

APPENDIX A

Preliminary Dam Inspection Report

Hydropower Feasibility Study
City of East Providence, Rhode Island

PRELIMINARY INSPECTION
OF
TURNER, HUNT'S MILL, & OMEGA
DAMS

DRAFT

The Essex Partnership LLC
Newport, Rhode Island

November 2010



Hydropower Feasibility Study
City of East Providence, Rhode Island

Preliminary Inspection
of
Turner, Hunt's Mill, and Omega
Dams

Prepared for:

The Essex Partnership LLC
Newport, Rhode Island

Prepared by:

MBP Consulting
Portland, Maine

DRAFT

November 2010

TABLE OF CONTENTS

Section	Page
1.0 Summary	1
2.0 Introduction.....	2
3.0 Dam Description.....	3
3.1 Turner Reservoir Dam.....	3
3.2 Hunt’s Mill Dam	4
3.3 Omega Pond Dam	5
4.0 Inspection	6
4.1 Turner Reservoir Dam.....	6
4.2 Hunt’s Mill Dam	8
4.3 Omega Pond Dam	9
5.0 Conclusions and Discussions	10
5.1 Turner Reservoir Dam.....	10
5.2 Hunt’s Mill Dam	11
5.3 Omega Pond Dam	12
6.0 Recommendations	13
6.1 Turner Reservoir Dam.....	13
6.2 Hunt’s Mill Dam	13
6.3 Omega Pond Dam	14
7.0 Opinion of Probable Cost of Remedial Measures.....	15
7.1 Turner Reservoir Dam.....	15
7.2 Hunt’s Mill Dam	15
7.3 Omega Pond Dam	15
8.0 Comparison of RIDEM and FERC Dam Safety Regulations.....	16
9.0 References.....	17
Appendices	
Appendix A: Inspection Photographs.....	18

1.0 SUMMARY

A preliminary inspection of Turner Reservoir, Hunt's Mill, and Omega Pond dams, all located on the Ten Mile River, Rhode Island, was performed on October 13, 2010. The purpose of the inspection was to evaluate their condition in relation to potential hydropower development and public safety. The inspection was conducted by MBP Consulting (MBP), Portland, Maine acting as a subcontractor to The Essex Partnership LLC (Essex), Newport, Rhode Island. The inspected dams are small to intermediate size, run-of-river structures. Two dams, Hunt's Mill and Omega Pond, are classified by the State of Rhode Island (State) as low hazard potential facilities¹ and Turner Dam is rated as high hazard potential structure².

Visual inspection of the dams was performed with the spillways in an overflow condition, except the Turner Dam which was in non-overflow condition. Flow over the spillways limited the assessment of the Hunt's Mill and Omega Pond facilities. The preliminary results indicate that all inspected dams are structurally sound and in fair condition. There were no apparent conditions that would preclude them from hydropower development. No adverse conditions were observed that require immediate remedial actions.

The Turner Reservoir Dam is classified by the State as a high hazard potential structure and would therefore be subject to compliance with Part 12 of the Federal Power Act (Dam safety) if it was to be redeveloped for hydropower under a Federal Energy Regulatory Commission (FERC) license. More detailed analyses and studies would have to be performed to determine if additional remedial measures would be required to meet FERC safety criteria. The Hunt's Mill and Omega Pond Dams are classified as low hazard structures by the State.

Based on the inspection findings, major recommendations related to public safety include restoration of the manholes to monitor condition of the drainage system of the left embankment of the Turner Reservoir Dam and repair of the leaking headrace entrance closure wall and deteriorated upstream wall of the Hunt's Mill Dam.

Typical recommendations related to operation and maintenance of the inspected dams include; brush and tree removal, repair of deteriorated concrete surfaces, and repointing of stone masonry structures.

It is also recommended that the Hunt's Mill and Omega Pond Dams be inspected during a low flow period to observe the exposed water retaining structures for signs of deterioration, seepage, undermining, and structural distress. This inspection should be supplemented by an underwater and/or bathymetric survey of the submerged areas of dams, as required. Installation of fish passage facilities is currently underway of planned for each dam. This work will require dewatering portions of the project areas and presents an opportunity for more detailed inspection and survey prior to and during construction work. Following the above-water and underwater inspection findings, additional remedial measures should be developed, as necessary.

¹ Failure of dams with low hazard potential classification can result in no probable loss of human life and low economic and /or environmental losses (Reference 1).

² Failure of dams with high hazard potential classification can probably result in loss of human life (Reference 1).

This report includes an opinion of probable cost for recommended remedial measures (Section 7) and comparison of dam safety regulations adopted by the Rhode Island Department of Environmental Management (RIDEM) and FERC (Section 8).

2.0 INTRODUCTION

A visual inspection of Turner Reservoir, Hunt's Mill, and Omega Pond dams, all located on the Ten Mile River, a tributary of the Seekonk River, in the City of East Providence, Providence County, Rhode Island was conducted by MBP on October 13, 2010. The purpose of the inspection was to identify existing or potential deficiencies in water retaining structures which could adversely impact their operation, integrity, and public safety and/or complicate the development of hydropower. The inspection was performed as a part of a hydropower feasibility study undertaken by Essex and the City of East Providence (City), RI, the owner and operator of the dams.

As part of this assessment MBP also reviewed available documentation on each dam, including previous dam inspection reports, photographic records, engineering assessments and drawings, and fish passage restoration plans. Interviews with the representatives from the City were conducted to gain additional information on each site and understand current operations and maintenance practices.

3.0 DAM DESCRIPTIONS

3.1 Turner Reservoir Dam

The James V. Turner Reservoir Dam (State No. 407, National No. RI01002), is the most upstream dam of the inspected projects. The 1,550 foot-long dam consists of a left³ embankment, spillway, low level outlet, and right (west) dike (References 2, 4-10). The dam supports an impoundment with a maximum reservoir storage and surface area of 3,100 acre-feet and 390 acres, respectively. Historically the impoundment was used for public water supply. According to State records use of the reservoir as a water supply source was abandoned circa 1970 due to water quality concerns. The impoundment is currently served to provide recreational opportunities. Efforts to restore upstream fish passage on the river will expand its use to provide spawning and rearing habitat for anadromous fishes (river herring and shad). The dam is classified by the State as an intermediate size structure with high hazard potential.

The left earthen embankment spans the original river streambed, and is 525 feet long, 22 feet above the original streambed grade and 15 feet wide at the top. Upstream and downstream slopes are 3H:1V (horizontal to vertical) and 4H:1V, respectively. The top of the embankment is at el. 51.0⁴. The upstream slope is armored with 3 foot-thick riprap and the top and downstream slope are grassed. Embankment seepage control is provided by a corewall and drainage blanket installed in 1984. According to engineering drawings there is a concrete corewall with the top el. 48± is 3 feet below the top of the embankment and contains a steel sheet pile cutoff at the base extending to underlying bedrock. A 6-inch diameter perforated drain runs along the concrete corewall footing and discharges through an outlet in the downstream end of the left concrete retaining wall. A manhole on the top of the embankment provides access to the drain pipe. A 300 foot-long, 1 foot-thick gravel drainage blanket is located at the toe of the embankment and extends from the left abutment toward the spillway. The blanket contains two 6-inch diameter seepage collection pipes with the outlets in stone gabion walls at the toe of the blanket. There is a 16-inch diameter storm drain within the embankment discharging in the middle of the left retaining wall. Manholes at the toe of the embankment provide access to the blanket and stormwater drains.

The concrete overflow spillway is 200 feet long with a rounded crest at elevation 46.0 and a maximum freeboard of 5 feet. The toe of the spillway is protected with a 30-35 foot-wide concrete stilling basin and a 50 foot-wide stone apron located immediately downstream of the stilling basin. The left concrete retaining wall between the spillway and left embankment extends about 100 feet downstream. The spillway is likely founded on sedimentary type bedrock.

The 25 foot-long concrete low level outlet abuts the right end of the spillway. The structure contains two 54-inch diameter conduits and a 66-inch diameter penstock intake. The invert of the conduits and intake are at el. 29.5 and el. 32.25, respectively. The penstock is buried into the

³ The terms "left" and "right" refer to an orientation looking in the downstream direction.

