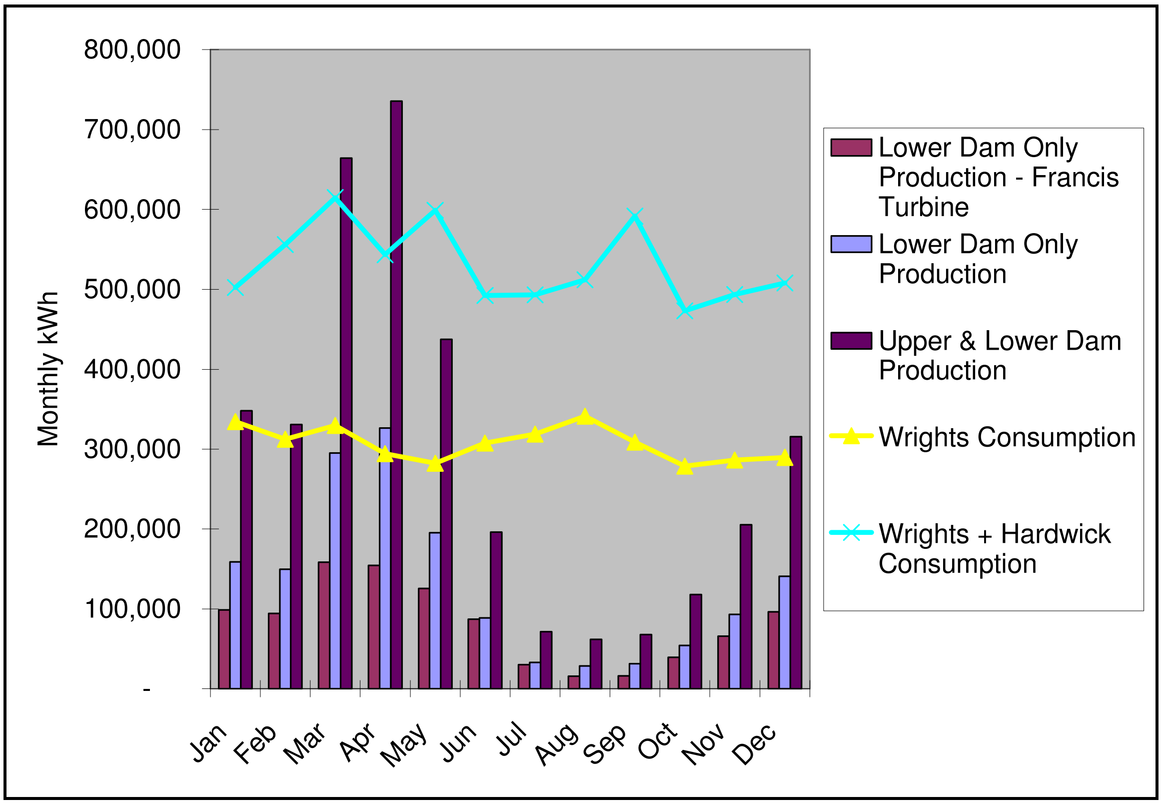
### *1.3.9 Stakeholder Identification*

Besides the elected officials and immediately adjacent property owners, other likely concerned entities in the state and regional area can be found in listed in Appendix C.

## *1.4 Energy Use Opportunities*

A great portion of electricity consumption from an on-site hydroelectricity facility could be used Wrights or a Wrights / Hardwick combination. Figure 1-8 simultaneously displays the 2004 monthly electricity consumption for Wrights and a Wrights Hardwick combination along with estimates of monthly electricity production using long-term Quaboag river flow datasets. Run-of-river electricity production is very seasonal. Peaking in the spring and hitting a low in the summer.

**Figure 1-9**
**Monthly 2004 Electricity Consumption Compared to Long-Term Estimated Electricity Production**




All things being equal it is optimal for project payback for electricity to be consumed on-site avoiding 9 ¢/kWh retail charges, rather than selling excess production into the grid at 4.5 ¢/kWh. Table 1-2 displays the amount and percent of production that would be consumed on-site assuming estimated monthly electricity production is evenly spread over each hour of the month[2]. The scenarios show that between two-thirds and nearly all of the electricity production would be consumed on-site.

**Table 1-2**
**Scenarios of Percent Production Consumed On-Site**

| Dam Scenario | Annual kWh Production | % Annual On-Site Consumption: Wrights Only | % Annual On-Site Consumption: Wrights + Hardwick |
|---|---|---|---|
| Lower Dam Only Production – Francis Turbine | 983,072 | 99.5% | 100.0% |
| Lower Dam Only Production | 1,595,255 | 91.2% | 98.9% |
| Upper & Lower Dam Production | 3,551,656 | 67.0% | 87.0% |

## *1.5 Environmental Impact and Permitting/Regulatory Analysis*

Hydroelectric development involves extensive environmental permitting at the local, state and federal levels. Since the lower dam is well maintained and would result in essentially no impacts to bordering wetlands, fewer state regulations would be triggered if the refurbishment is solely for this dam. If the upper dam is refurbished, the broader body of state regulations associated with the Massachusetts Environmental Policy Act , Threatened and Endangered Species and wetland regulations will be applicable and would create additional impacts to the cost and the timeframe to implement such a project.

[2] While this assumption is clearly not correct, it probably makes little difference to this analysis, as hydroelectricity production, with the exception of snow melt, has very little correlation to the hour of the day.

### *1.5.1 FERC Licensing*

Hydroelectric licensing or exemption from licensing requirements is under the purview of the Federal Energy Regulatory Commission (FERC) and this agency's actions may supersede some local and State regulatory approval authority. A potential developer of hydroelectric project must file an application with FERC for a license or exemption from licensing if the project is or will be:

(1) located on a navigable waterway of the U.S.;
(2) occupying U.S. lands;
(3) utilizing surplus water or water power from a U.S. government dam; or
(4) located on a body of water over which Congress has Commerce Clause jurisdiction, project construction occurred on or after August 26, 1935, and the project affects the interests of interstate or foreign commerce.

Wrights is most likely considered to be on a navigable waterway and therefore an application must be filed for the repowering of either dam. The estimated time frame for FERC approval of either a license or an exemption is estimated to be between three – four years.

Under the Federal Code of Regulation (CFR) Subpart D, Section 4.30 (b) (17), Wrights is considered a minor water power project if only the lower dam is developed:

*" license or unlicensed, existing or proposed water power project that would have a total installed capacity of 2,000 horsepower (1.5 megawatts (MW)) or less."*

Three distinct licensing application pathways are available under this Subpart. After July 2005, Integrated Licensing Process (ILP) will become the default process and FERC approval will be needed for the other two processes that exist. A license is granted for a 30 to 50 year period and conveys the right to eminent domain.

The ILP will provide for greater coordination among the FERC and state agencies with authority to impose conditions on a licensee. FERC staff will provide greater assistance to the applicant and stakeholders. There is a simultaneous FERC environmental scoping process to facilitate early issue identification. Increase public participation occurs under the ILP and there is a establishment of schedules and deadlines for all participants including the FERC's staff.

#### *1.5.1.1 FERC Licensing Exemption*

Wrights can seek an exemption from FERC licensing under 18 CFR Subpart K- Exemption of Small Hydroelectric Power Projects of 5 MW or less. For the purposes of the exemption, Wrights' project meets the definition of a "small hydroelectric power project" contained at 18 CFR 4.30(b)(29). Exemptions are issued in perpetuity and do not convey the right to eminent domain. Exemptions are subject to non-standard terms and conditions as FERC may prescribe (18 CFR 4.105(2)), and standard (mandatory) terms and conditions. (18 CFR 4.106). In the event of a FERC license exemption, additional state permitting requirements may be imposed.

### ***1.5.2 Energy Facility Siting Board (EFSB) Process***

The EFSB coordinates the state and local permitting and licensing of hydropower generating facilities in the Commonwealth by simplifying requirements for permits and licenses. No new permits for new dams or those associated with repairs to fully breached dams for power generation have been issued through the EFSB facilitation process in at least 20 years in the Commonwealth of Massachusetts. Approximately 40 permits were issued through the EFSB facilitation process for dam refurbishment and approximately half of these were constructed during the past 20 years. All of these approvals were associated with "run of river" projects versus store and release none of which have been proposed or approved since the 1980's. The last hydro project was reviewed in 1992 by the EFSB. Since then, there has been minimal or no licensing activities associated with hydropower.

The EFSB process is expected to take approximately 6 months if the submissions are considered technically complete however, extended reviews for additional technical data requests are common. Additional background on the EFSB process can be found in Appendix D- Energy Facility Siting Board Process

### 1.5.3 ***Massachusetts Environmental Policy Act (MEPA)***

The MEPA regulations were promulgated to create a uniform system for compliance with MEPA, M.G.L. c. 30, Sections 61 through 62H, inclusive.  The purpose of MEPA (301 CMR 11.00) is to provide for public review of the potential environmental impacts of projects for which agency action is required, and to assist each agency in using all feasible means to avoid damage to the environment or, to the extent damage to the environment cannot be avoided, to minimize and mitigate damage to the environment to the maximum extent practicable.

MEPA review depends on whether MEPA has jurisdiction over a project, and whether one or more review thresholds contained in Section 11.03 of the regulations are met or exceeded by a project.

**Jurisdiction**

As set forth in 301 CMR 11.01(2)(a), MEPA establishes jurisdiction over: a project undertaken by an agency; those aspects of a project within the subject matter of any required permit; a project involving financial assistance; and those aspects of a project within the area of any land transfer. MEPA jurisdiction determines the scope, if an EIR is required.  MEPA jurisdiction is broad when a project is undertaken by an agency or involves financial assistance.  MEPA jurisdiction is limited when a project is undertaken by a person and requires one or more permits or involves a land transfer but does not involve financial assistance.

MEPA jurisdiction extends to the Wrights mill hydropower project.  First, the project is receiving financial assistance in the form of a grant from the Massachusetts Technology Collaborative, a quasi-public agency of the Commonwealth.   Second, assuming that one or more permits are required or the project, MEPA jurisdiction extends to those aspects of a project within the subject matter of any required permit, including the potential for mandatory EIR.  This potential exists for a Review Threshold is triggered in that over 5,000 $ft^2$ of bordering wetlands would be flooded by the construction of the upper dam.  Additional background on MEPA Review Thresholds can be found in Appendix D.

### 1.5.4 Endangered Species

According to the Massachusetts Natural Heritage Atlas (11th Edition, 2003), the Quaboag River from it's confluence with the Ware and Chicopee Rivers upstream to a point just above the upper Wright's dam is both a "Priority Habitat of Rare Species" (PH 325) and an Estimated Habitat of Rare Wildlife" (WH 576). Coordination with the Massachusetts Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife was initiated by filing a Rare Species Information Request with the Massachusetts Natural Heritage and Endangered Species Program Database Appendix F – Threatened and Endangered Specie . Based on their review dated May 12, 2005, the project was determined to be located within the habitat of the following state-protected species (See Appendix F):

**Table 1-3**
**State-listed Species at Project Site**

| Scientific Name | Common Name | Taxonomic Group | State Status |
|---|---|---|---|
| *Gomphus abbreviatus* | Spine-Crowned Clubtail | Dragonfly | Endangered |
| *Rhodoecia aurantiago* | Orange Sallow Moth | Moth | Threatened |
| *Ophiogomphus aspersus* | Brook Snaketail | Dragonfly | Special Concern |

In order to implement the project, a Massachusetts Conservation and Management Permit would be required to be obtained during design since there is the presence of these species at the project site. Guidelines for submitting a Conservation Permit Application are also included in Appendix F.

Also included in the state review letter is a requirement for both the upstream and downstream passage for the American eel (Anguilla rostrata) and for adequate flow in any bypassed reach to maintain water quality and biological diversity.

### 1.5.5 ***Wetlands – Impacts and Mitigation***

The Quaboag River in West Warren descends through a relatively narrow valley with a steep gradient. The impoundment associated with reconstruction of the breached dam would be narrow, thereby limiting potential losses of Bordering Vegetated Wetlands. The reconstruction of the upper dam is estimated to flood over 5,000 $ft^2$ of bordering wetlands primarily along the northern bank of the Quaboag River. However, over 10,000 $ft^2$ of wetlands can be replicated on Wrights property to replace bordering wetlands at a minimum replacement ratio of 2:1 from this impact. The construction of the penstock, and power house, while in the river bank area primarily on rip wrap was not observed to impact wetlands. The construction of the service road would most likely impact additional areas of wetland.

A full wetland delineation and survey of the boundaries, a functional assessment and mitigation plan would be required during design. Based on the preliminary refurbishment concept, the proposed project could have the following effects on wetland and wildlife resources.

Banks

- Temporary disturbance in power channel
- Flooding of existing banks, and re-establishment of new banks on river
- Rip-Wrap areas affected by penstock construction

Bordering Vegetated Wetland

- Loss (change to land under water) estimated at > 5,000 square feet
- Small gain (conversion of upland to BVW) ; Goal 2:1 ratio

Land Under Water (Aquatic Habitat)

- Deepening of power channel and river channel above breached dam
- Altered substrate (sediment accumulation)
- Temporary construction impacts at both dam sites (cofferdams, etc.)

Riverfront Area and Buffer Zone

- New structures (penstock, power building, road) within previously developed resource areas

- Possible access road through undeveloped forest

Fisheries habitat

- Re-establish impediment to fish passage
- Altered channel habitat for resident fish

Wildlife Habitat

- Alteration of possible wood turtle (Species of Special Concern) habitat (both positive and negative alterations possible)
- Potential for State Conservation permit requirements for the state-listed dragonfly and moth species

A potential site for mitigating permanent wetland resource impacts was identified along an unnamed tributary stream within 0.5 mile of the upper and lower dams and mill complex. This site is previously flooded wet meadow adjacent to a pond, and surrounded by an upland field. The stream flows through the meadow in a confined channel 3 to 5 feet wide and exits the site through a breached beaver dam. There is no other standing water in the meadow. Portions of this meadow could be enhanced for wetland wildlife by flooding or excavation of pools to create aquatic and emergent wetland habitat for waterfowl, wading birds, amphibians, reptiles, and semi-aquatic mammals. The property is owned by the Wrights and is approximately 11 acres.

Meadow (Parcel E) Available for Wetland Mitigation

The construction activities in the riverbank may prompt Quaboag River sediment sampling and analysis. If there is historic contamination of river sediments, additional characterization studies and remediation may be required depending on the nature, concentrations and extent of contamination that may be identified.

### *1.5.6 Regulatory Permitting Summary Tables*

Boreal prepared permitting summary tables to identify the potentially applicable local, State and Federal requirement, the authority and citation, and permit approval timeframe as is outlined below. Wrights is located in the West Warren portion of the Town of Warren in the area zoned as “V- Village”. The power house most likely will be considered an Accessory Buildings or Use based on the definitions in the bylaws.