⁴ All elevations in the report taken from the previous inspection reports, unless otherwise noted, are in feet and refer to the National Geodetic Vertical Datum (NGVD).

ground and runs approximately 2,400 feet along the right river bank toward the Hunt's Mill Dam downstream. In the past, the penstock was used for water supply and was abandoned in 1970. A brick gatehouse on the top of the outlet structure contains three manual operators to adjust the position of slide gates for the conduits and penstock. The right concrete retaining wall, curved in plan, extends about 100 feet downstream from the outlet structure.

The right earthen dike is 750 feet long, 6 feet high, and 15 feet wide at the top which is at el. 51.0. The 3H:1V upstream slope of the dike is covered with riprap. The dike top and 2H:1V downstream slope are grass protected.

The reservoir banks also include a west berm and east earthen dikes 1 and 2 to contain the impoundment during high water. The east dikes are 2 feet high, 15 feet wide at the top, and 550 feet long (dike 1) and 350 feet long (dike 2). These features were not observed as part of the inspection.

The dam drainage area is 48 square miles. For a high hazard structure the project spillway design flood (SDF) is equal to one half of the probable maximum flood ($\frac{1}{2}$ PMF). Phase II analysis (Citation__) calculated the $\frac{1}{2}$ PMF outflow to be 16,828 cubic feet per second (cfs) resulting in overtopping of the earthen dam structures by 1.2 feet under current condition and by 1.65 feet with the proposed fishway (References 6, 10). The combined hydraulic capacity of the existing spillway and outlet works is 9,316 cfs or 55 percent of the $\frac{1}{2}$ PMF. The existing spillway capacity with both outlet gates closed or inoperable is 8,750 cfs or 52 percent of the $\frac{1}{2}$ PMF. Installation of the fishway will reduce the spillway and low level outlet capacity to 9,022 cfs or 54 percent of the $\frac{1}{2}$ PMF.

The dam was built in 1934 and repaired in 1984-1990. The rehabilitation activities included installation of a drainage blanket at the toe of the left embankment (1984), resurfacing of the spillway, outlet works, and retaining walls (1989), placement of stone riprap on the upstream slope of the right dike and stone gabions at the toe of the right retaining wall to control scour (1990). Construction of a denil fish ladder on the left side of the spillway, designed by the US Army Corps of Engineers (USACE), is scheduled for the fall of 2010.

The dam was previously inspected by the USACE in 1981, New England Engineering in 1982, RIDEM in 1989, 1999, 2001, 2004 and 2007, City in 2004, and Pare Corporation in 2007. The most recent inspection reports (2007) found the dam to be in good to fair condition.

3.2 Hunt's Mill Dam

The Hunt's Mill Dam (State No. 405, National No. RI02601), is located on the Ten Mile River approximately 2,600 feet downstream of the Turner Reservoir Dam. The 175 foot-long dam consists of an overflow spillway and a closure wall at an abandoned headrace entrance. The appurtenant facilities, all abandoned, include a penstock, headrace, pumphouse, and a 100 foot-long tailrace (References 2, 11-14). There is also a pond retaining wall upstream of the intake closure wall at the City's park area. The dam with impoundment storage of 140 acre-feet and surface area of 0.4 acres is classified by the State as a small size structure with low hazard

potential. The dam was used for hydropower generation and public water supply from the 1930s to 1970. The Hunt's Mill Dam is currently used for recreation.

The curved stone masonry spillway is 125 feet long, 10 feet high and is founded on bedrock. A 36" diameter concrete conduit penetrates the spillway near the right end, continues a short distance downstream and terminates in a rounded concrete stilling well. The headrace entrance was sealed with a steel sheet pile and concrete wall. The headrace downstream of the entrance closure wall has a short, open flume transitioning into an underground steel penstock which leads to the pumphouse. The pumphouse contains a 144 kW vertical Francis hydro-generating unit, presently retired. The 100 foot-long tailrace re-joins the river downstream of the pumphouse.

According to the National Inventory of Dams (NID) inventory, the dam was built in 1928 (Reference 11), however, hydropower generation is reported to have existed at the site since 1893 (Reference 14). There are no construction or inspection records of the dam. There is a photographic record of the dam taken by the City during the March 31, 2010 flood. The photos indicate that the dam was completely submerged during the flood with the pond level at the top of the upstream retaining wall. Fish passage designed by the USACE, New England District is currently being installed at the right side of the dam will remove the concrete conduit and stilling well and utilize the abandoned headrace.

3.3 Omega Pond Dam

The Omega Pond Dam (State No. 406, National No. RI01001), is located at the confluence of the Ten Mile and Seekonk Rivers. The 200 foot-long, 18 foot-high dam consists of an overflow spillway and abutment walls. The dam impoundment has storage of 280 acre-feet and surface area of 33 acres and is used for recreation and supply water by several adjacent industries. The dam is classified by the State as a small size structure with low hazard potential.

The 112 foot-long, 15 foot-high spillway is a concrete gravity structure with downstream stone facing. The stone facing was built of nine stair-stepped granite courses, each 20 inches high (Reference 16). The spillway crest and base are at el. 9.90 and el. -5.4±, respectively (Reference 17). The spillway crest is 4 feet wide and inclined upward in the downstream direction. The 15 foot-wide spillway base is supported with four rows of wooden piles installed across the streambed. Foundation seepage control is provided with two rows of 6 inch-thick, 24 foot-deep wooden splined pile sheeting located at the heel and toe of the structure. The spillway toe is protected with a 70± foot-wide concrete apron with wooden planking on the top and supported with wooden foundation piles.

Massive, stone-mortared walls with the top at el. 14.8 feet (NGVD) or 4.9 feet above the spillway crest form both spillway abutments. The abutment walls support a steel truss railroad bridge located immediately downstream of the dam. The original drawings (Reference 16) indicate that the abutments contain concrete core walls, similar in construction to the spillway, extending 42 feet into earthen railroad embankments.

The existing dam was built in 1918 downstream of an original timbercrib dam erected in 1883. There are no construction or inspection records of the previous dam. Similar to the Turner and

Hunt's Mill Dams, the Omega Pond Dam is scheduled for installation of a fishway to restore anadromous fish runs in the river. The fish passage designed by the USACE, New England District will be installed at the right side of the dam utilizing a portion of the existing spillway. The fishway drawings contain the project elevations surveyed by the USACE in 2009 and include plans of the existing and original dams.

4.0 INSPECTION

Prior to site visits, available data including the RIDEM and NID records, aerial maps, historic photographs, previous inspection reports, studies for proposed hydropower developments and fishway installation at the dams, and other pertinent information were reviewed.

The inspection briefly started with Hunt's Mill Dam, proceeded to the Turner Dam, then Omega Dam, and ended at the Hunt's Mill Dam. The inspection included visual observation of the dams from both abutments for signs of misalignment, movement, settlement, sinkholes, cracking, leakage or seepage, excessive deterioration, erosion, scouring, and vegetation growth. Pond water level control equipment, such as gates, were observed for serviceability and access. A digital photo record was made at each dam site to document findings and for later reference (Appendix A).

Where available, observations were compared with the findings from previous inspections. The inspection was performed by Myron Petrovsky, P.E. of MBP assisted by Fred Szufnarowski, P.E. and Jon Petrillo of Essex. Senior Planner for the City, Mr. Patrick Hanner was present at the beginning of the inspection.

The inspection was conducted on October 13, 2010. The weather was clear with ambient temperature in the mid-60s° F. The following are inspection findings for each dam arranged in upstream to downstream order.

4.1 Turner Reservoir Dam

During the time of the inspection, the reservoir was lowering with the one outlet gate half-open and the other outlet gate closed in preparation for construction of a fish passage at left end of the spillway. The reservoir level at the beginning of the inspection was 2.3 feet below the spillway crest. The tailwater level was measured 2.7 feet below the top of the downstream section of the left retaining wall.

Left Embankment. The inspection was conducted with silt fences installed along the top and toe of the embankment for scheduled construction of a fish passage at the spillway this fall. The embankment top will serve as an access route to the construction area.

The upstream slope of the embankment covered with dumped, 3 to 4-foot size blasted stone riprap was in stable condition (Photo 5). The slope showed no signs of sloughing or excessive erosion. The riprap at some areas of the slope was displaced exposing bedding, more notably at the spillway area. Some woody vegetation was growing through open spaces in riprap. The top and downstream slope covered with manicured grass, were solid with no areas of significant

erosion, cracking, wetness, seepage, or animal activities observed. The drainage blanket installed at the toe of the embankment was firm, with no soft spots noted. The drainage blanket discharged through two, 6-inch diameter seepage collection pipe outlets stone gabion walls at the toe (Photo 6). The gabion walls appeared stable with the pipe outlets discharging no flow. The area downstream of the drainage blanket was covered with a large body of stagnant water which is reported to be the location of the original stream. The toe of the embankment and a portion of the drainage blanket were overgrown with trees and woody brush not allowing a thorough inspection (Photos 2, 5, 6). The vegetation's root systems may penetrate the blanket and reduce its hydraulic efficiency.

The foundation drain collecting seepage at the base of the concrete corewall appeared to be functioning with moderate discharge observed exiting the semi-submerged pipe outlet in the left retaining wall. The seepage flow was clear, with no signs of soil migration. Some small pieces of bacterial greenish sludge were coming out of the pipe. The manholes installed on the top of the embankment and drainage blanket to monitor the condition of the underground collection drains were not accessible for observation.

Spillway. The spillway with the exposed crest and downstream face appeared to be true to the original alignment (Photos 1, 2). No signs of movement, sagging, or deterioration of the structure, which was rehabilitated in 1989, were observed. The downstream face was dry including vertical expansion joints separating the spillway monoliths. The spillway toe was submerged and the stilling basin and riprap revetment were not visible through the water. No pressure boils indicating excessive seepage at the base were observed at the toe area. A pile of stone was accumulated in the stilling basin floor near the left retaining wall at a distance of approximately 20 feet from the spillway (Photos 2, 3). This stone accumulation, not noted in the previous inspection reports, could be the result of riprap displacement during the record flood of March 31, 2010. The spillway approach and discharge channels were clear from debris. The approach channel at the area near the left training wall appeared to be partially silted with the top of sediment measured 5-7 feet below the spillway crest.

Retaining Walls. Both the left and right concrete retaining walls, resurfaced in 1989, appeared stable and solid (Photos 1-3). The left wall showed some signs of deterioration with two areas of minor spalling on the top (Photo 3). The channel face of the wall contained a near horizontal crack, approximately 4 feet above tailwater, covered with efflorescence (Photo 2). The crack and vertical construction joints, observed from the right bank of the discharge channel, were dry. The area at the downstream end of the wall was densely vegetated impeding the inspection (Photo 2). The right retaining wall contained a few small areas on the top with deteriorated concrete at vertical construction joints and a sub-horizontal crack with efflorescence at the downstream end (Photo 1). The wall appeared to be sound. The top of stone gabion walls installed over the spillway channel floor in 1990 to control scour from low level outlet discharges at the retaining wall base were visible. The assessment of the gabion walls as an erosion protection measure was difficult due to submergence.

Low Level Outlets. The outlet works, repaired in 1989, were observed from the left embankment and right dike and appeared sound, stable, and operable (Photo 1). No significant cracking, deterioration, or signs of movement were found. A random cracking observed on the upstream

face of the structure appeared superficial. The juncture of the outlet with the right dike was tight, with no signs of depression or erosion at the interface between two structures. The outlet conduits, which were half-exposed on the downstream side, appeared sound. The brick gatehouse walls and floor observed from the outside and inside were intact and free of structural cracks. The manual gate operators were reportedly in serviceable condition (Photo 4). Although not a structural concern, the plywood flooring of the gatehouse appeared to be nearing the end of its useful life and if left in its current state may pose a safety hazard.

Right Dike. The right earthen dike extending between the outlet works and right dam abutment was stable and in sound condition (Photos 1, 7). The shallow structure was covered with manicured grass on the top and downstream slope and heavy riprap on the upstream slope. The dike was true to the design alignment and showed no signs of sinkholes, cracking, wetness, or active seepage. The slope riprap refilled in 1989 was stable with some missing or displaced stones at the area near the outlet structure. Woody brush was growing in gaps between some riprap stones. The toe of the dike was sparsely vegetated with large trees and a manicured grass understory.

4.2 Hunt's Mill Dam

Spillway. During the time of the inspection, the pond level estimated at an existing staff gage was 3.9 feet below the top of the upstream retaining wall. The spillway was discharging a few inches of flow impeding a thorough inspection of the structure and other project facilities. The curved stone masonry spillway appeared to be true to the original alignment (Photos 8, 9). No visible signs of movement or deterioration of the structure were observed through moving water. The pattern of the flow over the spillway crest was relatively uniform indicating that the crest was intact and contained no large gaps created by missing stone blocks. The spillway approach channel was generally unobstructed to the flow. The left abutment overgrown with dense vegetation (Photo 8) was inaccessible for evaluation. The toe of the spillway in immediate proximity was covered with discharging flow. Approximately 30-50 feet downstream of the spillway, the streambed exposed highly irregular rock outcrops with a massive rock island rising to nearly the level of the spillway crest and then dropping about 10-15 feet to the streambed. This rock island may reduce the spillway capacity by early submergence during high water.

Conduit and Chamber. The right side of the spillway contained a 36" diameter steel conduit penetrating through the structure (Photo 9), then connected to a reinforced concrete pipe (Photo 10) leading to a concrete chamber (Photo 11). The steel conduit was rusty and corrosion pitted but appeared sound. This conduit has reportedly been removed after the inspection as part of the fish passage construction project. A section of the concrete pipe attached to the steel penstock was severely deteriorated exposing steel reinforcing. The 12 inch-thick concrete chamber, about 8-10 feet in diameter, was deteriorated with friable, laminated concrete observed on the upper part of the structure. The conduit outlet at the chamber floor was moderately leaking. The riverside chamber wall contained a 2 foot-deep waste weir with wooden planks for releasing excess water (Photo 11). The conduit between the spillway and the chamber was supported with concrete pedestals which were not accessible for the inspection.

Headrace. The abandoned headrace consisted of an open flume and underground steel penstock leading to the pumphouse. The entrance to the headrace from the pond was plugged with PZ-steel sheet piles and sealed with a concrete wall on the downstream side. The composite closure wall appeared stable and in fair condition. The steel piling was well interlocked, with no apparent gaps and signs of movement or buckling (Photos 12, 13). The concrete wall was generally free of major cracks and deterioration, however, the left side of the concrete wall was leaking at the juncture with the riverside headrace wall (Photo 13). The headrace walls of brick and stone masonry construction covered with concrete showed signs of deterioration resulting in spalling and missing concrete cover in some areas (Photo 14). The floor of the headrace was vegetated with brush and covered with debris impeding the inspection (Photo 13). The underground section of the headrace (penstock) was inaccessible and not inspected. The mortared-stone pumphouse containing an original turbine-generation unit was in excellent condition.

Pond Retaining Wall. The wall on the right side of the pond extends upstream from the headrace entrance encompassing a portion of the pond adjacent to the City park (Photo 15). The wall of mortared rubble was covered with concrete. The concrete cover on about two thirds of the wall length was deteriorated to a depth of 2 inches exposing steel reinforcing on the top (Photos 15, 16). The end of the wall, overgrown with dense vegetation, was disintegrated exposing original masonry.

4.3 Omega Pond Dam

Spillway. During the time of the inspection, the spillway was discharging a 1-2 inch-deep flow impeding a thorough visual inspection (Photos 17, 19). The maximum spillway freeboard measured at the right retaining wall was 5 feet conforming to the original drawings. The spillway alignment between the abutment walls was straight and true to the design intent. The cascading flow pattern was smooth and uniform suggesting no presence of areas with significant erosion or damage on the crest and downstream face (Photo 17). The discharge channel containing a concrete apron covered with timber planking was inundated with shallow water. The apron flow surface was relatively even, with no major disturbances which could be the result of deep scour.

Abutment Walls. The spillway abutment walls supporting the downstream steel truss railroad bridge appeared stable and plumb (Photos 17, 19, 21). No signs of wall instability or seepage were observed. The cut stone blocks forming the walls were intact and in place, except the right wall where a stone block was likely missing at the bottom of the steps (Photo 21). The top of the left wall covered with concrete experienced surficial erosion (Photo 18). Both walls contained a number of open masonry joints with missing mortar (Photos 17, 21). Concrete corewalls at each abutment as indicated on the project drawings, were not observed. However, the areas with assumed corewall location were heavily vegetated obstructing the inspection (Photos 17, 19). The earthen railway embankments forming the dam abutments were stable and watertight.