**Table 1-3**
**Local Applicable Regulations – Town of Warren Zoning By-Law**

| Regulation/Permit | Authority | Citation | Approval Time | Comments |
|---|---|---|---|---|
| Manufacturing or Industrial Use | Special Permit by Planning Board | Section 3.25 (2) Industrial<br>Section 5.1 Special Permits<br>Section 5.15 (2) | 100 days max | Note: 5.15 (2) No draw or discharge will be allowed that would exceed 100,000 gallons of water per day or that would degrade the Class B status of the river |
| Increase in present industrial use | Use Permitted | Section 3.25 (3) Industrial | | |
| Variances | | Section 5.2 (1) | | “A literal enforcement of the provisions of this by-law would involve a substantial hardship financial or otherwise to the petitioner or appellant” |

| Regulation/Permit | Authority | Citation | Approval Time | Comments |
|---|---|---|---|---|
| Earth Removal | Special Permit by Planning Board | Section 8.0 | 78 days | No earth shall be removed from any lot in the Town of Warren unless the Board grants a special permit. Less than 500 $yd^3$ is exempt for many conditions. |

**Table 1-4**
**State Applicable Regulations[3]**

| Regulation/Permit | Authority | Citation | Approval Time | Comments |
|---|---|---|---|---|
| MEPA Determination: Notice of Intent and Environmental Notification Form (ENF) | Executive Office of Environmental Affairs | MEPA Regulations, 301 CMR 11.00 | ~90 days | See narrative above - Jurisdictional authority occurs with State financial assistance; ENF will document whether various thresholds are met requiring an Environmental Impact Report (EIR); |
| MEPA: Environmental Impact Review | | MEPA Regulations, 301 CMR 11.00 | | See narrative above - Mandatory EIR "alteration of one or more acres of bordering vegetating wetlands |
| NPDES Stormwater General Permit<br>Notice of Intent | Mass Department of Environmental Management & | Joint State/Federal Program under the CWA | | Required if more than one acre of land is disturbed. |

[3] Notes: Portions adapted from Renewable Energy Research Laboratory, University of Massachusetts at Amherst - Community Wind Power Fact Sheet #7 ;

| Regulation/Permit | Authority | Citation | Approval Time | Comments |
|---|---|---|---|---|
| | US EPA | | | |
| Massachusetts General Law Chapter 91 | | | | Projects located in, on, over, or under any non-tidal, navigable river or stream on which public funds have been expended either upstream or downstream within the river basin, except for any portions not normally navigable during any season by any vessel. |
| Notice of Intent | Mass. Natural Heritage and Endangered Species Program | 321 CMR 10:00 | | See Appendix D; Site "estimated habitat of rare wildlife"and . Threatened Species review is underway. No Areas of Critical Environmental Concern are known to be located in on the project's portion of the Quaboag River. |
| Conservation and Management Permit | Mass. Natural Heritage and Endangered Species Program | 321 CMR 10:00 Massachusetts Endangered Species Act – required if a "take" is required | | Applicable to Upper Dam - Protects ~ 190 species of vertebrate and invertebrate animals and 258 species of native plants that are listed as Endangered, Threatened or of Special Concern in Massachusetts |
| Wetlands Protection Act, M.G.L. c. 131 | Mass Department of | 310 CMR 10.54 Alterations to | | No anadromous or catadromous |

| Regulation/Permit | Authority | Citation | Approval Time | Comments |
|---|---|---|---|---|
| s.40, | Environmental Protection | Riverbanks<br>310 CMR 10.55 Bordering Vegetated Wetland Delineation Criteria and Methodology<br>310 CMR 10.56 Land Under Water Bodies<br>310 CMR 10.57 Land Subject to Flooding<br>310 CMR 10.58 Riverfront Area | | fish currently live in the Quaboag River. We are not aware of plans to restore these species to the Quaboag River. (e.g. 310 CMR 10.35 may not be applicable) |
| Massachusetts Forest Cutting Practices Regulations | Mass Department of Environmental Management | (304 CMR 11.00) require reviews of forest cutting plans and potential impacts on rare species. | | |
| General Access Permits | Massachusetts Department of Highways | | | Needed if road modifications to State roads must occur |
| Wide Load Permits | Massachusetts Department of Highways | | | Route approval required; Road limits may require funding of separate road survey by a Civil Engineering firm. |
| Project Notification Form | Massachusetts Historical Commission (MHC) | MGL Ch. 9 Sections 27-32 | 30 days | Any new construction projects etc. that require funding, licenses, or permits from any state, federal agencies must be reviewed by MHC for impacts to |

| Regulation/Permit | Authority | Citation | Approval Time | Comments |
|---|---|---|---|---|
| | | | | historic and architectural properties. Purpose is to protect important historical and architectural assets of Commonwealth. |
| Noise control policy | Massachusetts Department of Environmental Protection | MGL 310 CMR 7.09 -7.10 | criteria | At nearest property line or residence: No increase by more than 10 dB(A) above ambient; or<br>No “pure tone” condition. |
| Site approval | Energy Facility Siting Board (EFSB) | M.G.L. c. 164, §69H | | Applicable due to ENF- Hydro supplement required. Primarily concerned with plants over 100 MW; new transmission lines over 1 mi long or over 69 kv |
| NEPOOL Interconnection System Impact Study & Facility Study | RTO-NE | | None – informational only | For projects under 5 MW the submittal of form 18.4 does not trigger a system impact study. It provides information to RTO-NE for system planning purposes. |

**Table 1-5**
**Federal Applicable Regulations**[4]

| Regulation/Permit | Authority | Citation | Approval Time | Comments |
|---|---|---|---|---|
| Habitat Conservation & Incidental Take Permit | Fish & Wildlife Service | Endangered Species Act | | Not applicable – No Federally Threatened and endangered species identified. |
| FERC Certification as Qualifying Facility (QF) | Federal Energy Regulatory Commissi on | 18 CFR Sec. 8.11 | 10 business days | http://www.ferc.gov/industries/electric/gen-info/qual-fac.asp |

## 1.6 Engineering and Interconnection Requirements

### 1.6.1 Base Case Scenarios Installations

In preparing the RFP for the hydroelectric equipment, Mr. William Fay looked at historical flow data, total head, and square drainage area. The RFP was submitted to three manufacturers. The basis for choosing these manufacturers was prior experience in providing equipment to similar size projects. The three manufactures were VATECH, Canadian Hydro Components and Ossberger Industries. Replies to the RFP were received form VATECH and Canadian Hydro Components and are summarized in Table 1-6 and Table 1-7.

**Table 1-6**
**VATECH Quotation**

| Attribute | Quote |
|---|---|
| **Lower** | **US $1,542,000** |
| Turbine Type | 1 Horizontal S-type Kaplan |
| Runner Diameter | 2120 mm |
| Turbine Speed | 171 RPM |
| Max Turbine Output | 865 KW |

[4] Notes: Portions adapted from Renewable Energy Research Laboratory, University of Massachusetts at Amherst - Community Wind Power Fact Sheet #7 ;

| Attribute | Quote |
|---|---|
| Speed Increaser Type | Parallel Shaft, Horizontal Offset |
| Generator Type | Horizontal Induction |
| Generator Rating | 830KW |
| Speed | 900 RPM |
| Voltage | 480 |
| Number of units | 1 |
| | |
| **Lower and Upper** | **US $1,703,000** |
| Turbine Type | 1 Horizontal S-type Kaplan |
| Runner Diameter | 1900 mm |
| Turbine Speed | 240 RPM |
| Max Turbine Output | 1950 KW |
| Speed Increaser Type | Parallel Shaft, Horizontal Offset |
| Generator Type | Horizontal Synchronous |
| Generator Rating | 1850 KW |
| Speed | 900 RPM |
| Voltage | 4160 |
| Number of units | 1 |

**Table 1-7**
**Canadian Hydro Components Quotation**

| Attribute | Quote |
|---|---|
| **Lower** | **US $1,212,500** |
| Turbine Type | Axial Flow Vertical |
| Runner Diameter | 1500 mm |
| Turbine Speed | 240 RPM |
| Max Turbine Output | 376 KW |
| Generator Type | Horizontal Synchronous |
| Generator Rating | 350 KW |
| Speed | 240 RPM |

| | |
|---|---|
| Voltage | 480 |
| Number of units | 2 |
| Total Output | 700 KW |
| | |
| **Lower and Upper** | **US $1,565,000** |
| Turbine Type | Axial Flow Vertical |
| Runner Diameter | 1250 |
| Turbine Speed | 450 RPM |
| Max Turbine Output | 855 KW |
| Generator Type | Horizontal Synchronous |
| Generator Rating | 800 KW |
| Speed | 450 RPM |
| Voltage | 480 |
| Number of Units | 2 |
| Total Output | 1600 KW |

### *1.6.2 Dam Engineering*

The reconstructed upper dam is a run-of-river dam where most of the dam crest acts as an uncontrolled spillway to pass water in the river. A low level outlet may be installed for dam safety purposes and to maintain limited stream flow in the river between the upper and lower dams.

The reconstruction of the upper dam will require an evaluation of the existing structures and design of new structures to meet current state dam safety requirements. The minimum evaluations required for the dam will be:

(1) Hydrologic Studies to establish the drainage basin for the dam and to calculate the flood inflow curves used to design the dam/spillway.
(2) Hazard Classification of the Dam. This will be used to set the design standards for the dam and is based on storage capacity, dam height, and potential for damage to downstream structures/residences.

(3) Geotechnical/Structural evaluation of existing dam, and foundations for the reconstructed dam.
(4) Hydraulic studies of the dam to determine crest height and length that optimizes the hydroelectric performance of the system while safely passing the design floods.
(5) Stability analyses of existing and new dam/spillway.
(6) Design of appurtenances (outlet gates if required).
(7) Emergency Action Plan. If the hazard classification warrants an EAP a dam breach analysis will be performed to determine downstream inundation maps and a list of potential contacts, which would be flooded, would be established along with procedures for contacting downstream entities.

Final design drawings and specifications will be developed during the evaluation and used to obtain a dam construction/reconstruction permit. Our evaluations will also be submitted during the permitting process in the form of technical memorandum.

Although no modifications are anticipated on the lower dam, the state may still require an inspection of the lower dam as part of the permitting process.

## *1.6.3 Electrical*

### *1.6.3.1 Electrical Interconnection Plan*

**Figure 1-10**
**Turbine Generator Interconnection Plan – 600 Volt Option**

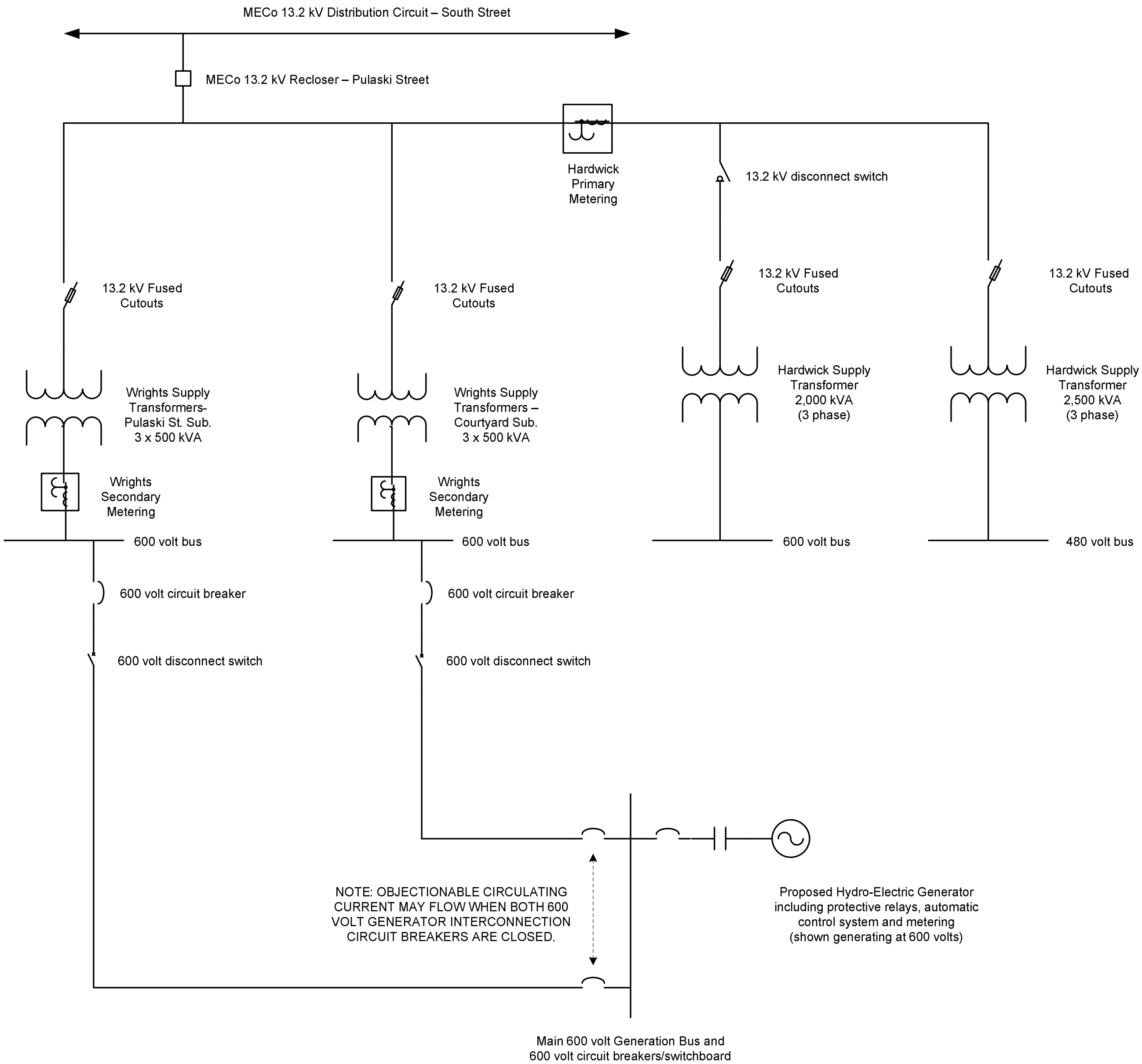
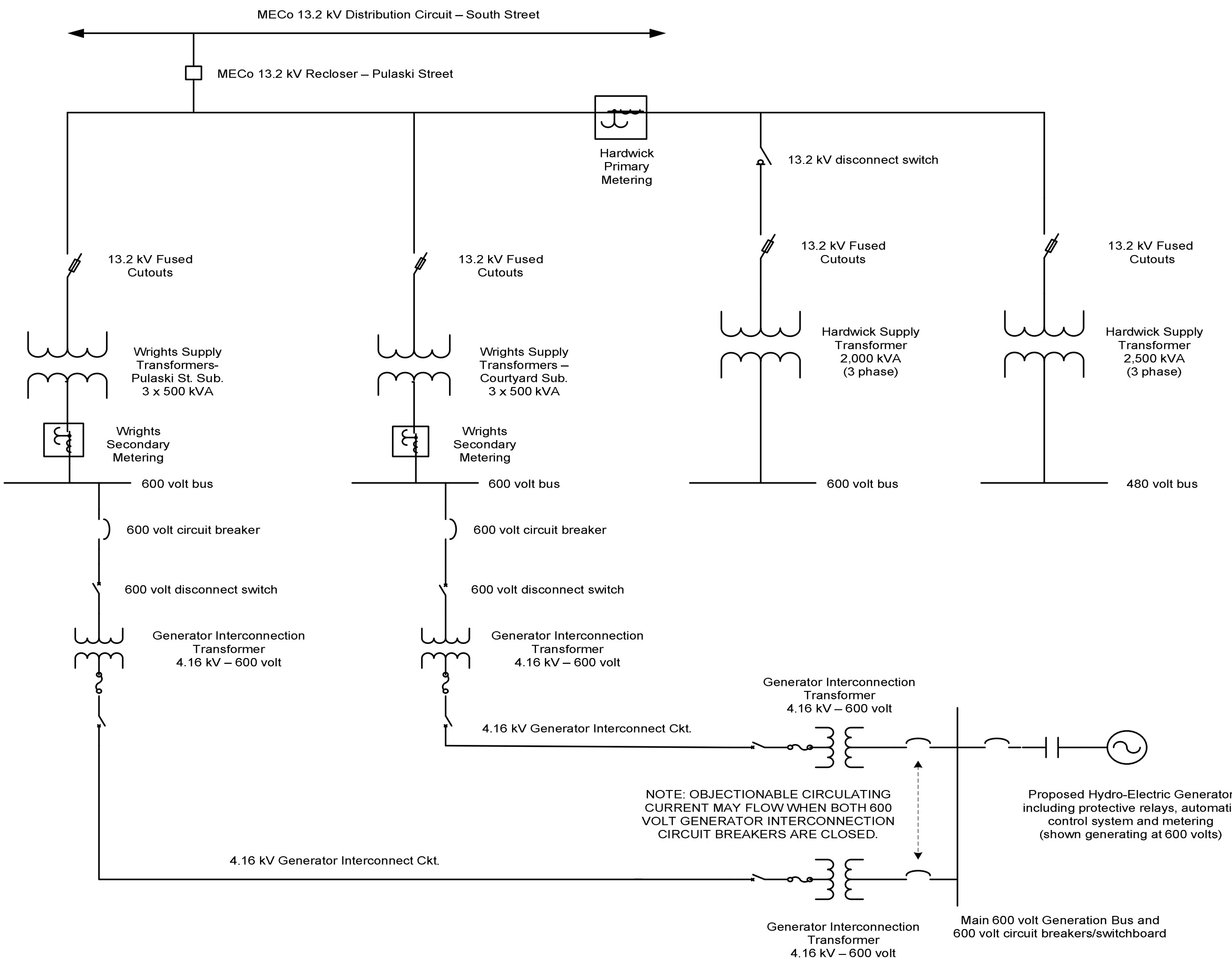


**Figure 1-11**
**Turbine Generator Interconnection Plan – 4.16 kV Option**




Four (4) alternative hydro-electric generator station ratings are being considered as part of this feasibility study: Alternative 1: Lower dam - 265 kW total output; Alternative 2 – Lower dam: 830 kW total output; Alternative 3- Upper and lower dam: 1850 kW total output and Alternative 4- Lower dam: 830 kW in Bldg 8 or Bldg 9. The generator cost proposals that were obtained by others as part of this feasibility study are based on a single generator and include a controls/switchgear package. Therefore, the generator is depicted on the electrical interconnection plans as a single unit with the generator controls/switchgear.