5.0 CONCLUSIONS AND DISCUSSIONS

Based on review of project information and field observations made during the October 13, 2010 site visits, the inspected Turner, Hunt's Mill, and Omega dams appear to be structurally sound, safe, operational, and well suited for hydropower development. There are no major structural, maintenance or operational deficiencies in the dam projects requiring immediate remedial actions. The dams appeared true to the original alignment as shown in the project drawings and were in reasonable condition. All dams were able to withstand the record, March 31, 2010 flood without noticeable change in condition.

The toe of the spillways was not inspected for scour, erosion, undermining, and seepage due to submergence. During construction of fish passage facilities, the City may take advantage of a rare opportunity to inspect, survey, and evaluate the condition of the coffer-dammed and dewatered portions of the dams which are usually submerged.

5.1 Turner Reservoir Dam

- The high hazard potential dam observed with the reservoir lowered and no water flowing over the spillway appeared true to the original alignment and stable. The project was in process of preparations for installation of fish passage facilities at the left end of the spillway.
- The exposed spillway, resurfaced in 1989, was in sound condition, with no signs of erosion, cracking, or seepage. Stone piles accumulated at the left area of the spillway stilling basin, not observed in the previous inspections, could be the result of spillway operation during the record March 31, 2010 flood.
- According to the hydrologic studies conducted in 1981 and 1982 (References 5, 6), the existing spillway is undersized and cannot pass the ½ PMF, the project spillway design flood (SDF), resulting in overtopping and failure of the earthen embankment dam by erosion. High hazard dams under the FERC jurisdiction would be required to conduct a hydrologic/hydraulic study to determine the Inflow Design Flood (IDF) involving dam break analysis and incremental inundation assessment of the impacted downstream areas. The resulting IDF may be equal to the PMF or be a fraction of the PMF.
- The concrete retaining walls supporting the left embankment and right dike were rehabilitated in 1989. The walls experienced relatively minor deterioration in the form isolated spalling and random cracking. No seepage through or around the walls was observed. The downstream areas of the walls were heavily vegetated obstructing the inspection.
- The low level outlet concrete substructure and brick superstructure (gatehouse) were in good order, with no significant signs of deterioration (excepting the interior flooring). The outlets, gates, and operators were in serviceable condition. The penstock intake gate located in the gatehouse was closed long ago (circa 1970), abandoned, and its operability is unknown.

- The left embankment (aka an embankment dam) was stable and well maintained. The upstream slope riprap placed in 1990 was displaced at the area near spillway and showed signs of opportunistic vegetative colonization. The downstream face and toe appeared sound with no evidence of seepage. The corewall foundation drain was functioning, discharging a moderate flow. Both drainage blanket pipe outlets appeared to be dry which could be the result of the embankment watertightness or reduction in drainage effectiveness due to internal siltation or/and plugging with vegetation roots. The toe of the embankment was densely covered with trees and brush. The manholes installed to monitor and maintain drainage systems of the embankment were inaccessible for the inspection (overgrown??). The top of the embankment containing the manhole(s) will be used as an access route during construction of the fishway.
- The right dike was stable, well maintained and in sound condition.
- The reservoir perimeter west berm and dikes 1 and 2 were not observed during this inspection.

5.2 Hunt's Mill Dam

- The low hazard potential dam observed with the spillway discharging flow over the crest appeared in good alignment and stable. The left spillway abutment was densely overgrown and not inspected.
- The 3 to 4-foot diameter steel/concrete conduit penetrating through the right end of the spillway and connected to the concrete chamber downstream was significantly deteriorated exposing steel reinforcing in its concrete section. The conduit was not visible on the pond side through a shallow depth of water. The pipe leakage at the chamber outlet was minimal. The chamber concrete was in poor to fair condition.
- The steel sheet pile/concrete wall plugging an entrance to the abandoned headrace from the pond was stable and in fair condition. The wall was moderately leaking at the downstream corner with the left headrace wall. The open headrace flume walls, overlaid with concrete, were deteriorated at several areas and appeared stable. The flume floor was covered with debris and vegetated. The underground penstock was inaccessible. The stone masonry pumphouse containing a retired hydro-generating unit was in excellent condition.
- The upstream concrete/masonry wall located along the right shoreline of the pond and adjacent to the headrace entrance was deteriorated significantly. The wall is not a critical project structure, however, failure of the wall could result in the bank erosion and undermining of the City's park security fence.
- The site is scheduled for installation of a fish passage at the right dam abutment. According to available drawings (Reference 12), the construction will involve removal of the concrete conduit and chamber, and lowering of the headrace entrance closure wall.

- The dam is not equipped with a low level outlet for maintenance or repairs. The City may consider installation of outlet works at the location of the abandoned conduit or headrace closure wall during construction of fish passage.

5.3 Omega Pond Dam

- The low hazard potential dam, observed with a 1 to 2-inch deep flow over the spillway, appeared well aligned and conformed to the original plans.
- Based on the observed flow pattern, the spillway crest, downstream face, and apron had not experienced significant deterioration due to the continuous impact of the flowing water.
- The spillway abutment walls made of granite ashlar stone were intact and stable with some masonry joints open due to missing mortar.
- The earthen railway embankments abutting the dam were stable and watertight. The dam abutments were overgrown with dense vegetation impeding the inspection. The concrete corewalls extending from the dam into the embankments, as indicated on the original drawings, were not found.
- The dam is scheduled for installation of fish passage facilities at the left end of the spillway. The fishway will occupy about 31 feet of the spillway length (Reference 17) which will likely reduce the hydraulic capacity of the spillway.
- The project does not have a low level outlet to draw the pond level down for maintenance and repair of the dam. The City may consider installation of a new outlet works at the dam during construction of the fish passage facility.

6.0 RECOMMENDATIONS

There are no major safety or maintenance/operation concerns with the inspected dams requiring immediate attention or implementation of remedial measures. The following recommendations are proposed to verify the inspection findings, and improve a long-term reliability, operational readiness, and safety of the City's dams. Implementation of the proposed recommendations will also aid the City to comply with the FERC safety regulations if the dam sites are otherwise feasible for development of hydroelectric power.

6.1 Turner Reservoir Dam

1. Conduct, under direction of a professional engineer, a visual inspection and survey of the dewatered dam construction area prior to and during installation of the fish passage. Perform an underwater and/or bathymetric survey of the remaining submerged areas at the toe of the spillway and outlet works during a low flow period. Based on the above-water and underwater inspection findings, develop remedial measures for the dam, as necessary.
2. Repair the areas of the left and right concrete retaining walls with surface concrete deterioration.
3. Repair the inaccessible manholes of the left embankment and evaluate the internal condition of drains and drainage blanket. Protect the manholes from traffic during construction of the fish passage.
4. Monitor water level and flow in the left embankment manholes quarterly coupled with recording the reservoir level to ensure proper function and identify changes in flow rates and/or water clarity.
5. Monitor the seepage flow at the foundation drain outlet in the left retaining wall quarterly for change in condition combined with recording the reservoir level to ensure proper function and identify changes in flow rates and/or water clarity.
6. Replace riprap in the areas of the upstream slope of the left embankment and right dike with displaced or missing riprap.
7. Cut and remove vegetation from the toe of the left embankment and downstream areas of the left and right retaining walls and inspect the cleared areas of the structures. Include vegetation control at the dam into a project maintenance plan.
8. Inspect the west berm and dikes 1 and 2 located in the reservoir perimeter and assess their condition.

6.2 Hunt's Mill Dam

1. Conduct a visual inspection and survey of the dewatered dam construction area prior to and during installation of a proposed fish passage. Perform an underwater and/or bathymetric survey of the remaining submerged areas of the of the spillway during a low flow period. Based on the above-water and underwater inspection findings, develop remedial measures for the dam, as necessary.
2. Repair the leaking area of the closure wall at the headrace entrance.
3. Repair deteriorated concrete on the interior surfaces of the open flume headrace walls.
4. Repair the deteriorated upstream concrete/masonry wall located along the right shoreline of the pond and adjacent to the headrace entrance.
5. Inspect the abandoned underground steel penstock of the headrace and evaluate condition.
6. Cut and remove trees and brush from the left spillway abutment. Inspect the cleared area and evaluate condition.

6.3 Omega Pond Dam

1. Conduct a visual inspection and survey of the dewatered dam construction area prior to and during installation of a proposed fish passage. Perform an underwater and/or bathymetric survey of the remaining submerged areas of the spillway and apron during a low flow period. Based on the above-water and underwater inspection findings, develop remedial measures for the dam, as necessary.
2. Repoint open joints in the masonry work of the right and left abutment retaining walls of the dam.
3. Cut and remove brush and trees from the upstream areas at the left and right abutment retaining walls. Inspect the cleared abutment areas and assess condition.

7.0 OPINION OF CONSTRUCTION COST OF REMEDIAL MEASURES

An opinion of remedial cost for each dam was developed based on the available project data, inspection findings, recommendations, and our experience with similar repair projects. The remedial measures considered include items which are related directly to dam safety. Operation and maintenance (O&M) items, such as brush and tree removal, masonry repointing, grass mowing, riprap replacement, or repair of deteriorated concrete surfaces were considered to be O&M items and were not included in the cost estimate.

7.1 Turner Reservoir Dam

- Inspect by a professional engineer the dewatered areas of the dam prior to and during construction of the fish passage. \$5K-\$10K
- Conduct the underwater/bathymetric survey of the submerged areas of the spillway and outlet works. \$5K-\$10K
- Repair the inaccessible manholes of the left embankment. \$10K-\$15K
- Total** **\$20K-\$30K**

7.2 Hunt's Mill Dam

- Conduct the underwater/bathymetric survey of the submerged areas of the spillway. \$5K-\$10K
- Repair the leaking headrace entrance closure wall. \$5K-\$10K
- Repair the deteriorated upstream concrete/masonry wall. \$10K-\$20K
- Total** **\$20K-\$40K**

7.3 Omega Pond Dam

- Conduct the underwater/bathymetric survey of the submerged areas of the spillway and spillway apron. \$5K-\$10K
- Total** **\$5K-\$10K**

8.0 COMPARISON OF RIDEM AND FERC DAM SAFETY REGULATIONS

A brief comparison was made between the RIDEM and FERC dam safety regulations based on RIDEM *Rules and Regulations for Dam Safety* (December 2007) and FERC *Engineering Guidelines for Evaluation of Hydropower Projects* (2003) and *Operating Manual for Inspection of Projects and Supervision of Licenses for Water Power Projects*.

Hazard Classification. Both agencies use high, significant, and low hazard potential classification for dams based on the guidelines developed by the USACE for the National Program for the Inspection of Non-Federal Dams in 1976 and FEMA in 1998. The dam hazard potential rating in the State is established based on dam size (small, intermediate, high) and evaluation of downstream population and major infrastructure at risk.

The FERC approach to dam hazard is based on hydrologic analysis of the watershed and incremental impact of downstream flooding with no-failure and failure of the dam.

Spillway Design Flood (SDF). There are apparently no State regulations for the SDF to be used for different dam hazard ratings. The states usually accept the USACE criteria for selection of the SDF based on a hazard potential classification and dam size. With the existing dam size and hazard rating, the SDF for the Turner Dam is the PMF and is the 50 to 100-year flood for the Hunt's Mill and Omega dams.

FERC requires that the inflow design flood (IDF) for dams with significant or high hazard category (Turner Dam) to be determined. The IDF for the project is defined as the flood when combined with a dam failure will cause no significant incremental impact to downstream areas. The IDF could be equal to the full PMF or a fraction of the PMF. There are no FERC hydrologic/hydraulic requirements for low hazard dams (Hunt's Mill and Omega dams).

Stability Analysis. There are no State regulations for stability of dams.

FERC requires that dams with high and significant hazard potential classification be analyzed for stability. For the Turner Dam, major water retaining structures such as a spillway, outlet works, left embankment, and right dike, should be evaluated for stability. No stability analysis would be required by FERC for Hunt's Mill and Omega dams.

Emergency Action Plan (EAP). The State has apparently no EAP regulations.

FERC requires that EAP's be developed for dams with high and significant hazard potential rating.

Inspection Frequency. The State requires that high hazard dams to be inspected every 2 years and significant and low hazard dams every 5 years.

FERC mandates that dams with high and significant hazard potential be inspected by a FERC approved independent consultant every 5 years and all dams by a FERC engineer annually.

9.0 REFERENCES

General

1. Federal Emergency Management Agency. *Federal Guidelines for Dam Safety: Hazard Potential Classification Systems for Dams*. October 1998.
2. CE Maguire Inc. *Reconnaissance Study. Turner Reservoir Dam and Hunts Mill Pond Dam. Ten-Mile River. Proposed Small-Scale Hydro Development*. August 1980.
3. US Army Corps of Engineers. *Real Estate Plan, Feasibility Phase. Ten Mile River Ecosystem Restoration, East Providence, RI*. June 2004.

Turner Reservoir Dam

4. National Inventory of Dams. *James V. Turner Reservoir Dam. RI*.
5. US Army Corps of Engineers. *James V. Turner Dam. Phase I Inspection Report*. January 1981.
6. New England Engineering Inc. *James V. Turner Dam. Phase II Investigation*. October 1982.
7. Pare Corporation. *James V. Turner Dam. Phase I Inspection Report*. September 21, 2007.
8. RIDEM. *James V. Turner Reservoir Dam Inspection Report*. October 7, 2004 & December 6, 2007.
9. US Army Corps of Engineers. *Fish Passage Facility at Turner Reservoir Dam. Ten Mile River, East Providence, RI*.
10. US Army Corps of Engineers. *Turner Reservoir-Construction of Fish Passage: responses/clarifications to RIDEM*. September 12, 2008.

Hunt's Mill Dam

11. National Inventory of Dams. *Ten Mile Reservation Dam. RI*.
12. US Army Corps of Engineers. *Fish Passage Facility at Hunt's Mill Dam. Ten Mile River, East Providence, RI*.
13. East Providence. *East Providence Comprehensive Plan Update 2010-2015. Historical and Cultural Element*.
14. Durkee, Brown, Viveiros, Werenfels Architects. *Hunt's Mills Pump/Re-Use Study. Sustainable Technology Education Center*. February 2009.

Omega Pond Dam

15. National Inventory of Dams. *Omega Pond Dam. RI*.
16. O. Perry Sarle Engineer. *Omega Pond Dam. Design Drawings (3)*, 1918.
17. US Army Corps of Engineers. *Fish Passage Facility at Omega Pond Dam. Ten Mile River, East Providence, RI*.

Appendix A
Inspection Photographs



Photo 1. Turner Reservoir Dam. Spillway, outlet works, right retaining wall, and right dike from left embankment.



Photo 2. Turner Reservoir Dam. Spillway, left retaining wall, and left embankment from right river bank. Note horizontal crack in left retaining wall (red arrow), stone pile in tailwater (blue arrow), and vegetation at left embankment toe.



Photo 3. Turner Reservoir Dam. Left retaining wall. Note areas with concrete deterioration (red arrows) and pile of stone in tailwater (blue arrow).



Photo 4. Turner Reservoir Dam. Low level outlet gatehouse with two floor gate operators.



Photo 5. Turner Reservoir Dam. Left embankment from spillway.



Photo 6. Turner Reservoir Dam. Stone gabion wall with drain pipe outlet (arrow) at toe of left embankment.



Photo 7. Turner Reservoir Dam. Right dike looking toward gatehouse. Note upstream slope area with missing riprap (arrow).



Photo 8. Hunt's Mill Dam. Spillway from right abutment.



Photo 9. Hunt's Mill Dam. Abandoned power penstock at spillway toe.



Photo 10. Hunt's Mill Dam.
Deteriorated concrete section of
abandoned penstock (arrow).



Photo 11. Hunt's Mill Dam.
Concrete chamber interior with
upstream penstock inlet on bottom
and waste weir with wooden
planks in riverside wall (arrow).
Note concrete wall deterioration.



Photo 12. Hunt's Mill Dam.
Upstream view of abandoned
headrace entrance closure wall
(arrow).