The proposed generator station will be interconnected to the Wrights electrical supply system on the customer side of the MECo revenue metering to maximize the economic benefit of the on-site generation. The interconnection from the generator station to the Wrights existing electrical system can be accomplished at the 600 volt level to be consistent with the voltage of the Wrights existing electrical system. This interconnection plan is shown in Figure 1-10.

At the 830 kW total generator station output level, the 600 volt interconnection cost is reasonable. However, at the 1850 kW generator station output level, the 600 volt interconnection cost almost doubles. Therefore, an alternative 4.16 kV interconnection option has been evaluated as shown in Figure 1-11.

Both the 600 volt and 4.16 kV interconnection plans include an electrical connection from the generator station to each of the two supply substations to Wrights. The two supply substations to Wrights are referred to as the "Pulaski St. Sub." and the "Courtyard Sub." on in Figure 1-10and Figure 1-11. However, only one (1) of the two (2) circuits should be normally closed and energized at any given time to avoid creating a path for the flow of objectionable circulating currents. Circulating current can flow whenever an electrical loop is established between two points in an electrical system. Circulating current can cause excessive thermal loading and increase system losses (see Section 1.7.2.5 Technical Discussion of Interconnection Plans).

The generator interconnection plan does not include a connection to Hardwick Knitted Fabrics to avoid objectionable circulating current that could flow between the electrical systems of Wrights and Hardwick Knitted Fabrics. It would also be difficult to control the amount of hydro-electric generation that would flow to either Wrights or Hardwick Knitted Fabrics if a simultaneous electrical interconnection existed.

The hydro-electric generators are proposed to be three phase, 60 Hertz, machines. The hydro-electric generators may be either induction or synchronous machines. The generator quotes obtained by others as part of this feasibility study indicate that the 830 kW generator is an induction machine and the 1850 kW generator is a synchronous machine. The electric utility interconnection requirements for each type of machine will be summarized in Section 1.7.2.2

For the 600 volt interconnection plan, the generator is proposed to operate at 600 volts to be consistent with the 600 volt main service voltage of Wrights. For the 4.16 kV interconnection plan, the generator could operate at a different voltage and the generator step-up transformer voltage rating would be modified accordingly.
The generators are anticipated to operate in parallel with the MECo electrical distribution system and therefore will require protective relaying as specified by MECo. The protective relays are intended to sense abnormal conditions on the electrical system such as short circuits, over and under voltage conditions, and frequency excursions. If an abnormal system condition is detected, the protective relay system will cause the generators to shutdown and be disconnected from the electrical distribution system.

As shown in Figures 1-10 and 1-11, the generator will be connected to the 600 volt main generator bus and switchboard by a dedicated 600 volt circuit breaker. The generator will be equipped with a control system to safely and automatically connect the generator to the main generation bus and supply power to the electrical loads. Depending upon the selection of generator type (induction or synchronous), the generator will either be brought up to rated speed and be synchronized with the 600 volt main generator bus (for a synchronous generator) or be brought up to rated speed and excited by reactive current flow from the MECo distribution system (for an induction generator).

Two (2) interconnection circuits are shown on Figures 1-10 and 1-11 from the generator station to the existing Wrights electrical system: one circuit is connected to the Wrights Pulaski Substation and the other is connected to the Courtyard Substation. Since only one circuit can be connected at any given time, each circuit will be rated to transfer 100% of the total maximum rated generator station output with a 25% margin as required by the National Electric Code. Therefore, the total generation station output can be connected to either the Pulaski Street Substation or the Courtyard Substation. There will be a requirement for additional protective relaying for the 1850 kW total generator station output alternative to sense the power flowing into the Wrights 1500 kVA supply transformer at either the Pulaski Street or the Courtyard Substation during light load conditions. For full generator output and less than 430 kW of substation load, the 1500 kVA transformer would become overloaded and the protective relaying would be designed to detect this condition and trip the generator off.

The cost of two (2) interconnection circuits may not be justified for this project. Therefore, the interconnection plan may be modified to include only a single interconnection circuit from the generator station to the existing Wrights electrical system. Electrical interconnection cost estimates are provided in Section 1.7.2.6 for both the 600 volt and 4.16 kV interconnection plans, both total generation station output alternatives, and for both a double interconnection circuit (as shown in Figures 1-10 and 1-11) and a single interconnection circuit.

#### *1.6.3.2 Interconnection Requirements*

According to the MECo Interconnection Requirements Document, M.D.T.E. No. 1052, MECo has specific standards and requirements for the interconnection of distributed generation such as the proposed hydro-electric generator alternatives. The interconnection requirements address electrical system protection, revenue metering, operation, and the configuration of the primary interconnection equipment.

MECo will review the proposed design of the electrical interconnection facilities and will perform analyses to determine the impact of the proposed generation on their electrical distribution system. Based on the results of MECo's analysis, certain modifications may be needed within the MECo distribution system and/or to the interconnection facilities. The interconnection requirements for the proposed hydro-electric generator alternatives are based on the generator output rating and generator type (synchronous or induction). The proposed 830 kW, three phase, induction generator alternative is classified as a "Category 4, Type B-3 facility" and the proposed 1850 kW, three phase, synchronous generator is classified as a "Category 5, Type C-3" facility.

With regard to generator reactive power capability, the 830 kW induction generator is not required to provide var support to the MECo distribution system but may require the installation of capacitors to limit the amount of reactive power that is drawn from the MECo system for generator excitation. However, the 1850 kW generator is required to provide reactive capability and voltage support to the MECo distribution system since it is a Category 5 facility. MECo will establish the specific reactive capability requirements as part of their Distribution Facility Impact Study and Distribution Facility Detailed Study.

Based on a review of the MECo Interconnection Requirements, it is anticipated that the protective relay scheme for the hydro-electric generator interconnection will include over/under frequency relays, over/under voltage relays, and overcurrent relays.  All relays shall monitor all three phases and the system protection scheme will include a ground fault detection scheme.  The 1850 kW generator alternative may require a zero sequence overvoltage relay for ground fault detection since the existing Wrights supply transformers are ungrounded.  Upon sensing conditions that exceed allowable operating limits, the protective relay scheme shall send a trip signal to the generator interconnection circuit breaker which shall cause the circuit breaker to open and isolate the generator from the rest of the Wrights electrical supply system.

MECo may also require that the protective relay scheme include transfer trip capability. In this scheme, the generator will receive a trip signal upon the opening of one or more MECo distribution system switching devices to prevent the generator from energizing an isolated portion of the MECo system (referred to as an "island" condition).  The transfer trip signal may be communicated by either radio or fiber optic communications from the MECo equipment to the generator protective relay scheme which will cause the generator circuit breaker to open.  The requirement for a transfer trip scheme is morel likely for the 1850 kW synchronous generator alternative than for the 830 kW induction generator option.  This is due to the greater likelihood of the synchronous generator to self-excite and the larger generator capacity.

#### *1.6.3.3 Revenue Metering Modifications*

According to the MECo Interconnection Requirements Document, M.D.T.E. No. 1052, the revenue metering requirements for the proposed hydro-electric generator alternatives are based on the generator output rating and generator type(synchronous or induction).  The proposed 830 kW, three phase, induction generator alternative is classified as a "Category 4, Type B-3 facility" and the proposed 1850 kW, three phase, synchronous generator is classified as a "Category 5, Type C-3" facility.

The MECo revenue meter requirement for each proposed generator alternative is the same.  Wrights will have to install Bi-directional revenue meters with one set of registers to record energy flows from MECo to Wrights during periods when Wrights is a net consumer of energy and a second set of registers to record energy flows from Wrights to MECo during periods when Wrights is a net producer of energy.

According to the MECo revenue meter requirements, Wrights has the choice of including the feature of interval meter capability with remote access for the 830 kW generator alternative (Category 4 facility). This feature can be included with the required bi-directional metering. Wrights is required to install a bi-directional meter with interval meter capability and remote access for the 1850 kW generator alternative (Category 5 facility).

As shown on Figures 1-10 and 1-11, the existing MECo revenue metering for Wrights is located at the secondary of each of the Wrights 13.2 kV- 600 volt supply transformers. Each existing metering point to Wrights is presently equipped with two (2) current transformers and three (3) potential transformers. This will allow the connection of 2 ½ stator metering which is anticipated to be sufficient to accommodate the bi-directional revenue meter required by MECo for either generator alternative. The proposed generator interconnection plan is to connect the generator to the 600 volt bus of the Wrights 13.2 kV – 600 volt supply transformer on the Wrights side of the revenue meters. Therefore, the location of the existing metering instrument transformers will not have to be changed.

#### *1.6.3.4 Electrical Interconnection Equipment Details*

The technical details of the major power system components associated with the electrical interconnection of the hydroturbine generator are described in this section.

#### *1.6.3.5 Technical Discussion of Interconnection Plan*

The proposed interconnection plan for the hydro-electric generators includes an electrical connection from the generators to each of the two supply substations to Wrights but does not include a connection to Hardwick Knitted Fabrics.

The project team expressed an interest in connecting the proposed generators to the 600 volt service of Hardwick Knitted Fabrics and the two (2) 600 volt services at Wrights to limit the export of power to the MECo distribution system. However, this feasibility study review indicates significant potential operating issues associated with this scenario and therefore the proposed interconnection plan does not include a connection to Hardwick Knitted Fabrics.

The most significant operating issue associated with connecting the proposed hydro-electric generators to both Wrights and Hardwick Knitted Fabrics is the possibility of circulating and/or load current flowing between the two electrical systems. Depending upon the relative source impedance and electrical loads between Wrights and Hardwick Knitted Fabrics, real and reactive power flows could occur between the 13.2 kV MECo electrical supply to Wrights, through the 13.2 kV – 600 volt transformer (s) and 600 volt circuit(s) to the new generation switchboard, and back to Hardwick Knitted Fabrics. This condition could increase system losses and cause thermal overloads of the supply transformers and 600 volt circuits. This connection also could cause the flow of objectionable fault current during short circuit conditions.

These conditions could be detected and mitigated by automatic detection and circuit breaker operation by protective relaying and control systems on the potentially affected circuits. In addition, Wrights and Hardwick Knitted Fabrics could develop operating protocols to manually open or close the appropriate 600 volt circuit breakers to connect only one 600 volt substation at a time to the generator to prevent objectionable circuit conditions.

Objectionable circulating currents could also flow if an electrical connection existed between the Wrights Pulaski Street Substation and the Wrights Courtyard Substation due to the differences in the 13.2 kV – 600 volt transformer impedances, different electrical loading levels between the substations at different times of the day, and the physical distance between them. Electrical load flow and short circuit analyses can be used to predict the severity of circulating current. However, for the purpose of this feasibility study, only one (1) interconnection circuits will be energized at any time.

There are two (2) 600 volt interconnection circuits shown on Figure 1-10 to interconnect the generator station to the Wrights existing electrical system. One (1) 600 volt circuit is connected to the 600 volt bus at Pulaski Street Substation and one (1) 600 volt circuit is connected to the 600 volt bus at Courtyard Substation. Each 600 volt interconnection circuit will consist of multiple three phase sets of single conductor cables installed in conduit. The 830 kW generator alternative will require three (3) sets of 500 kcmil copper conductors, insulated for 600 volt operation, and installed in Galvanized Rigid Conduits. The 600 volt interconnection circuit for the 1850 kW generator alternative will require six (6) sets of 500 kcmil copper conductors, insulated for 600 volt operation, and installed in Galvanized Rigid Conduits.

Common to both generator alternatives are 600 volt circuit breakers to terminate both ends of the interconnection circuit and a 600 volt bolted pressure switch at each Wrights substation to provide a visible open point for ensuring that the generation is disconnected from the rest of the Wrights electrical system. As noted in Section 1.6.3.1, each interconnection circuit is rated to transfer the entire generation plant output and only one of the interconnection circuits will be energized at a time to avoid objectionable circulating currents. Therefore, Wrights may decide to only install one of the two interconnection circuits.

There are two (2) 4.16 kV interconnection circuits shown on Figure 1-11 to interconnect the generator station to the Wrights existing electrical system. The generator is shown to generate at 600 volts and each 4.16 kV interconnection circuit will be connected to the generator station by a 600 volt – 4.16 kV generator step-up transformer. The 4.16 kV circuits will be connected to the 600 volt bus at Pulaski Street Substation and Courtyard Substations by 4.16 kV – 600 volt step-down transformers.

The 4.16 kV – 600 volt transformers shall be three phase units with integral 4.16 kV fuses and load break disconnect switches. The transformers will be rated consistently with each generator alternative as follows: for the 830 kW generator alternative, the transformers will be rated 1000 kVA each; for the 1850 kW generator alternative, the transformers will be rated 2500 kVA each.

Each 4.16 kV interconnection circuit will be a three phase circuit consisting of three (3) single conductor cables. Each 4.16 kV interconnection circuit for the 830 kW generator alternative will require one (1) set of 1/0 AWG copper conductors, insulated for 4.16 kV operation, and installed in a Galvanized Rigid Conduit. Each 4.16 kV interconnection circuit for the 1850 kW generator alternative will require one (1) set of 4/0 AWG copper conductors, insulated for 4.16 kV operation, and installed in Galvanized Rigid Conduit.

Common to both generator alternatives are 600 volt circuit breakers to terminate both ends of the 600 volt transformer terminals and a 600 volt bolted pressure switch at each Wrights substation to provide a visible open point for ensuring that the generation is disconnected from the rest of the Wrights electrical system. As noted in Section 1.7.2.1, each interconnection circuit is rated to transfer the entire generation plant output and only one of the interconnection circuits will be energized at a time to avoid objectionable circulating currents. Therefore, Wrights may decide to only install one of the two interconnection circuits.

#### *1.6.3.6 Cost Estimate for Electrical Interconnection*

Electrical interconnection cost estimates are provided in this Section for the two (2) generator installation alternatives associated with a new powerhouse that were contemplated for installation near Building 15 (Alternative 2 lower dam only – 830 kW generator and Alternative 3 upper and lower dam – 1,850 kW generator). Electrical interconnection cost estimates are also provided in this Section for two (2) other alternatives that were later identified and described as follows: Alternative 1 - lower dam – 265 kW generator for installation in Building 9; Alternative 4 – 830 kW generator for installation inside Building 8 or 9. The cost estimates for all four (4) Alternatives are presented in Table 1-8 to facilitate review.

**Table 1-8**

**Interconnection Cost Estimates**

| Alternative | Description | Cost |
|---|---|---|
| 1. | 830 kW Generator near Bldg. 15 | |
| a. | 600 volt interconnection/single circuit: | $230,000 |
| b. | 600 volt interconnection/double circuit: | $460,000 |
| c. | 4.16 kV interconnection/single circuit: | $200,000 |
| d. | 4.16 kV interconnection/double circuit: | $400,000 |
| | | |
| 2. | 1,850 kW Generator near Bldg. 15 | |
| a. | 600 volt interconnection/single circuit: | $440,000 |
| b. | 600 volt interconnection/double circuit: | $880,000 |
| c. | 4.16 kV interconnection/single circuit: | $285,000 |

| | | |
|---|---|---|
| d. | 4.16 kV interconnection/double circuit: | $570,000 |
| | | |
| 3. | 830 kW Generator in Bldg. 8 or Bldg. 9 | |
| a. | 600 volt interconnection/single circuit: (interconnection to Courtyard Sub. only) | $177,000 |
| | | |
| 4. | 265 kW Generator in Bldg. 9 | |
| a. | 600 volt interconnection/single circuit: (interconnection to Courtyard Sub. only) | $69,000 |

Alternatives 2 and 3 are depicted in the electrical one line diagrams in Figure 1-10and Figure 1-11of this report. Figure 1-10 depicts the 600 volt electrical interconnection plan and Figure 1-11 depicts the 4.16 kV electrical interconnection plan. The one line diagrams depict electrical interconnection circuits from the generator to both of Wrights electrical supply substations. These interconnection options are referred to as “600 volt interconnection/double circuit” and “4.16 kV interconnection/double circuit” in the following cost estimate table.

The electrical interconnection of Alternatives 2 and 3 also can be accomplished with an electrical circuit to just one of the Wrights electrical supply substations. These interconnection options are referred to as “600 volt interconnection/single circuit” and “4.16 kV interconnection/single circuit” in the following cost estimate table. Although the single circuit options offer less operating flexibility than the double circuit options, the costs for the single circuit options are considerably less expensive.

Alternative 4 is to install an 830 kW generator in either Building 8 or Building 9 and to interconnect it via a single 600 volt electrical circuit specifically to the Wrights electrical supply substation referred to as the “Courtyard Substation.” The electrical interconnection circuit route from Building 8 or 9 to the Courtyard Substation is shorter than the route from Building 15 to the Courtyard Substation. Therefore the interconnection costs for Alternative 4 is less expensive than the 600 volt interconnection/single circuit option for Alternative 2.

Alternative 1 is to install a 265 kW generator in Building 9 and to interconnect it via a single 600 volt electrical circuit to the Courtyard Substation. The electrical interconnection circuit for Alternative 1 only requires a single set of 600 volt power cables due to the 265 kW rating of this generator. Therefore, this is the least expensive interconnection alternative.

### *1.6.4 Upper Dam*

The refurbishment of the upper dam (Scenario 3) consists of restoring the site back to its original status with additional spillway area. We analyzed two potential designs for repairing the dam. The first design is to create a spillway and abutments at the site of the 40 foot breach. This spillway would utilize the existing abutment structure as a center peer and would make a large abutment at the northern side of the river. Also, it would utilize significant flashboards to further increased spillway area and decrease a repeat of the 1955 flood. This reconstruction would increase spillway area by 40 feet and make the dam significantly safer in design than the original structure built in 1908. The estimated impoundment when full would be roughly 300 feet up river towards, but not up to, another breached dam immediately above upstream.

The second potential design is to build up the northern bank's earthen embankment with excavation and then install two large concrete sill Obermeyer waste gates. In the case of high water, these gates would open and decrease the volume of water over the spillway that they would be tied into.

Either of these two repairs would utilize the existing dam structure. Repairs to the granite, especially the abutments on both sides of the river would be extensive. The spillway area itself, with elegantly cut capstones is in relatively good shape.

In order to achieve this repair to the upper dam a road would need to be constructed on the southern side of the canal closest to the mill. This road would allow permanent access to the dam for repairs and maintenance for the life of the project. For construction purposes it would be necessary to get a one-time, temporary easement over the Conrail railroad tracks in order to build the new spillway or gate structure.

Estimated cost: $250,000

**Power Canal**

The canal should be clear-cut of all debris and trees that have grown in and around it and sediments removed.

The design and existing parts of the mechanically operated wooden head gates can be reutilized. The wooden gates are easily duplicated and the racks, pinions and screw mechanisms are primarily intact. The only noticeable missing part is a hand wheel actuator that could easily be remade.

Estimated cost: $60,000

**Head Gates and Trash Racks**

Tying the penstock to the upper canal will require repairs to the granite substructure at the end of the canal nearest the mill. Trash racks will have to be installed at this point as well as an intermediate head gate or butterfly valve to allow for dewatering of the penstock without dewatering of the entire project.

Estimated cost: $70,000

**Penstock Penetration**

The penstock is a large diameter steel pipe that conveys water from the power canal to the power house. This penstock could tie into the power canal in either two ways. The old powerhouse located at the end of the power canal could be demolished. This building is an addition to a much larger building Wrights is using for material storage. If removed this would allow for a straight route alignment out into the mill yard. Another way the penstock could enter the power canal is via the 14' spillway located at the end of the canal. The drawback with this solution is that it eliminates the spillway, a necessary portion of the canal, and it is perpendicular to the ultimate penstock direction. A concrete water box would need to be placed in place of the spillway in order to accommodate this ninety-degree turn for this option.

Estimated cost: $80,000

**Penstock and Saddles**

The penstock is a significant capital cost to the entire project. The entire length of penstock from the end of the power canal to the powerhouse is 1507'. It is difficult to estimate costs associated with this penstock due to the fluctuating price of steel and the enormity of the civil works associated with securing this length 8 foot diameter reinforced pipe to the bank of the Quaboag River.

Depending where the canal penetration would be located, the penstock would enter the mill yard for some distance and then turn into the floodwall along the south shore of the river embankment. The narrow stretch of earth between the floodwall and the embankment would be utilized for as great of distance as is possible. The penstock would then remain along the floodwall until it penetrates the lower dam. After exiting the lower dam the penstock would follow the building #9 and the river bottom until it invades the mill side embankment. The Quaboag River then turns approximately 90 degrees to the south and the penstock would follow the river embankment around toward the back of the mill until it approached the catwalk/sewer pipe main bridge structure. The mill side support would be removed and replaced by the penstock and a reinforced saddle designed to bear the weight of both the bridge structure, sewer pipe and the catwalk. From this point the penstock would have a relatively straight course into the powerhouse. The penstock would have concrete and or steel saddles at appropriate intervals to carry the load of the penstock when full of water.

We believe that staging areas for excavation and concrete can be utilized throughout the penstock route. The most challenging area will be directly above and below the lower dam. If allowed to do construction in the confines of the river, during the summer months when flow is at a minimum, constructing the penstock is feasible.

We located 1700 feet of used, penstock 8 feet in diameter that could potentially be used for this project. If this penstock has the structural integrity to last the design lifetime of the project, it could significantly reduce capital costs.

Estimated cost: $800,000
Estimated cost used penstock: $550,000

**Powerhouse**

The new powerhouse will be constructed as a reinforced concrete open flume foundation with a metal butler building enclosure approximately 2500 square feet. It will be used primarily to house the turbine, generator, switchgear, actuator and computer components.

The powerhouse will be located between the old office building and the employee parking lot on the West side of South Street. The location is easily accessible to all construction equipment.

Estimated cost: $350,000

Site of Future Powerhouse beneath lower dam on east side riverbank.

**Turbine and Generator**

Turbine and generator quotes can be found in Appendix G.

**Used Equipment**

In many instances used hydroelectric equipment can be utilized for new projects. The turbine, generator and actuator must be rehabilitated before installation. Usually this equipment is not as efficient as modern, but it can come at a significantly reduced cost. For this scenario to work more time must be allowed to locate and rehab the equipment and depending on the type a 10-30% loss of efficiency can usually be expected.

Estimated cost used: $650,000

Switchgear for used equipment: $75,000

**Total Estimated Equipment Cost for Scenario 3 - Refurbishment of Upper Dam: $2,627,750**

### *1.6.5 Lower Dam*

Two scenarios were examined associated with the lower dam repowering at the Wright's mill. The first scenario, Scenario 1, is the simplest and least expensive.

**Scenario 1**

Using existing civil works at the lower dam, head gate and mill building structure for the powerhouse, initial capital costs can be kept to a minimum. The downside of this scenario is that the electricity capacity of the project declines as it utilizes less head and relies on less modern, potentially used hydroelectric equipment.

**Trash Racks**

Trash racks to keep large debris from entering the system need to be put into place before the head gates. The head gate structure can be easily modified with steel cross members to accommodate these trash racks.

Estimated cost: $25,000

**Head Gate Structure**

The lower dam is still in use by the mill for process and fire protection water. This process water is controlled by an oversized set of steel bulkhead sluice gates. These gates are side by side in a hefty retaining wall/ sluiceway that is of modern construction. The dimensions of these intakes are large enough to handle the CFS requirements of an appropriate turbine when combined. The mechanical systems of these gates appear to be in excellent working condition.

Estimated cost: $17,000

**Penstock**

A 45'long, in ground penstock, six foot in diameter, would need to be tied into the head gate structure. The process water for the mill would then be retied into the penstock. The penstock would need to take a slight turn toward the river and then enter the first floor of building #9. The Penstock will continue for approximately 55 feet at ground level inside, where it will ultimately tie into the turbine pressure chamber. Engineering must take into consideration the effects of building penetration and condensation of the indoor portion of penstock.

Estimated cost: $62,000

**Equipment Setup**

The turbine, generator, actuator and switchgear will need to be rigged into the building and permanently mounted. The largest pieces of this equipment are the pressure chamber and generator.

Estimated cost: $45,000

**Tailrace Construction**

The tailrace will need to be dredged so as to give the draft tube area to release flows back into the river. The draft tube will connect to the indoor pressure chamber and proceed to puncture the base of building #9. The draft tube will be of the elbow type and will allow for the elevation of the surge tank and turbine on the first floor. Engineering will have to consider the structural integrity of the draft tube penetration.

Estimated cost: $94,000

**Equipment**

Equipment will consist of a horizontal Francis type turbine with pressure case, a direct coupled or transmission drive synchronous or induction generator, a hydraulic actuator and switchgear. The generator and switchgear will be 600 volt. All of the above equipment may be new, used or rebuilt depending on availability.

Estimated cost: $210,000

**Total Estimated Equipment Cost Scenario 1: $604,912** (includes overhead and surplus equipment)

**Scenario 2**

The second scenario associated with the lower dam consists of additional penstock and the construction of a new powerhouse. Under this option, if the lower dam only is refurbished, in terms of penstock construction, there are larger challenges in terms of staging and erection for construction vehicles, creating trash rack and head gate infrastructure and penetration of the penstock into the existing dam.

The only way to accomplish anchoring for these structures is to continue the existing floodwall along the front of building #9 and tying it into the first twenty-five feet of the dam spillway. By building a more pronounced abutment against the building and anchoring this abutment 25 feet out onto the spillway, a head gate and trash rack area can be built into the abutment. The penstock would be submerged into the spillway and newly constructed abutment and the trash rack and head gate would be built upstream. A catwalk from the existing floodwall would allow access to this area.

**Total Estimated Equipment Cost Scenario 2: $2,029,750**

Lower Dam – Future Penstock route will run on south-side riverbank

**Fire Protection and Process Water**

Wrights currently utilizes the lower impoundment for fire protection and process related cooling water. During construction there could be a period of time that the intakes for these water intakes are above waterline. The solution for this is not addressed in this report but it is assumed that cost-effective temporary engineering water supply solutions exist.  It will be addressed if, and when the next phase of design and engineering takes place.

# 2 Economic Feasibility Analysis

## *2.1 Costs for Major Scenarios*

See Appendix G for the turbine and penstock quotes received for this project. A summary cost estimates are provided below in Table 2-1, **Error! Not a valid bookmark self-reference.** and Table 2-; They display the summary of costs for various configurations of equipment and dam implementation. As can be seen, the repair and use of the upper dam adds significant additional costs to the project.

**Table 2-1**
**Costs for 265 kW Francis Turbine at Lower Dam**

| Cost Category | Cost |
|---|---|
| Equipment costs | $210,000 |
| Trashracks | $25,000 |
| Penstock | $62,000 |
| Headgate penetration | $17,000 |
| Building 9 penetration | $38,000 |
| Equipment setup | $45,000 |
| Tailrace construction | $94,000 |
| Overhead | $49,100 |
| Contingency (15%) | $81,015 |
| Total | $621,115 |

**Table 2-3**

**Costs by Equipment Configurations**

| Project Category | New Penstock-VA Equip | New Penstock-CHC Equip | New Penstock-Used Equip | Used Penstock-VA | Used Penstock-CHC | Used Penstock-Used Equip |
|---|---|---|---|---|---|---|
| **Upper Dam - Repair Breach** | $250,000 | $250,000 | $250,000 | $250,000 | $250,000 | $250,000 |
| **Power Canal - Clear & Ready** | $60,000 | $60,000 | $60,000 | $60,000 | $60,000 | $60,000 |

| Project Category | New Penstock-VA Equip | New Penstock-CHC Equip | New Penstock-Used Equip | Used Penstock-VA | Used Penstock-CHC | Used Penstock-Used Equip |
|---|---|---|---|---|---|---|
| **Head Gates & Trash Racks** | $70,000 | $70,000 | $70,000 | $70,000 | $70,000 | $70,000 |
| **Penstock Penetration** | $80,000 | $80,000 | $80,000 | $80,000 | $80,000 | $80,000 |
| **Penstock (new)** | $800,000 | $800,000 | $800,000 | | | |
| **Penstock (used)** | | | | $550,000 | $550,000 | $550,000 |
| **Powerhouse** | $350,000 | $350,000 | $350,000 | $350,000 | $350,000 | $350,000 |
| **Equipment(VA)** | $1,703,000 | | | $1,703,000 | | |
| **Equipment (CHC)** | | $1,565,000 | | | $1,565,000 | |
| **Equipment (used)** | | | $725,000 | | | $725,000 |
| **Engineering** | $100,000 | $100,000 | $100,000 | $100,000 | $100,000 | $100,000 |
| **Project Management** | $100,000 | $100,000 | $100,000 | $100,000 | $100,000 | $100,000 |
| **Contingencies (15%)** | $526,950 | $506,250 | $380,250 | $489,450 | $468,750 | $342,750 |
| **Total** | $4,039,950 | $3,881,250 | $2,915,250 | $3,752,450 | $3,593,750 | $2,627,750 |

**Table 2-4**
**Costs by Dam Scenario Configuration**

| Dam Scenario | Permitting | Interconnection | Annual O&M | Insurance | Comment |
|---|---|---|---|---|---|
| Lower Dam Only – Francis 265 kW Turbine | $75,000 | $69,000 | $40,000* | $21,406 | *Assumes Wrights does daily maintenance. |
| Lower Dam Only | $75,000 | $200,000 | $40,000* | $21,406 | *Assumes Wrights does daily maintenance. |
| Lower and Upper Dam | $250,000 | $285,000 | $34,850* | $26,406 | *Assumes Wrights does daily maintenance |

O&M of the Wrights hydroelectric project would consist of a daily maintenance schedule as determined by the equipment manufacturer's recommendations. Some key pieces of this equipment would be the turbine system, the generator, the hydraulic actuator, the switchgear, head gates, trash racks, and any other operational equipment utilized in daily operations. Two part time employees would complete the overall operations of the site. These employees would be on-call 24 hours per day. They would respond, to any unplanned shutdowns of equipment or in case of emergency. The operations and maintenance also refers to site supplies purchased for daily operations. These site supplies usually consist of oil, grease, cleaning supplies, and office supplies etc. In Wrights case directly utilizing current employees of the textile operations significantly would reduce costs associated with O& M. Major repairs and capital improvements are not included within O&M.

The industry standard for insurance on hydroelectric dams consists of three types of insurance, liability, property, and boiler and machine. Liability usually refers to damages incurred to a third party such as incidental drowning. Property usually refers to a direct loss to the site in the form of fire, theft, or vandalism. Boiler and Machine usually refers to loss of a major mechanical component such as a turbine, generator or switchgear. In some instances B&M insurance can also carry a rider for loss of revenues associated with this loss. Flood insurance is usually difficult to acquire.

## *2.2 Benefits of Electricity Production*

There are three types of energy revenue and/or avoided costs resulting from an on-site hydroelectric project. First, and generally most valuable, is to avoid paying utility bill energy charges[5]. Second is to sell part or all of the production of a project into the wholesale market. Third is to capture revenue from selling renewable energy certificates (RECs) that are available for hydroelectric projects in some New England states, but not in Massachusetts (more on this later).

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[5] Customers that sign-up for competitive generation supply (e.g., Select Energy, Constellation Energy, Trans Canada) can get two bills one from MassElectric and one from their competitive generation supplier. For simplicity's sake we assume, regardless whether Wrights procures generation from a competitive supplier or default service, it will receive only one bill from MassElectric, and that that bill includes generation and all other charges.

The balance of this section describes these revenue streams in turn, and then describes potential environmental benefits from hydro turbine electricity production.