Photo 13. Hunt's Mill Dam. Downstream view of abandoned headrace closure wall leaking at left corner (arrow).



Photo 14. Hunt's Mill Dam. Concrete deterioration of riverside headrace open flume wall. Note stone masonry exposed due to missing concrete cover (arrow).



Photo 15. Hunt's Mill Dam. Retaining wall upstream of headrace entrance closure wall.



Photo 16. Hunt's Mill Dam.
Deteriorated concrete with
exposed reinforcement on top of
upstream retaining wall (arrow).



Photo 17. Omega Pond Dam.
Spillway and left abutment.



Photo 18. Omega Pond Dam.
Deteriorated concrete on top of
left masonry abutment.



Photo 19. Omega Pond Dam. Spillway and right abutment.



Photo 20. Omega Pond Dam. Top of right dam masonry abutment from railway bridge.

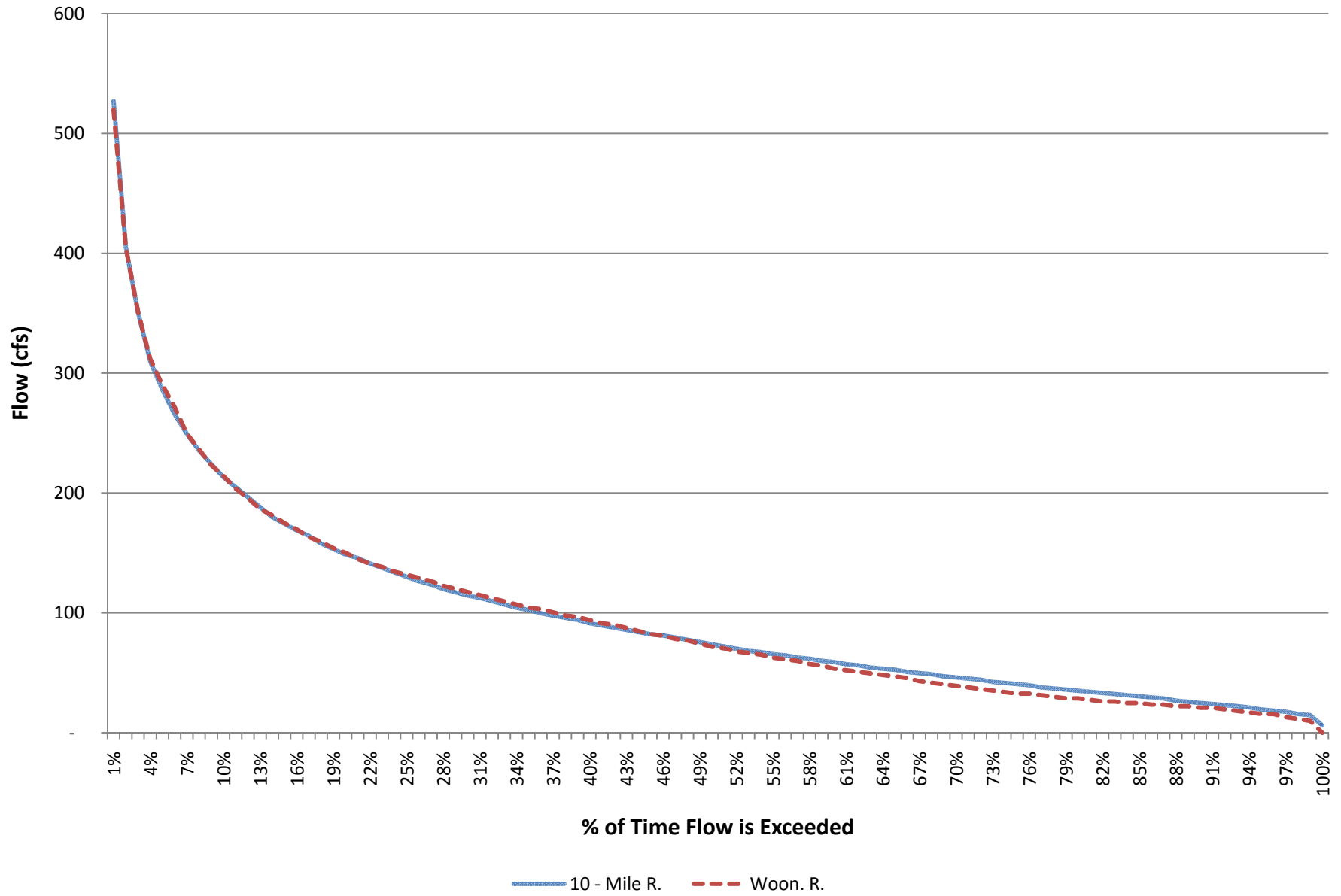


Photo 21. Omega Pond Dam. Right dam abutment from left abutment wall. Note open masonry joints , missing stone step at bottom (arrow) and vegetation.

APPENDIX B

Hydrologic and Hydraulic Data

Ten Mile & Woonasquatucket Rivers Annual Flow Duration Curve
(adjusted for 50 mi² drainage area)



ID	Site	BM	BM Notes	HW	TW	Gross Head (rounded)	D.A. (SqMi)	Notes
A	Turners Reservoir Dam	52.6	1,4	47.6	33.1	14.5	48	Pond was drawdown for fishpassage construction (10/13/10), HW assumes pond elev. @ spillway crest.
B	Turner - Hunt's Mill	see notes	1,4	47.6	25.6	22.0	48	Alt. develops head between 2 sites. Creates ~2.3k' bypass reach. Assumes new unit at Hunt's spillway.
C	Turner - Hunt's Mill 2	see notes	3,4	47.6	10.6	38.0	48	Alt. develops head between 2 sites. Creates ~3.5 k' bypass reach. Repowers existing unit and restores 66" penstock and tailrace.
D	Hunt's Mill Dam	38.0	1,4	34.0	25.6	8.5	49	Assumes discharge to upper pool area d/s of spillway to minimize instream flow concerns.
E	Hunt's Mill Dam 2	38.0	1,3,4	34.0	10.6	23.5	49	Assumes: intake at Hunt's Mill spillway, restore existing turbine & tailrace. Creates ~ 1.2k' bypass.
F	Omega Pond Dam	14.8	1,2,4	10.1	1.9	8.0	50	Tailwater is tidally influenced (see notes below). GH range; crest elevation (9.9' NAVD 88) +/- 1/2 tidal range (2.085')= 7.8-12'

BM Note References:

1. Elevation control from ACOE fishway plans (NAVD 88)

2. TW is tidally influenced:

a. Tidal range from NOAA Tidal Observation Station @ Providence (Sta. # 8454000) due to consistency in vertical datum w/ fishpassage plans.

http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=8454000 Providence, RI&type=Historic+Tide+Data

b. Mean tidal range @ station is 4.17'.

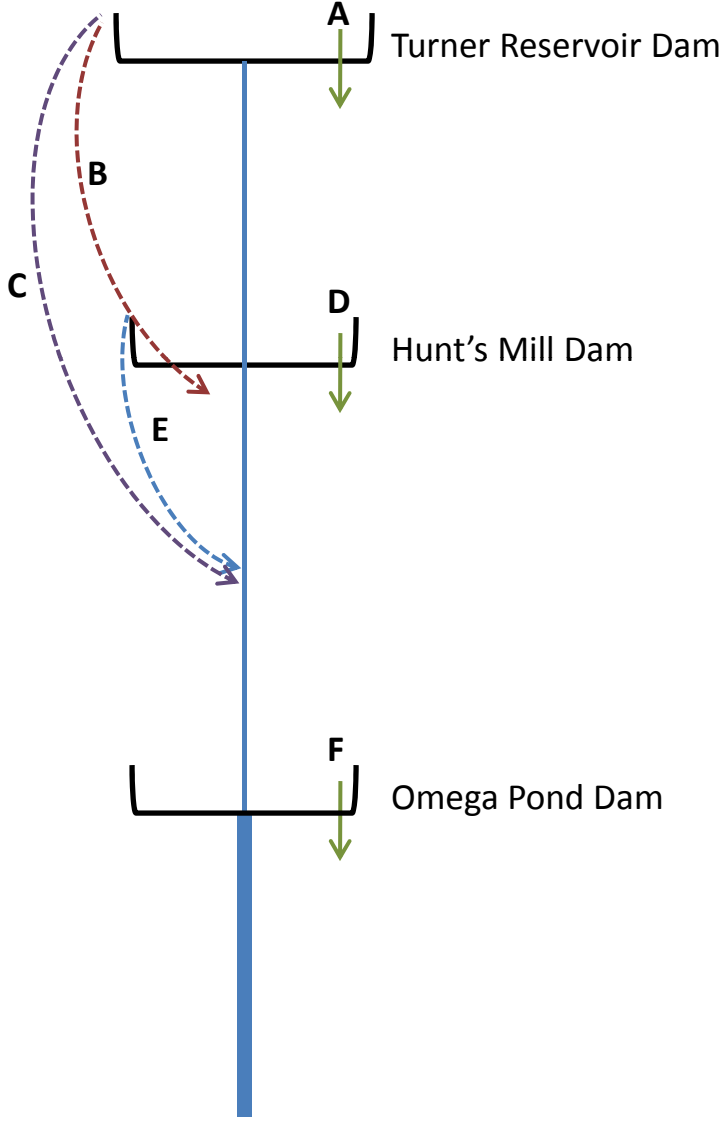
c. TW elev. recorded corresponds to -1.77 (NAVD 88) @ 15:00 on 10/13/10