### *2.2.1 Benefits of Avoiding Utility Bill Charges*

An electric bill from Massachusetts Electric consists of four types of charges:

i) Customer Charges
ii) Demand (kW) Charges
iii) Energy (kWh) Charges
iv) Other (e.g., metering, interconnection study)

Customer, demand, and "other" charges all are considered purely utility "wire charges". The energy charges are a mixture of "wire" and "generation" charges. The above charges are assessed for various "services" and include:

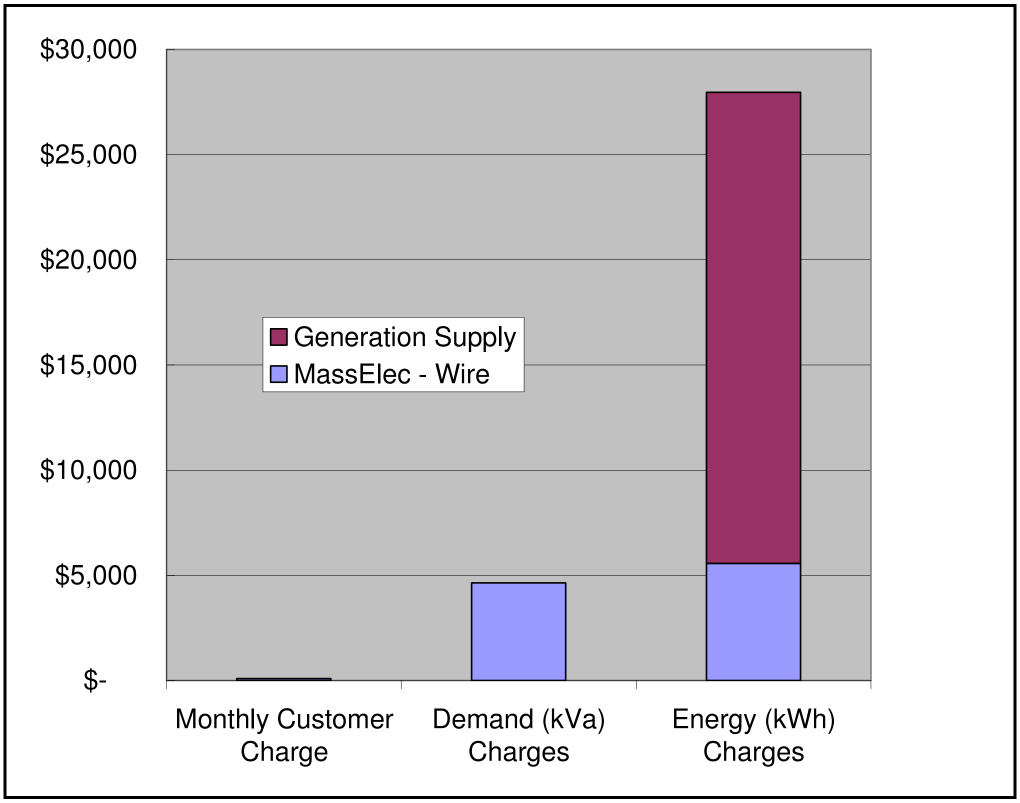
- Generation. Generation services currently can be purchased two different ways. They are:
    i. Basic Offer Service. Currently, this is the way Hardwick procures its generation. Basic Offer Service supplanted Standard Offer Service and Default Service as of March 1, 2005. and,
    ii. Competitive supply service (e.g., Constellation Energy, Select Energy, etc.); This is the way Wrights currently purchases their generation.
- Distribution;
- Transmission;
- Competitive transition (i.e., stranded costs);
- Energy efficiency; and,
- Renewable energy fund.

Unless a customer opts to totally disconnect from the grid and rely on a combination of on-site power and other sources of electricity (e.g., photovoltaics, banks of batteries, micro-turbines), they can not avoid monthly customer charges nor demand (kW) charges. It is possible for Wrights to potentially avoid some of their demand charges by lowering their monthly peak kW demand. Estimates of this benefit is very unclear without hourly production estimates for a full year.

What certainly can be avoided (in part) by the installation of a hydroelectric dam are energy charges. The amount of energy charges a customer pays on the utility bill varies by, their location, rate class and consumption patterns. Wrights and Hardwick are appropriately on Massachusetts Electric tariff class G-3 (i.e., Time-of-Use customer, for customers with over 200 kW in demand). The computation of the "wire charges" (all the charges with the exception of the generation charges) are defined in Massachusetts Electric's tariff (schedule of rates http://www.nationalgridus.com/masselectric/business/rates/4_tou.asp ). Energy charges constitute a very large share of Wrights electric bill, though the actual size will depend on a particular month's consumption size and pattern.

An analysis of Wrights August 2004 electric bill is shown in Figure 2-1. In August 2004 electricity charges totaled $32,702 for 972.9 kVA peak demand draw and 329,300 kWh energy consumption. Of the total $32,702 charge, 86%, or $27,971 were assessed on kWh consumption. If a hydroelectric facility had been in place in August 2004, then for every kWh produced it on average would have avoided 8.5 ¢/kWh ($27,971 / 329,300 kWh) in billed costs.

**Figure 2-1**
**Analysis of Charges for Wright's August 2004 Electricity Bill**




Wrights is now paying higher rates than they were in August 2004, and the avoided retail rates are approximately 9.0 ¢/kWh. This was caused by a higher portion of "wire" charges being assigned to energy consumption (kWh) rather than peak demand draw (kVa). In addition Wrights signed a contract for energy supply at 7.04 ¢/kWh for the last 10 months of 2005. This is higher than previous rates, but lower than the current average "Basic Service" rate of 7.5 ¢/kWh[6].

#### 2.2.1.1 *No Implementation of "Standby" Generation Charges*

Massachusetts Electric, unlike many utilities, does not impose "standby" generation charges on customers that install on-site generation.

### 2.2.2 *Value of Excess Generation Sold into the Wholesale Market*

When a hydroelectric facility is producing more energy than is being consumed on-site, the excess is sold to the wholesale energy market. All other things being equal, Wrights

[6] Average for variable rate service March through July 2005.

will want to size their project so at least a majority of the electricity generated is consumed on-site and not sold into the wholesale market, as retail rates are generally much higher than wholesale rates.

As seen in Table 2-2, the average hourly wholesale locational real time price for the ISO-NE West Central Massachusetts (WCMA) load Zone has generally ranged in the 4.5 ¢/kWh to 5.5 ¢/kWh[7]. The average wholesale price for the latest twelve months for which summary data are available is 5.0 ¢/kWh, which is approximately half of the cost of energy at retail that Wrights could avoid by consuming the project generation on site. Beyond entering into a bi-lateral power purchase agreement with a third party wholesale trader, the Massachusetts Electric tariff provides three relevant options to Wrights for selling excess power. They are:

- Enter a separate customized bi-lateral power purchase agreement with MECo.
- For those systems 1 MW or greater in size, receive the hourly ISO-NE spot price.
- For those systems less than 1 MW, receive the arithmetic average of the ISO-NE spot price for the previous month.

In general the average wholesale spot price will be higher than what can be negotiated for hydroelectricity production in a bi-lateral contract as there is a huge amount of deliverability risk for the wholesale trader which would be discounted significantly[8]. The balance of the financial analysis will assume that options ii or iii above, as relevant, will be implemented. This should be a reasonable assumption as any turbine will be sized so that most of its output is consumed on site. Thus any risk from low wholesale spot prices will be minimal.

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[7] Data summarized from www.iso-ne.com. In reality Wrights will not receive the WCMA ISO-NE zonal price for excess generation sold into the wholesale market, but the applicable West Warren nodal price. In practice the WCMA zonal price and West Warren nodal price will be virtually identical.

[8] It is questionable if a wholesale trader would even consider such a contract given the very small quantities of electricity (from their viewpoint) involved.

**Table 2-2**
**Recent Average Hourly ISO-NE Real Time Price**

| Quarter | Cents / kWh |
|---|---|
| Q4-2003 | 4.63 |
| Q1-2004 | 5.57 |
| Q2-2004 | 5.17 |
| Q3-2004 | 4.64 |
| Average | 5.00 |

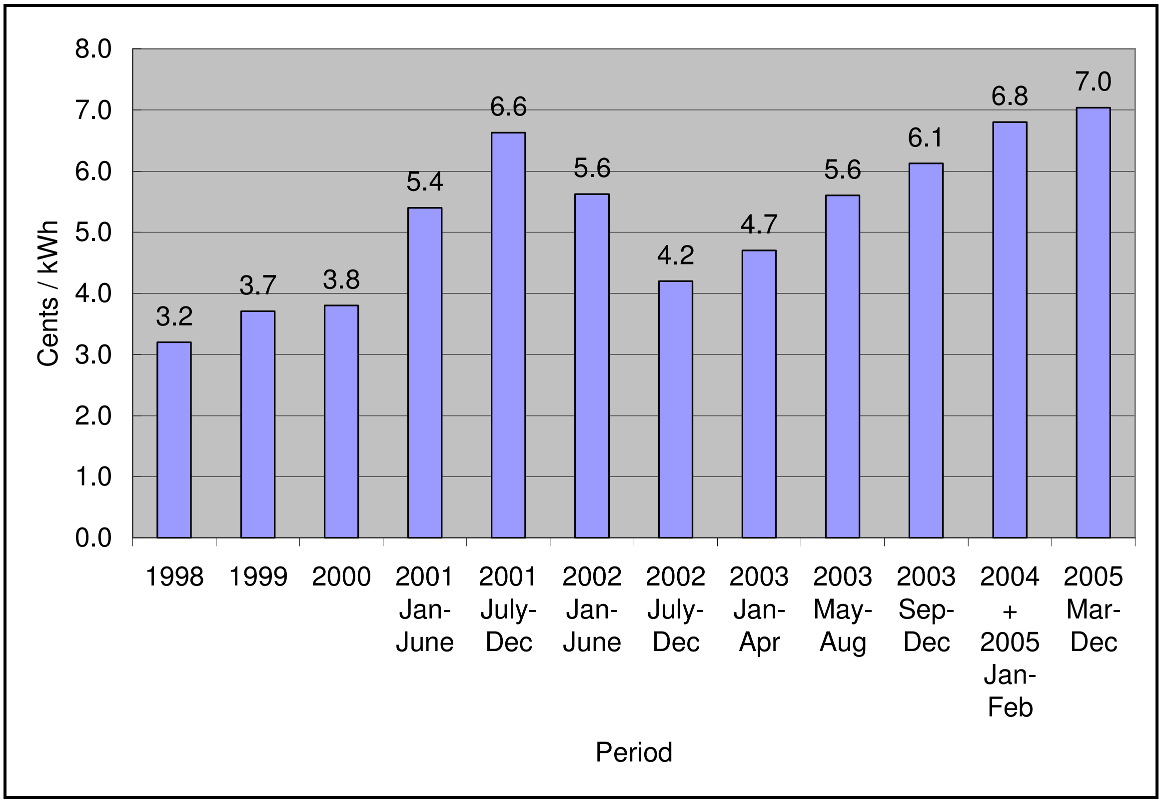
### *2.2.3 Protection from Volatile Electric Rates*

For as long as the hydroelectricity project is utilized, its fuel costs will be zero. This is in contrast to very volatile natural gas, fuel oil and electricity prices. A hydro project will provide a significant fraction of the energy consumed on-site and will dampen the risk associated with volatile fossil fuel driven energy prices, and make budgeting and forecasting of energy operating costs more certain (see Table 2-3). In 2000 Wrights was paying 3.80 ¢/kWh for the generation portion of its electric bill. For the last 10 months of 2005 the price for generation is 7.04 ¢/kWh. This change alone translates into an increase in electricity costs of $120,000 per year. A hydroelectric facility would have dampened the effect of those rate increases significantly.

**Table 2-3**
**Hydroelectric Output as Compared with Wrights' Consumption**

| Scenario | kW | Annual kWh | % Wrights' 2004 Consumption | Output that Would be Consumed On-Site: Wrights Only |
|---|---|---|---|---|
| Lower Dam Only – Francis Turbine | 265 | 983,072 | 99.5% | 100.0% |
| Lower Dam Only | 778 | 1,595,255 | 43% | 91% |
| Lower and Upper Dam | 1764 | 3,551,656 | 96% | 67% |

**Figure 2-2**
**Charges for Generation Portion of Wrights' Electricity Bill**




### *2.2.4 Renewable Energy Certificate Revenue*

An additional revenue stream for small hydroelectricity projects comes from legislative mandates to promote renewable energy sources. The potential revenue comes from the sale of Renewable Energy Certificates (RECs), or so called "green certificates". RECs are a tool created as a result of the Renewable Portfolio Standard (RPS) legislation adopted in some New England states, notably Massachusetts, Maine, Connecticut, and most recently Rhode Island. Accounting for RECs is the method to certify compliance with an RPS. The primary purpose of the RPS legislation is to create demand for new renewable electric generation sources which have significantly fewer environmental impacts than traditional fossil fuel based generation and which help diversify the domestic electricity generation mix thereby leading to greater long-term price stability.

Each state has different RPS rules. Hydroelectricity is not a RPS eligible technology in Massachusetts, but is so in Connecticut, Maine and Rhode Island. Maine's RPS rules provide eligibility for “old” hydro and other renewable fuels thus dampening the value of Maine RECs. Rhode Island’s RPS rules will not be finalized until the end of 2005. A run-of-river hydroelectricity project at Wrights would qualify for “Class I” Connecticut RECs, and thus is the focus of the balance of this subsection.

The Connecticut RPS mandates that 1% of all in-state investor owned utility service territory electric consumption come from new (post-2000) renewable resources by 2004. These levels increase over time annually to 7% in 2010.

**Table 2-7**
**Connecticut’s RPS Requirements**

| Year | Class I | Class I or II |
|---|---|---|
| 2004 | 1.00% | 3.00% |
| 2005 | 1.50% | 3.00% |
| 2006 | 2.00% | 3.00% |
| 2007 | 3.50% | 3.00% |
| 2008 | 5.00% | 3.00% |
| 2009 | 6.00% | 3.00% |
| 2010 | 7.00% | 3.00% |

The alternative compliance payment (ACP, i.e., penalty) for an electricity supplier not reaching these mandates in 2005 is $55.00 /MWh (5.5 ¢/kWh) for Connecticut served load. The ACP is adjusted for inflation. A hydroelectricity project at Wrights could be used to satisfy the Connecticut RPS[9]. It should be kept in mind that output from new wind farms, landfill gas, solar and other projects that sell their output into the ISO-NE wholesale market would create RECs that could be used to satisfy either the Massachusetts, Connecticut, or soon to be implemented Rhode Island RPS mandates.

### *2.2.4.1 REC Prices*

There is significant uncertainty in the REC markets. Rules are still in flux, additionally nearby states (New York, Pennsylvania, Rhode Island, and District of Columbia New

[9] Connecticut is the only New England state that allows out-of-state, behind-the-meter generation to be eligible for their RPS. It is not known if Rhode Island will follow suit.

York, Pennsylvania, and Rhode Island) have passed RPS legislation in the past couple of years, joining Massachusetts, Connecticut, Maine, and New Jersey. In short-term it is safe to say that RECs (1 REC = 1 MWh of attributes of output from a renewable generation source) are in high demand as can be seen in Table 2-

**Table 2-8**
**Prices for Connecticut Class I RECs[10]**

| Term | Bid Price | Offer Price | Last Price |
|---|---|---|---|
| Calendar Year 2005 | $35.00 | $37.00 | $35.00 |
| Calendar Year 2006 | $25.00 | $30.00 | $36.50 |
| Calendar Year 2007 | | $35.00 | |

### *2.2.5 Development Incentives*

All Massachusetts manufacturers are eligible for various economic incentives. These include low-interest loans, tax exempt bonds, and predevelopment assistance. See http://www.massdevelopment.com/custom/manufacturers.aspx for more details.

## *2.3 Tax Implications of Hydroelectricity Facility*

There are both tax incentives and tax costs for installation of a hydroelectric facility. This subsection describes potential tax impacts from a project.

### *2.3.1 Local Property Tax Exemption*

The Town of Warren has a property tax rate of $14.73 / $1000 assessed. The assessment will be based on a cost basis (at least for the first few years). Wrights may be able to directly or indirectly benefit (via better contract terms) from local property tax exemptions. Hydropower facilities are exempt from local property tax for a period of 20 years from the date of completion of the facility if construction commenced after January 1, 1979. To qualify for this exemption, the owner of the plant must agree to pay the host community at least 5% of the plant's gross income for the preceding calendar year in lieu of taxes. Eligible hydropower facilities include all real property relating to *hydroelectric*

[10] Evolution Express Market Report. April 6, 2005.

*power generation (land and buildings) and tangible property (turbines and other equipment ).*[11]

### *2.3.2 State Investment Tax Credit*

Wrights would qualify for a 3% state investment tax credit, see: http://www.dor.state.ma.us/help/guides/abate_amend/Corporate/issues/invcr.htm .

### *2.3.3 Depreciation of Assets*

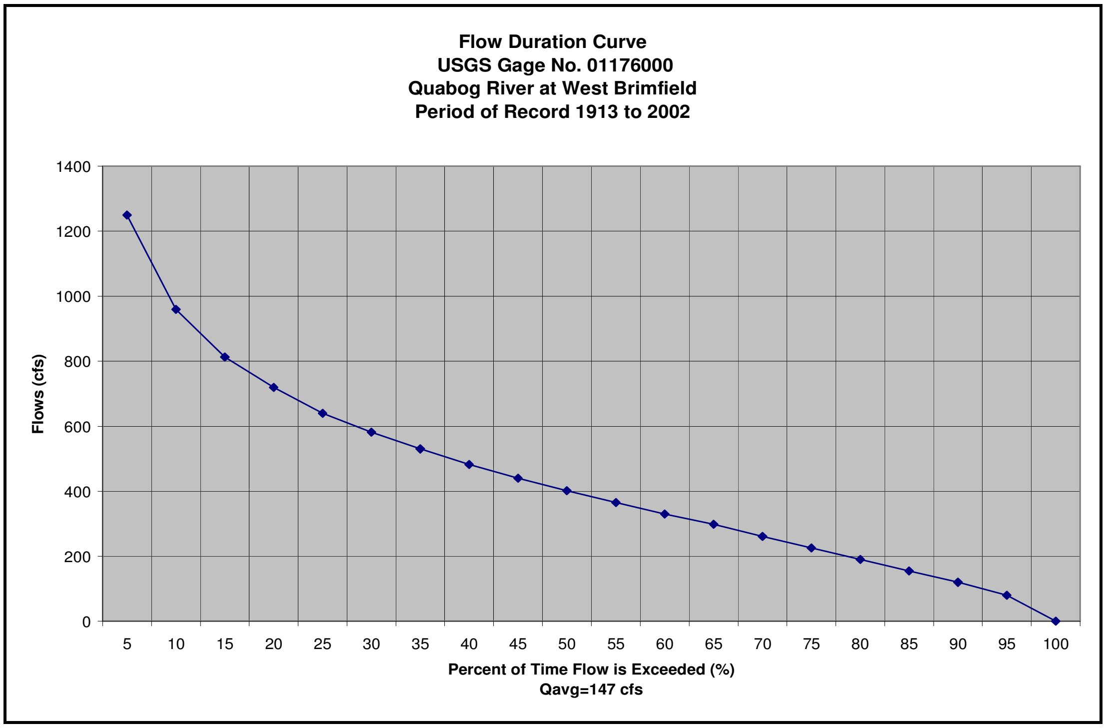
A hydroelectricity facility would be depreciated as a 15 year asset using the Modified Accelerate Cost Reduction System (MACRS). See IRS Publication 946.

## *2.4 Hydrologic Resource Assessment*

### *2.4.1 Hydrologic Data/ Flow Duration Curve*

The following chart depicts approximately 90 years of flow data collected on the Quaboag River at the West Brimfield monitoring station. From this flow duration curve, the average flow of 147 cfs is determined.

[11] http://www.mass.gov/doer/programs/renew/renew.htm#taxcred. We have asked the MA Department of Revenue to clarify the definition of "revenue". Importantly, we assume it does not include the value of avoided retail rates, but are looking for a clarification.




## *2.5 Analyze Financing / Ownership Options*

### *2.5.1 <u>Wrights' Ownership</u>*

In the case of Wrights ownership, management has noted the current cost of borrowing is in 9% range, and as such the balance of this report will use a 9% cost of capital as a base case input. The financial benefits of a hydroelectric project are, as described above, a combination of avoided utility costs and REC sales revenue. The degree of benefits are analyzed in Section 2.6 below.

### *2.5.2 <u>Third-Party Ownership</u>*

Third-party ownership also is a viable option. If a third-party owned and operated the hydro electric project, it is assumed that Wrights (and potentially Hardwick) would purchase as much of the electricity produced as possible, with the balance being sold to the wholesale market. In order to gain their own financing, the third-party would desire to enter into a long-term (e.g., 10 years) power purchase agreement with Wrights. It is assumed, the longer the agreement the less risk to the third-party, the better the price the third-party could offer. Before describing what forms a power purchase might take, it is important to note that costs that a hydro turbine would avoid on the MECo electric bill can be characterized as either 1) utility wire charges or 2) generation charges. While generation charges are more or less a function of the cost of fuel inputs (e.g., natural gas, oil, gas) the utility wire charges are set via regulation and might be viewed as more static, but set in a somewhat arbitrary fashion (see Section **2.2.1** for more detail on structure of electric bill components).

This agreement could take the following basic forms:

i) Fixed: A fixed price per kWh consumed by Wrights . This could be the same price for every year of the contract term or might be pre-set and vary year-to-year.

ii) A percent discount off of total electricity charges. For example, Wrights would pay and the third-party would receive 90% of what Wrights would have paid, if there had been no hydro generation.

iii) A pass-through of utility wire charges combined with a fixed price on generation or percent discount on generation: That is, Wrights would pay and the third-party would receive a pass-through price on all or a portion of the utility wire charges. This would be combined with a fixed or percent discount price on the generation portion of the bill.

iv) Either ii) or iii) above combined with a ceiling and/or floor on prices charged.

There are many other variations that could be concocted. As Wrights considers what contract structure is in their best interest, it should be repeated Wrights is already vulnerable to long-term electricity price volatility. Entering into a third-party contract will decrease the price volatility vulnerability and save money simultaneously.

## *2.6 Analyze Project Financials*

### ***2.6.1 Methodology for Determining Value of Electricity Generation***

The financial analysis combines project costs with project revenues to estimate the financial payback of the project. Some major facets of the hourly analysis include:

- Estimation of hourly consumption based on Wrights' 2004 historic hourly consumption patterns.

- Estimation of hourly production.  Above estimates of monthly production are evenly spread over each hour of a month.
- Hourly production up to the level of consumption is assigned as consumed in-house (avoiding purchase from MECo); hourly "over-production" is assigned as sold to wholesale ISO-NE market.
- The value of in-house consumption is determined by which MECo rate period the energy was consumed during (i.e., Peak of Off-Peak).  This value also changes by year as MECo transition charges are scheduled to decrease over time.
- The value of "over-production" for each hour is determined by the 2004 ISO-NE WCMA for the Western Central Massachusetts (WCMA) zonal price.

The amount of energy for each hour for each category is multiplied by its appropriate hourly value and then summed to compute the annual value of avoided retail consumption and the annual value of wholesale sales.

### 2.6.2 *Annual Benefits and Costs*

Beyond project design and construction costs, additional annual costs and benefits are incorporated into the analysis.  These include insurance, maintenance, interest costs, REC sales, and tax effects (local property taxes, depreciation, tax credit for capital equipment purchase, effect of interest, ongoing O&M costs, and lower cost of electricity purchase).

Revenue and costs are inflated either at a base inflation rate (e.g., 2%) a energy inflation rate (e.g., 4%) as appropriate, or not inflated as appropriate.

### 2.6.3 *Define Base Case Scenario*

**Table 2-4**
**Attributes for Financial Base Case Scenario**

| Attribute | Value | Comment |
|---|---|---|
| Electricity Consumption Patterns | Wrights Only | 3,683,478 kWh / year |
| Wholesale Market Prices | 2004 WCMA Locational Marginal Price | Based on weighted price of excess generation ~ 4.5 ¢/kWh |
| Site | | |
| Project Start Date | January 2005 | |

| Attribute | Value | Comment |
|---|---|---|
| Months to Complete | 12 | |
| General Inflation | 2% | |
| Energy Inflation | 4% | |
| Value of Avoiding Retail Generation | 7.04 ¢/kWh | Third-Party Generation Price 6.5 ¢/kWh |
| Value of Avoiding Retail Wire Charges | 1.95 ¢/kWh | First year only, changes over time |
| REC price | 3.0 ¢/kWh | Eligible for CT Class I Status |
| Loan Interest Rate | 9.0% | |
| Down Payment | 10% | |
| Loan Payback (Years) | 7 | |
| Marginal Federal Tax Rate | 34% | |
| Marginal State Tax Rate | 9.5% | |
| Depreciation Schedule | MARCS 15-Year | |
| Line Losses | 2% | |
| Grants | None | |

### ***2.6.4 Financial Results***

#### *2.6.4.1 Base Case Results*

Many of the attributes of the base case scenario are defined above in Table 2-4. In this subsection we provide a review of the financial results for the base case.

##### 2.6.4.1.1 Wrights Owned

Figure 2-3 and Figure 2-4 show the annual and aggregate cash flow for a project configuration of the upper and lower dam, used penstock and used generation equipment; the best financial results of all the equipment scenarios. What these show is that the cash flow is negative while the principal and interest for borrowing funds is being paid off. After these costs are paid-off, the project becomes cash-flow positive. The return of investment ranges from never, for the more expensive cost scenarios with no grants, to 12 years, with the most cost-efficient scenarios and 50% matching grant.

**Figure 2-3**
**Cash Flow for Wrights Ownership – No Grant**

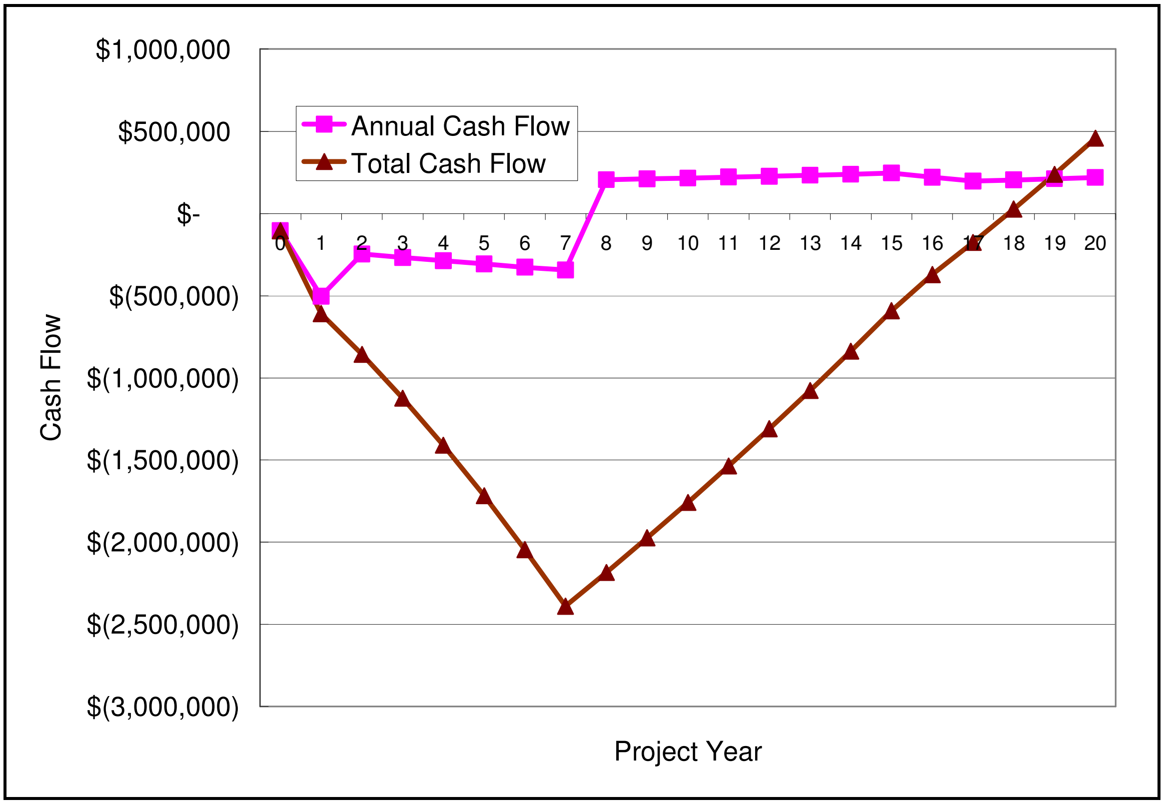


**Figure 2-4**
**Cash Flow for Wrights Ownership - 50% Grant Scenario**

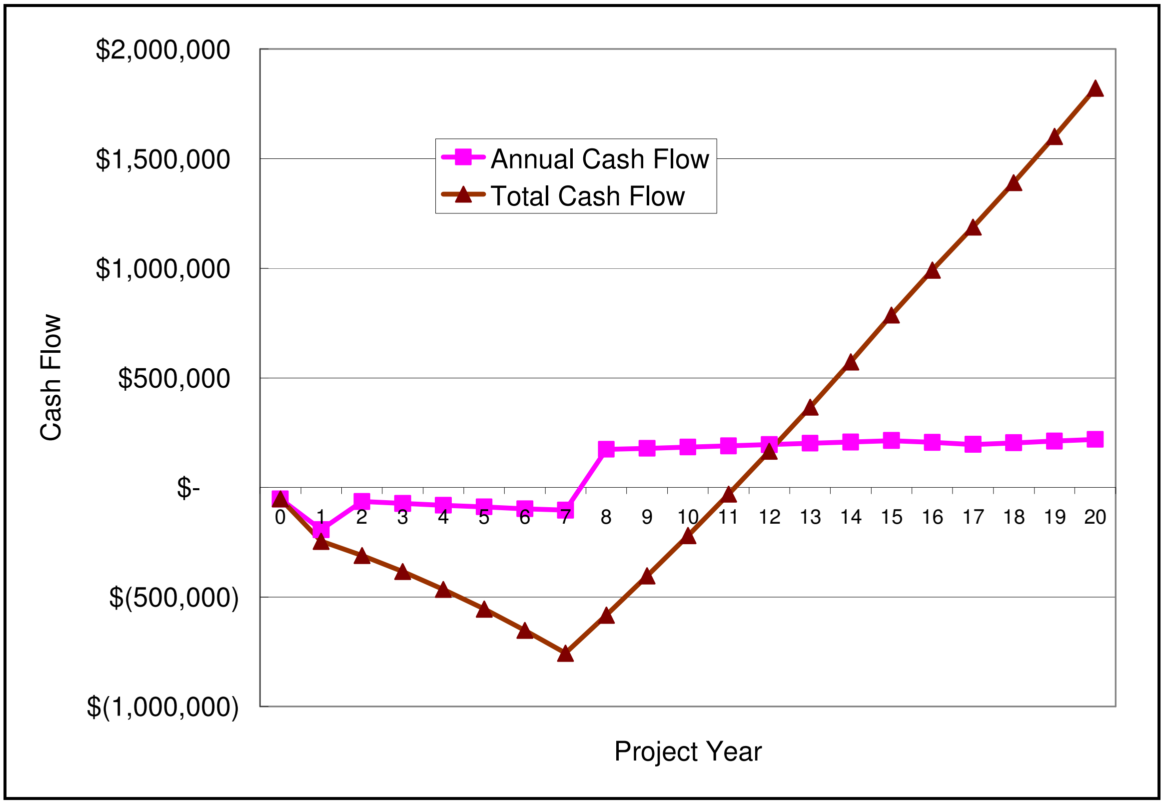



Table 2-5 provides summary financial results of the twelve project configurations without any grants, and Table 2-6 with the current maximum MTC CI$^3$ grant of $650,000. The financial results for the no grant scenarios are not viable and are driven by lower than anticipated energy capacity factors and higher costs. The results improve with a $650,000 grant but still are not compelling. Table 2-7 shows results if a 50% grant was awarded for design and construction. Twenty year returns are likely adequate, but ten year returns are probably not sufficient to justify investment.

**Table 2-5**
**Financial Results of Wrights Ownership –No Grant Scenario** [12]

| Project Configuration | IRR-10 Years | NPV-10 Years | IRR-20 Years | NPV-20 Years | Years Until Cash Flow Positive |
|---|---|---|---|---|---|
| Lower Dam Only – Francis 265 kW Turbine | n/a | $(427,449) | 0.95% | $(160,011) | 19.9 |
| Lower Dam Only-New Penstock-VA Equip | n/a | $(2,279,686) | n/a | $(1,594,648) | n/a |
| Lower Dam Only-New Penstock-CHC Equip | n/a | $(1,978,057) | n/a | $(1,318,382) | n/a |
| Lower Dam Only-New Penstock-Used Equip | n/a | $(1,672,199) | n/a | $(1,192,540) | n/a |
| Lower Dam Only-Used Penstock-VA Equip | n/a | $(2,165,259) | n/a | $(1,489,843) | n/a |
| Lower Dam Only-Used Penstock-CHC Equip | n/a | $(1,863,630) | n/a | $(1,213,577) | n/a |
| Lower Dam Only-Used Penstock-Used Equip | n/a | $(1,557,772) | n/a | $(1,087,735) | n/a |
| Upper & Lower Dam-New Penstock-VA Equip | n/a | $(2,510,337) | 0% | $(1,020,469) | 20.4 |
| Upper & Lower Dam-New Penstock-CHC Equip | n/a | $(2,384,010) | 1% | $(904,765) | 19.9 |
| Upper & Lower | n/a | $(1,877,961) | 1% | $(727,604) | 20.0 |

[12] IRR=Internal Rate of Return, NPV=Net Present Value. Unless explicitly noted elsewhere the interest rate used to compute NPV is 5.0%.

| Project Configuration | IRR-10 Years | NPV-10 Years | IRR-20 Years | NPV-20 Years | Years Until Cash Flow Positive |
|---|---|---|---|---|---|
| Dam-New Penstock-Used Equip | | | | | |
| Upper & Lower Dam-Used Penstock-VA Equip | n/a | $(2,281,483) | 1% | $(810,859) | 19.5 |
| Upper & Lower Dam-Used Penstock-CHC Equip | n/a | $(2,155,156) | 2% | $(695,155) | 19.0 |
| Upper & Lower Dam-Used Penstock-Used Equip | n/a | $(1,649,107) | 2% | $(517,995) | 18.9 |

**Table 2-6**
**Financial Results of Wrights Ownership –$650,000[13] Grant Scenario**

| Project Configuration | IRR-10 Years | NPV-10 Years | IRR-20 Years | NPV-20 Years | Years Until Cash Flow Positive |
|---|---|---|---|---|---|
| Lower Dam Only – Francis 265 kW Turbine | n/a<br>Note: project costs for this scenario projected to be $765,115. A grant over 50% of project costs is not considered feasible | n/a | n/a | n/a | n/a |
| Lower Dam Only-New Penstock-VA Equip | n/a | $(1,762,278) | n/a | $(1,120,747) | n/a |
| Lower Dam Only-New Penstock-CHC Equip | n/a | $(1,460,648) | n/a | $(844,482) | n/a |

[13] $650,000 is the maximum combined design and construction grant through the CI$^3$ program.

| Project Configuration | IRR-10 Years | NPV-10 Years | IRR-20 Years | NPV-20 Years | Years Until Cash Flow Positive |
|---|---|---|---|---|---|
| Lower Dam Only-New Penstock-Used Equip | n/a | $(1,154,791) | n/a | $(718,639) | n/a |
| Lower Dam Only-Used Penstock-VA Equip | n/a | $(1,647,851) | n/a | $(1,015,943) | n/a |
| Lower Dam Only-Used Penstock-CHC Equip | n/a | $(1,346,221) | n/a | $(739,677) | n/a |
| Lower Dam Only-Used Penstock-Used Equip | n/a | $(1,040,364) | n/a | $(613,834) | n/a |
| Upper & Lower Dam-New Penstock-VA Equip | n/a | $(1,992,928) | 2% | $(546,569) | 18.3 |
| Upper & Lower Dam-New Penstock-CHC Equip | n/a | $(1,866,601) | 3% | $(430,864) | 17.8 |
| Upper & Lower Dam-New Penstock-Used Equip | n/a | $(1,360,553) | 3% | $(253,704) | 17.3 |
| Upper & Lower Dam-Used Penstock-VA Equip | n/a | $(1,764,074) | 3% | $(336,959) | 17.3 |
| Upper & Lower Dam-Used Penstock-CHC Equip | n/a | $(1,637,747) | 4% | $(221,254) | 16.8 |
| Upper & Lower Dam-Used Penstock-Used Equip | n/a | $(1,131,699) | 5% | $(44,094) | 16.1 |

**Table 2-7**
**Financial Results of Wrights Ownership –50% Grant Scenario**

| Project Configuration | IRR-10 Years | NPV-10 Years | IRR-20 Years | NPV-20 Years | Years Until Cash Flow Positive |
|---|---|---|---|---|---|
| Lower Dam Only – Francis 265 kW Turbine | n/a | $(122,928) | 11% | $118,903 | 13.1 |
| Lower Dam Only-New Penstock-VA Equip | n/a | $(931,220) | 1% | $(359,572) | 20.0 |
| Lower Dam Only-New Penstock-CHC Equip | n/a | $(780,405) | 2% | $(221,439) | 18.5 |
| Lower Dam Only-New Penstock-Used Equip | n/a | $(697,680) | 0% | $(299,966) | 20.8 |
| Lower Dam Only-Used Penstock-VA Equip | n/a | $(874,006) | 1% | $(307,169) | 19.5 |
| Lower Dam Only-Used Penstock-CHC Equip | n/a | $(723,192) | 3% | $(169,036) | 17.9 |
| Lower Dam Only-Used Penstock-Used Equip | n/a | $(640,467) | 1% | $(247,564) | 20.0 |
| Upper & Lower Dam-New Penstock-VA Equip | n/a | $(689,476) | 10% | $647,278 | 13.0 |
| Upper & Lower Dam-New Penstock-CHC Equip | n/a | $(626,313) | 11% | $705,131 | 12.7 |
| Upper & Lower Dam-New Penstock-Used Equip | n/a | $(504,739) | 11% | $530,146 | 12.8 |
| Upper & Lower Dam-Used Penstock-VA | n/a | $(575,049) | 12% | $752,083 | 12.5 |

| Project Configuration | IRR-10 Years | NPV-10 Years | IRR-20 Years | NPV-20 Years | Years Until Cash Flow Positive |
|---|---|---|---|---|---|
| Equip | | | | | |
| Upper & Lower Dam-Used Penstock-CHC Equip | n/a | $(511,886) | 13% | $809,936 | 12.2 |
| Upper & Lower Dam-Used Penstock-Used Equip | n/a | $(390,312) | 13% | $634,951 | 12.2 |

### 2.6.4.1.2 Third Party Ownership

Given the poor financial results for the various project scenarios above for Wrights ownership, this analysis focuses on the most economic project scenario: "upper & lower dam-Used Penstock-Used Equipment" with a 50% grant scenario. Further it is assumed that a third-party owner sells Wrights generation at a fixed cost of 6.5 ¢/kWh for the project period, with no adjustments for inflation. This would be an 8% discount on the generation costs Wrights are currently paying (~$17,500 first year savings) and would almost certainly grow over time.

The financial results for a third-party owner will depend on their tax rates. If the tax rates are equivalent to those of Wrights then their financial results will be worse owing to Wrights' assumed economic advantage of lower O&M costs by utilizing in-house staff and lower property taxes[14]. Wrights' taxes will increase as a result of higher profits before taxes caused by lower energy costs; a substantial cost given Wrights' 44% marginal Federal and State tax rate[15]. The results are shown in Table 2-8 and Figure 2-5.

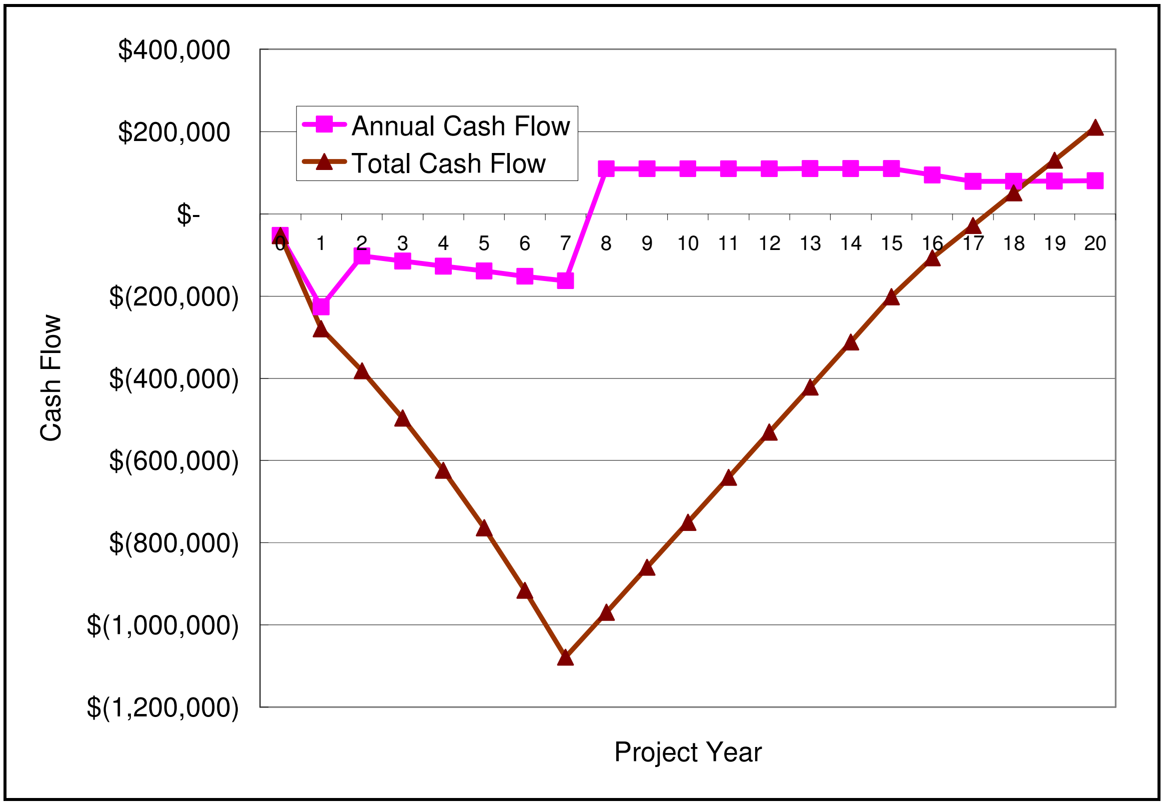
[14] Avoided generation costs under a Wrights ownership scenario is not assumed to be considered "revenue" for the computation of paying the Town of Warren 5% of revenue in lieu of local property taxes.

[15] The decrease in Wrights' energy costs, means increase in Wrights' profits before taxes, which results in more taxes paid on profits.

**Table 2-8**
**Compare Financial Results For Wrights and Third Party Owner : Upper & Lower Dam, Used Penstock, Used Equipment, 50% Grant**

| Financial Return | Wrights Ownership | Third Party Ownership |
|---|---|---|
| IRR – 20 Years | 12.7% | 1.8% |
| NPV – 20 Years | $634,951 | $(217,768) |

**Figure 2-5**
**Cash Flow for Third-Party Ownership - 50% Grant Scenario**




2.6.4.1.3 <u>Additional Analysis for Wrights.</u>

On May 23, 2005, results from a draft feasibility study for a Hydroelectric refurbishment at Wrights were presented as part of the Feasibility Study. The outcome of the meeting was to provide additional analysis for the case with a 265 kW Francis Turbine and modify the following inputs:

1. Increase the maximum feasible grant to 75% of project costs or $575,000 whichever is lower.

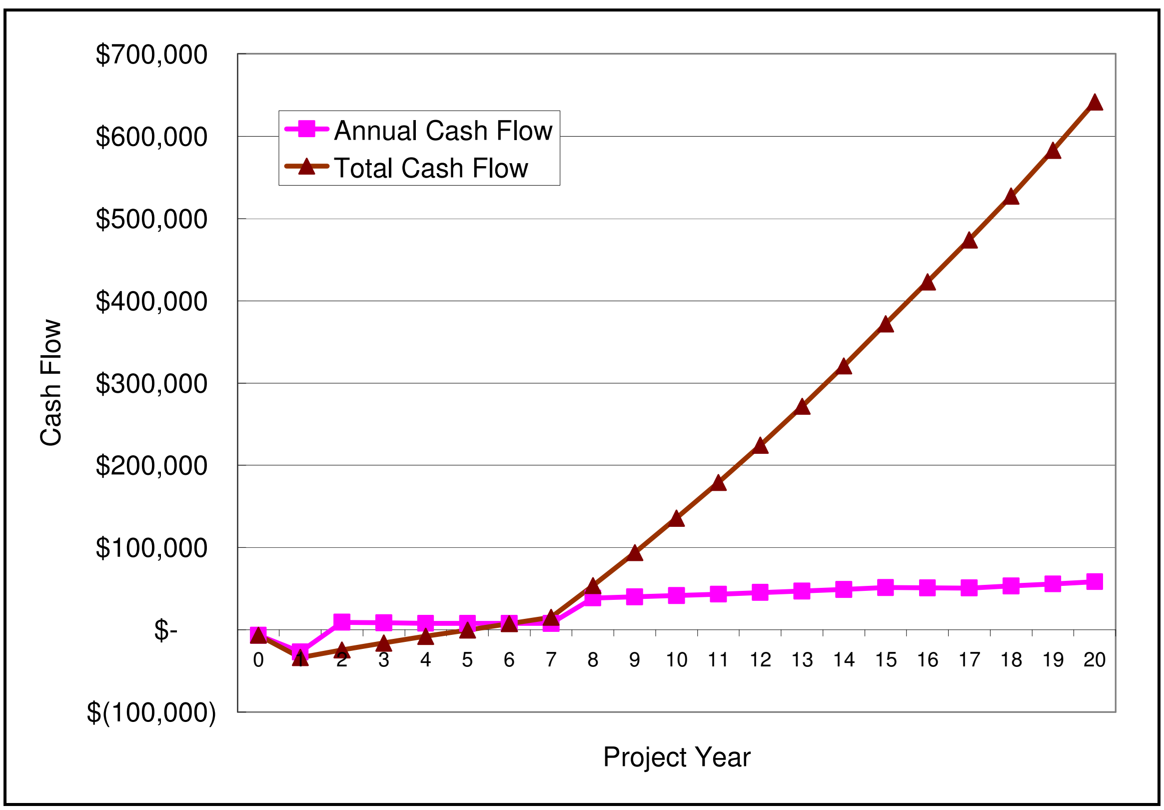
2. Change the annual O&M costs for the hydroelectric facility (net O&M on the interconnection) per estimates derived by Dave Siegel of Wrights and Luke Wright of Ware River Power. Conservative estimates result in these annual costs at $41,938.

3. Include additional borrowing costs for any year where the project is cash flow negative.

**Table 9 – Financial Results for Updated Scenario**

| IRR-10 | NPV-10 | IRR-20 | NPV-20 | Years to Cash Flow Positive |
|---|---|---|---|---|
| 31% | $56,364 | 37% | $306,450 | 6.0 |

**Figure -6**
**Financial Results for Updated Scenario**



Additional analyses can be run upon request.  For example Wrights was able to lock-in generation rates for 10 months a rate of to 7.04 ¢/kWh through December 2005 (and this is the rate used in our analysis).  Generation prices will almost certainly be higher upon contract renewal, and this will have an effect on the financial results.  An increase of generation charges to 8.00 ¢/kWh would result in a 10 year IRR of 52% and a project cash flow positive in 3.9 years.

#### *2.6.4.2 Interest Rate Sensitivity Analysis*

It is possible for Wrights to get some lower cost loans through the Massachusetts Economic Development Agency.  Table 2-10 displays the sensitivity of financial returns for a hydroelectric project.  As it turns out, financial returns are relatively insensitive to changes in interest rates.  The reason for this relative insensitivity is interest rate changes have smaller changes on cash flow than other factors.

**Table 2-10**
**Sensitivity of Returns to Interest Rate Variation for a Wrights Owned Project**

| Interest Rate | IRR-10 | NPV-10 | IRR-20 | NPV-20 | Years to Cash Flow Positive |
|---|---|---|---|---|---|
| 5.5% | -2% | $(273,041) | 15% | $752,222 | 11.4 |
| 6.0% | -3% | $(289,448) | 15% | $735,815 | 11.5 |
| 6.5% | -3% | $(305,973) | 14% | $719,290 | 11.6 |
| 7.0% | -4% | $(322,613) | 14% | $702,649 | 11.7 |
| 7.5% | -5% | $(339,369) | 14% | $685,894 | 11.8 |
| 8.0% | -5% | $(356,238) | 13% | $669,025 | 11.9 |
| 8.5% | n/a | $(373,219) | 13% | $652,044 | 12.0 |
| 9.0% | n/a | $(390,312) | 13% | $634,951 | 12.2 |

##### 2.6.4.2.1 Retail Generation Price

To review terminology, the retail generation price is the competitive portion of the Wrights' electricity bill charged on per-kWh basis.  Wrights' currently pays 7.04 ¢/kWh. There are additional energy (kWh) charges, plus demand (kVA) and customer charges on the Wrights' bill. The additional "wire" energy charges of 1.9 ¢/kWh are set per tariff, and are not negotiable.

Table 2-11 shows the sensitivity of retail generation prices under a Wrights ownership scenario. The financial returns are somewhat sensitive to retail price variation.

**Table 2-11**
**Sensitivity of Returns to Retail Generation Price Variation for a Wrights Owned Project**

| Generation Cost | IRR-10 | NPV-10 | IRR-20 | NPV-20 | Years to Cash Flow Positive |
|---|---|---|---|---|---|
| 4 ¢/kWh | n/a | $(688,131) | 5% | $6,299 | 15.8 |
| 5 ¢/kWh | n/a | $(590,164) | 8% | $213,092 | 14.3 |
| 6 ¢/kWh | n/a | $(492,197) | 10% | $419,886 | 13.2 |
| 7 ¢/kWh | n/a | $(394,230) | 13% | $626,679 | 12.2 |
| 8 ¢/kWh | -2% | $(296,264) | 15% | $833,473 | 11.4 |
| 9 ¢/kWh | 2% | $(198,297) | 18% | $1,040,266 | 10.7 |
| 10 ¢/kWh | 7% | $(100,330) | 21% | $1,247,060 | 10.1 |

## *2.7 Conclusions*

**Summary Conclusions**

- Significant state regulatory permitting requirements are triggered if the upper dam is rebuilt. These permitting processes impose a high degree of regulatory uncertainty concerning the ability to receive all the necessary approvals to repower the upper dam in a cost-effective and timely manner.
- The most financially viable scenario is for the lower dam and to refurbish it using existing infrastructure, a Francis turbine, and used equipment to the greatest extent possible. Additional analysis following review of the draft feasibility study produced an IRR-10 of 31%; NPV-10 of $56,364 and IRR-20 37% NPV $306,450 and six years to cash flow positive.
- After review of the draft feasibility study, the additional analysis and consultation with Wrights management, it is their opinion that the current predicted financials are not strong enough to warrant proceeding on the hydroelectric refurbishment project at this time due to possible restructuring of their distribution operation.

Wrights is willing to consider third party investment for this project in conjunction with a long term power purchase agreement with Wrights.

**Site Evaluation and Layout**

- The site has sufficient real estate necessary for equipment staging, upper dam repair, the construction of penstock and for a new power house.

- Additional well suited property most likely exists for the creation of new wetlands to mitigate for lost bordering wetlands from the refurbishment of the upper dam.

**Energy Use & Consumption**

- In 2004 Wrights consumed 3,683,478 kWh and Hardwick Knitted Fabrics consumed 2,695,600 kWh. Wrights electricity consumption is consistent with its operations; a one-shift operation, with significant off-shift consumption.

**Environmental Resource Assessment**

- Portions of the project site are situated in a Massachusetts Natural Heritage & Endangered Species Program designated “supporting natural landscape”. According to a Massachusetts Division of Fisheries and Wildlife Natural Heritage Program review letter relating to the project site area, threatened or endangered specie were identified.
- Over 5,000 $ft^2$ of bordering wetlands (roughly estimated to be between 1.5 and 2 acres, or around 80,000 square feet) would be flooded by the reconstruction of the upper dam triggering mandatory Environmental Impact Report (EIR) under the Massachusetts Environmental Policy Act (MEPA) (see below).

**Permitting**

- No new permits for power generation for new dams or those associated with repairs to fully breached dams have been issued through the EFSB facilitation process in at least 20 years in Massachusetts.
- Approximately 40 permits were issued through the EFSB facilitation process for dam refurbishment and approximately half of these were constructed during the past 20 years.

- Lengthy permitting processes exist for all options including: FERC exemption (3 – 4 years), MEPA review, and EFSB process. MEPA EIR would be triggered with upper dam refurbishment; it would not be triggered if only the lower dam was repowered.
- Significant permitting process cost and uncertainty exists for the breached upper dam refurbishment option, especially in terms of its wetland impact. Obtaining wetland permit approvals would require additional research and scoping during the design phase
    - The capital costs of wetland delineation, mitigation design and construction, and permitting may be prohibitive (estimated to be ~$250,000).
    - Wetlands can be replicated on Wrights property to replace bordering wetlands most likely at a minimum replacement ratio of 2:1 that would be flooded if the upper dam is reconstructed. However, high-valued bordering wetlands are difficult to replicate and additional acreage may be required for mitigation.
    - The construction of the penstock, and power house is not expected to impact wetlands but will affect riverbank.
    - The construction of the service road for the upper dam would most likely impact additional areas of wetland.
- Threatened and endangered specie review indicated the project exists within the habitat of three state-protected species. The presence of these species will require an additional state permit approval, a Conservation and Management Permit.
- There are existing regulatory initiatives in Massachusetts for the removal of dams versus their refurbishment or construction. These types of programs create additional institutional barriers for hydro power development or refurbishment in the Commonwealth.
- Massachusetts Fisheries and Wildlife's programs to protect and promote anadromous fish trigger the installation of eel ladders at both upper and lower dams. This requirement is independent of the fact that there are no migrating eels in the Quaboag but their need would be argued as necessary in case dams located downstream of Wrights were removed or eel passages were installed in the future on existing downstream dams.

**Engineering and Interconnection Requirements**

- The physical lower dam and power canal infrastructure can support refurbishment.
- Existing utilities and water uses can be maintained for Wrights and Hardwick Knitted Fabrics.
- The proposed hydroelectric generator may be interconnected to the Wrights existing 600 volt electrical system by multiple sets of 600 volt cables or by one (1) 4.16 kV, three phase, interconnection circuit.
- Interconnection paths for the proposed hydro-electric generator can be established to one or both of the Wrights existing 600 volt supply substations;
- Interlocking circuitry and protective relays should be installed to prevent both circuits from being connected to the generator at any one time.
- The simultaneous interconnection of the proposed hydroelectric generator to both Wrights and Hardwick Knitted Fabrics could cause real and reactive power flows between their respective electrical systems. Therefore, an interconnection circuit to Hardwick Knitted Fabrics is not recommended for consideration at this time.
- The lowest cost electrical interconnection alternative is a single 600 kV interconnection circuit from the hydro-electric generator station to Wrights Courtyard substations associated with installing the 265kW generator in Building 9.

**Economic Feasibility Analysis**

- If a hydroelectric facility were in place today, then for every kWh produced it on average would avoid 9.0 ¢/kWh in billed costs (approximately as large as $30,000 per month or 90% of Wrights monthly bill).
- In addition Wrights could earn 3.0 ¢/kWh or more selling renewable energy certificates from a run-of-river hydroelectric project.
- Project costs ranged from $0.8 million to $4.5 million installed.
- Paybacks for the no grant scenarios and the $650,000 grant scenarios were very long (over 15 years).
- Scenarios of economic payback were run assuming no grants, $650,000 grants, and 50% project costs scenarios. A summary of results follows.

**Table 2-12**
**Twenty Year Internal Rate of Return for Various Scenarios**

| Scenario | No Grant | $650,000 Grant | 50% Grant |
|---|---|---|---|
| Scenario #1 | n/a | n/a | 11% |
| Scenario #2 | n/a | n/a | 1% |
| Scenario #3 | n/a | 5% | 13% |

## 2.8 Next Steps

- Meet with MTC regarding possibility of increasing design and construction grant via the unsolicited bid process.
- Further investigate used hydroelectric and interconnection equipment to lower the capital costs.
- Investigate the feasibility of innovative run-of-river electric generation technology, such as the helical turbine or NatEl's fish friendly system.

# A Appendix A - Abutters List

**Table 2-13**
**Wrights Parcels and Abutters**

| Parcel | Acres | Description | Abutters |
|---|---|---|---|
| A | 6.21 | Downstream of site – check if donated to town | Berthaume - N<br>Bouchard- N<br>Baron- N<br>Czapla- N<br>Arsenault - N<br>Town of Warren Fire Station- N<br>Nurek-N<br>Wozniak -N<br>Kuchta -N<br>Trzepacz- NW<br>McWhirter- NW<br>Witaszek - NW<br>Conrail -S |
| B | 9.21 | Downstream of site check if donated to town | Conrail |
| C | 65.60 | Main mill site | Conrail Easement to North<br>Misiaszek - S<br>Hardwick Knitters - W<br>Zabeek -S<br>Sekula -S<br>Baldyga- W<br>Morin - W |
| D | 10.8 | South of site; brook on western border | Guzik (nearest)<br>Korzec Misiaszek<br>Bagiga<br>Lavallee |
| E | 11.06 | South of site; bisected by brook | Zwirecki<br>Hollyer<br>Sidur |
| F | 0.97 | Not contiguous with site – off of Fairbanks Rd | N/A |
| G | 1.43 | N side of Conrail tracks between Conrail and Rte 67 | N/A |
| H | 8.72 | Eastern boundary on the Quaboag – Zoned Rural | Hershey<br>Lizak Bus Service<br>Hoffey<br>Conrail |
| TOTAL | 114 | | |

# B Appendix B – U.S. Army Corps of Engineers Hazard Potential

# C Appendix C – Draft Stakeholder List

# D Appendix D- Energy Facility Siting Board Process

**Overview**

In accordance with the statute and regulations, the EFSB does the following:

(1) establishes preliminary notification forms and other forms to be employed for permitting and licensing;
(2) conducts pre-licensing conferences between developers and permitting and licensing agencies jointly with the Secretary of Environmental Affairs;
(3) assists in resolving disputes between developers and agencies concerning the form, content, level of data, and schedules of information and data requirements;
(4) increases the cooperation between the state and federal licensing agencies; and
(5) serves as a forum for final administrative appeal for any party aggrieved by a permitting and licensing agency's action or failure to act.

Unless a party files a final administrative appeal, the Siting Board's sole function is to coordinate the permitting and licensing of hydropower projects that are less than 100 megawatts such as Wrights;; it does not review and issue an approval for such projects.

Coordination of Permitting and Licensing When an ENF is Being Filed

Under the EFSB regulations a coordination procedure exists for the permitting and licensing when an ENF is required and Wrights will require an ENF. The form to be completed and submitted to the EFSB and agencies is the ENF-Hydropower Supplement. The coordination procedure is outlined below.

- Review of Draft Notification Form. Before filing with the permitting and licensing agencies, Wrights must submit a draft version of the combined ENF-Hydropower Supplement to the Siting Board. The EFSB will make a determination in writing, not later than 10 days after receiving the form, whether or not it is complete.

- Filing. Wrights must file the ENF-Hydropower Supplement with the Siting Board and the list of agencies contained in the form. The filing must be made no later than 60 days after official notice in the Federal Register that Wrights has filed for a license or exemption with FERC. Wrights may request an extension of this filing upon a showing of good cause. The filing does not effect the requirement to publish a notice of intent to submit an ENF within thirty (30) days before filing the ENF.

- Effect of Filing. The receipt of the ENF-Hydropower Supplement by the agencies will trigger the MEPA review process and the review process of all agencies.

- Pre-Licensing Conference. The Siting Board will set a date for the pre-licensing conference within 40 days after the EFSB receives an ENF-Hydropower Supplement, or within 30 days after publication in the Environmental Monitor of the notice to intent to submit an ENF, whichever is sooner. The pre-licensing conference may be held in conjunction with the MEPA Unit's scoping session and may be held at or near the project site. The EFSB will notify or direct Wrights to notify all agencies, federal regulatory agencies, providers of financial assistance, the electric utility in whose service territory the proposed facility is located, and other interested persons or parties of the time, date and place of the pre-licensing conference. A Siting Board designee and a designee of the Executive Office of Environmental Affairs will chair the pre-licensing conference. Matters for discussion will include Wrights' proposal and the responses of the agencies and other participants. The agencies may be asked to comment upon: (1) their jurisdiction over the project; (2) their particular concerns regarding the project; (3) what additional information, data, and studies they will need; and (4) what additional forms or applications Wrights will be required to fill out.

- Statement of Agency Requirements. Within 15 days after the pre-licensing conference, each agency notified of the pre-licensing conference will mail or deliver a statement to Wrights, with a copy sent to the Siting Board on the same day. The statement will specify: (1) the extent of the agency's jurisdiction over the project as proposed; (2) the agency's particular concerns regarding the project; (3) what additional information, data or studies the agency will need in order to make a permitting or licensing decision; (4) what additional forms or applications developers will be required to fill out; and (5) that the agency's specifications (1-4 above) are complete and accurate.

- Determination of Filing Adequacy. Once Wrights has filed the information, data, studies, forms and applications asked for by an agency, they will mail a letter to that agency, with a copy sent to the Siting Board, stating Wrights opinion that it has filed all materials necessary for that agency to make a final decision. Within 15 days after receipt of the letter from, an agency will mail a responding letter, with a copy sent to the Siting Board on the same day, stating either: (1) that the materials filed are sufficient for the agency to make a final decision; or (2) what additional materials are still needed. If the agency requests additional materials. Wrights should file the additional requested materials. If the agency does not respond within seven days after this filing, the filing will be presumed complete.

- Information Deadlock. If Wrights believes that an agency is unreasonable in requiring additional information, data, or studies, it may withhold the required materials and request a permit or license denial. The denial will be provided within seven days by the agency. This denial may be then be appealed to the Siting Board, after exhaustion of administrative remedies at the denying agency, as an "action or failure to act."

- Project Alterations. If substantial changes or modifications in the design or operational plans of Wrights' project after the pre-licensing conference, Wrights must send a description of the changes or modifications to each agency notified of the pre-licensing conference, and to the Siting Board. If an agency finds the changes or modifications significant, it may send Wrights an amended Statement of Agency Requirements. If an amended Statement is not sent within fifteen (15) days after receipt of the notice of change or modification, Wrights and Siting Board may assume that they will not affect that agency's requirements or final decision.

- Informal Dispute Resolution.  Upon request of Wrights or an agency, the Siting Board will make reasonable efforts to assist them in resolving disputes concerning the form, content, level of detail and schedules of agency requirements.

- Time Limits for Agency Decisions.  Once the Siting Board determines, based on the informal or written communications between Wrights and agencies, that no agency requires any further materials from Wrights to make a final decision, the Siitng Board will set a single time limit of not greater than ninety (90) days within which all agencies must issue their final determinations whether or not to issue the appropriate licenses, certificates, sign-offs, or other evidence of approval of the application.

- Effect of Environmental Impact Report Upon Time Limits.  If Wrights is required to file an Environmental Impact Report (EIR), the Siting Board may alter the time framework of the coordination procedure contained in 980 CMR 11.00.  If the upper dam is developed, a mandatory EIR is required so therefore, the Siting Board may decide to alter the timeframe for the coordination procedure.

# E Appendix E – MEPA Review Thresholds

**Review Thresholds**

In accordance with 301 CMR 11.01(2)(b) and 11.03, MEPA review is required when one or more review thresholds are met or exceeded and the subject matter of at least one review threshold is within MEPA jurisdiction. A review threshold that is met or exceeded specifies whether MEPA review will consist of an ENF and a mandatory EIR, or of an ENF and other MEPA review if the Secretary of Environmental Affairs so requires. The subject matter of a review threshold is within MEPA jurisdiction when there is broad, or full-scope, jurisdiction, or when the subject matter of the review threshold is conceptually or physically related to the subject matter of one or more permits or the area subject to a land transfer.

Pursuant to Section 11.03, the review thresholds do not apply to a lawfully existing structure, facility, or activity. While the dams and the Wrights mill complex are existing structures, the generation of hydropower at the mill is not an existing activity. Most likely, the installation of hydroelectric generating turbines at the mill site to generate electricity would be considered a "new" activity. Section 11.02 of the MEPA regulations defines "new" as "any work or activity that is not: (a) existing; (b) being carried out currently as part of, used by, or generated by a previous, actual or permitted use of the project site; or (c) being carried out within three years since the latter of discontinuance of the previous use or issuance of the relevant permit."

The review thresholds contained in Section 11.03 pertain to twelve topic areas. Of these, only the wetlands, waterways and tidelands review threshold may apply to the project because of the potential wetland impacts.

The potentially applicable wetlands, waterways and tidelands review threshold in Section 11:03(3) are identified below:

(3) Wetlands, Waterways and Tidelands

(a) ENF and Mandatory EIR

1. Provided that a Permit is required:

a. alteration of one or more acres of salt marsh or bordering vegetating wetlands; or

b. alteration of ten or more acres of any other wetlands.

2. Alteration requiring a variance in accordance with the Wetlands Protection Act.

3. Construction of a New dam.

4. Structural alteration of an existing dam that causes an Expansion of 30% or any decrease in impoundment Capacity.

ENF and Other MEPA Review if the Secretary So Requires

1. Provided that a Permit is required:

b. alteration of 500 or more linear feet of bank along a fish run or inland bank;

d. **alteration of 5,000 or more sf of bordering or isolated vegetated wetlands;**

e. New fill or structure or Expansion of existing fill or structure, except a pile-supported structure, in a velocity zone or regulatory floodway; or

f. alteration of 1/2 or more acres of any other wetlands.

3. Dredging of 10,000 or more cy of material.

4. Disposal of 10,000 or more cy of dredged material, unless at a designated in-water disposal site.

6. Construction, reconstruction or Expansion of an existing solid fill structure of 1,000 or more sf base area or of a pile-supported or bottom-anchored structure of 2,000 or more sf base area, except a seasonal, pile-held or bottom-anchored float, provided the structure occupies flowed tidelands or other waterways.

Whether these review thresholds applies and if they do, to what extent, will depend on the ultimate definition of the project and conclusion on the project's wetland impacts. If a mandatory EIR is required, which is highly likely for the upper dam refurbishment, the project can seek a waiver of the mandatory EIR requirement pursuant to 301 CMR 11.11. As set forth in 310 CMR 11.11(3), in the case of a mandatory EIR review threshold, the Secretary will at a minimum base the finding on waiver on a determination that (1) the project is likely to cause no damage to the environment, and (2) ample and unconstrained infrastructure facilities and services exist to support the project..

# F Appendix F – Threatened and Endangered Specie Response + Guidelines for Submitting a Conservation Permit Application

# G Appendix G – Turbine Quotations