3. Hunt's Mill Tailrace TW elevations derived from FIS floodprofile; expressed in NGVD 29. Approximate NGVD 29 tailrace elevation of 12' converted to NAVD 88. To determine conversion factor - NGVD 29 elevation of Turner Spillway = 49', NAVD 88 elevation of Turner Spillway = 47.6; conversion of NGVD to NAVD by subtracting difference [1.4'] from the NGVD elevation. Calculated tailrace elevation at Hunt's Mill is approximately 10' NAVD 88 (NGVD 29 elevation of 12 - 1.4 = 10.6' NAVD 88).

4. Several inconsistencies in available information were noted during site hydraulic analysis. For example, Corps noted tailwater elevations at Turner Reservoir below headwater elevations at Hunt's Mill located downstream. To compensate for these inconsistencies FEMA FIS floodprofiles were used to estimate the available gross head at options which developed head between Turner and Hunt's Mill. These data were provided in NGVD 29 and were subject to the conversion factor described above to maintain consistent vertical control datums.

APPENDIX C

Preliminary Project Configurations



A Turner's Reservoir Dam



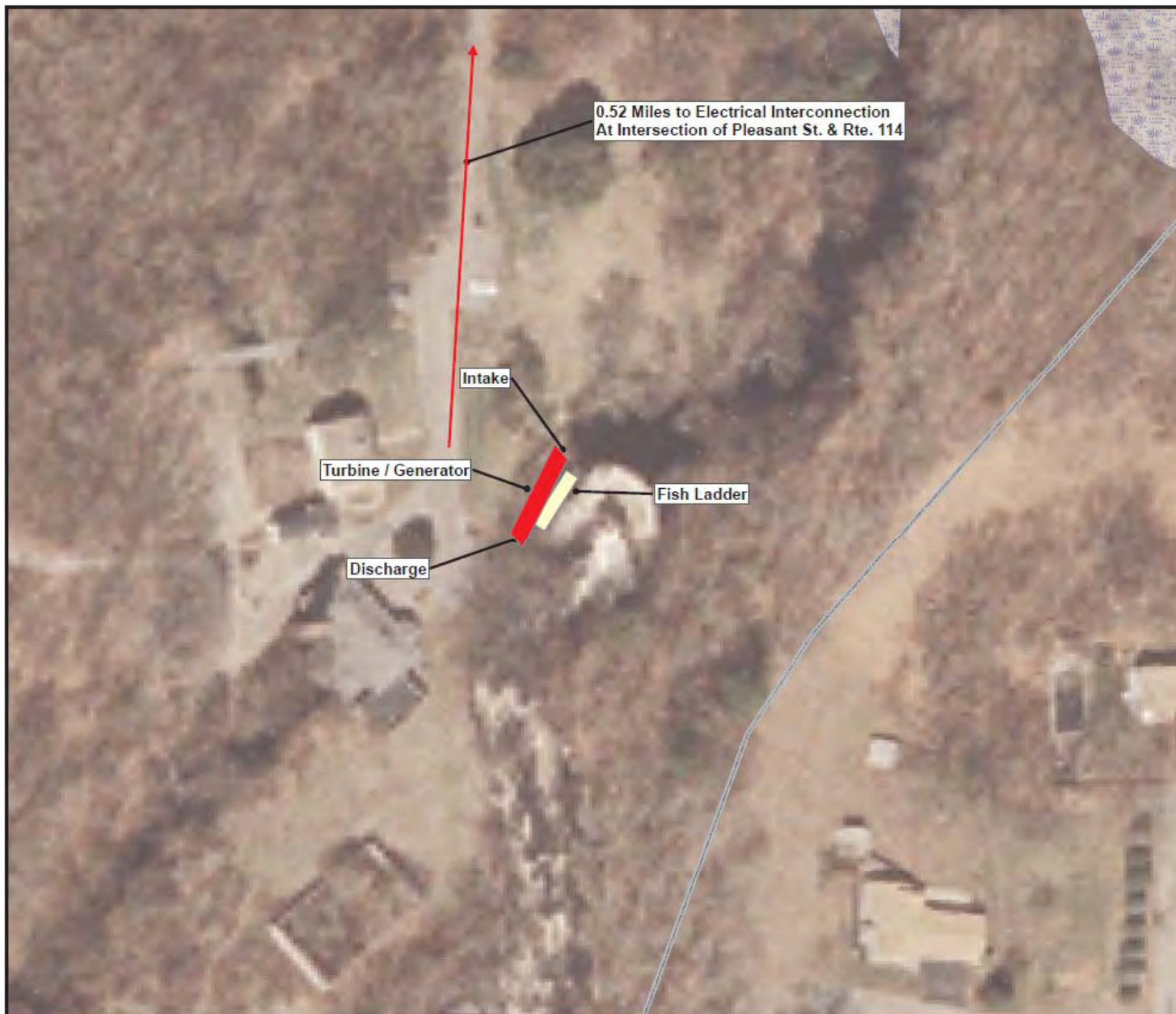
B Turner – Hunt's Mill



C Turner – Hunt's Mill 2



D Hunt's Mill Dam



D

Hunt's Mill 2



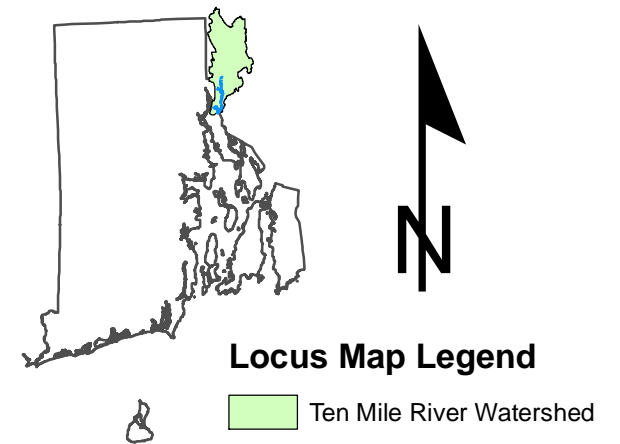
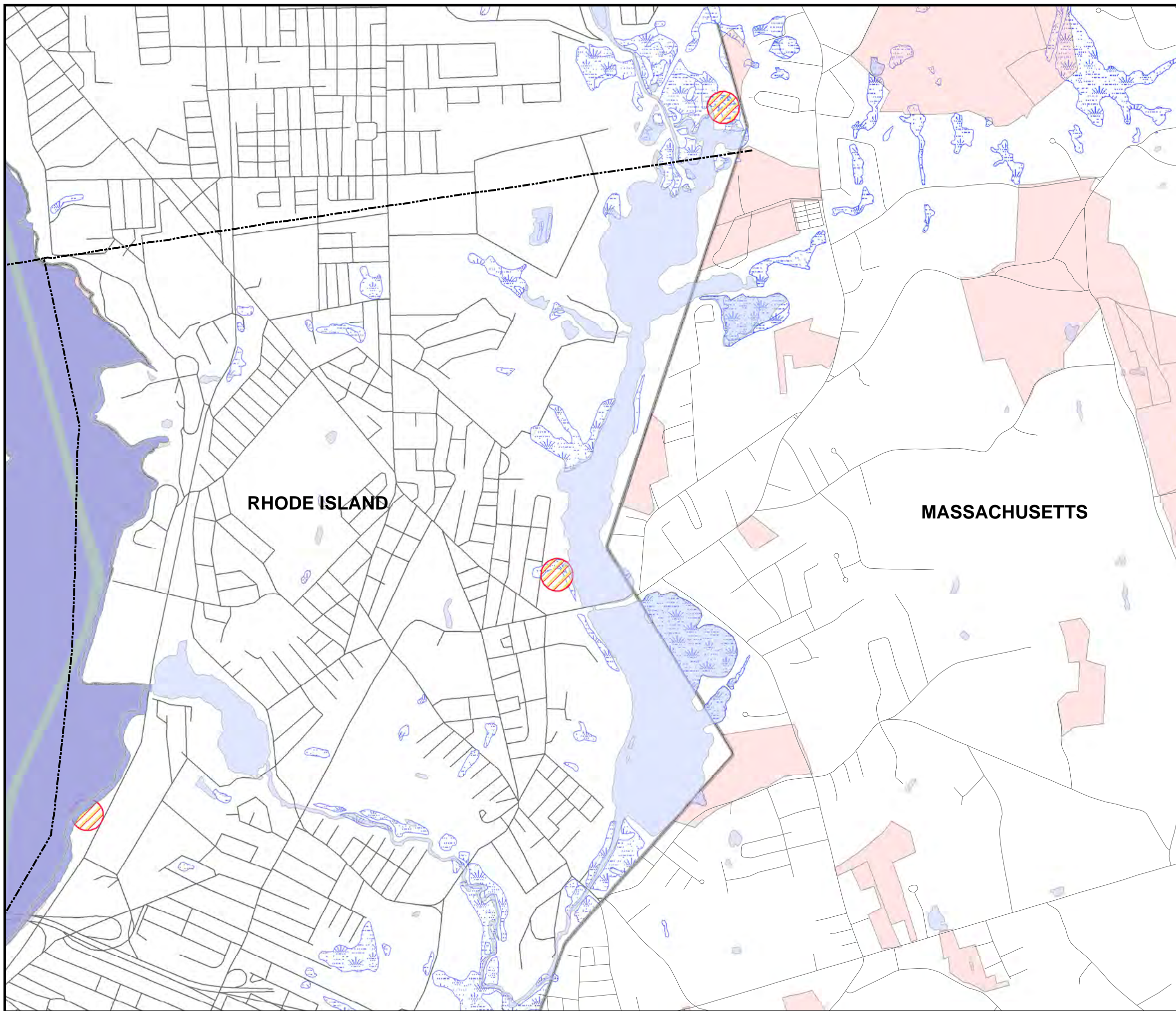
E

Omega Pond Dam



APPENDIX D

Natural Resource Mapping



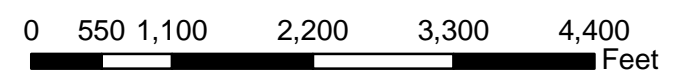
Digital Reference Layers Reviewed:

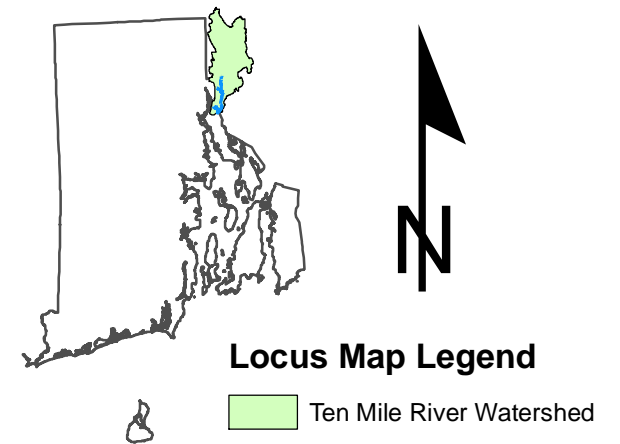
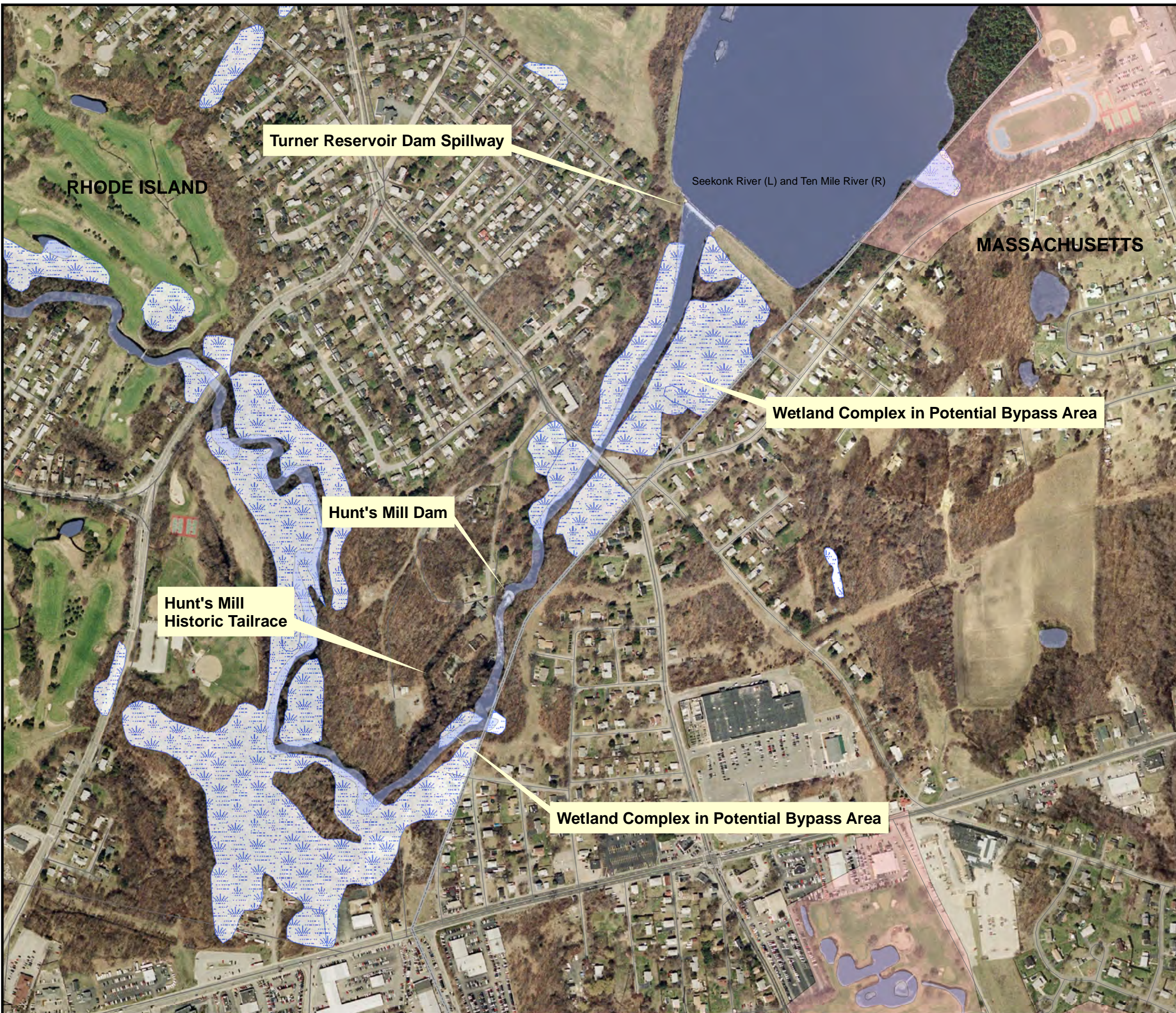
Rhode Island:
 RINHESP Rare Species Occurrences
 RIDEM Wetlands
 CRMC Water Types & Wetland Resources
 FEMA 100-yr Floodplain

Massachusetts:
 BioCore Mapping (June 2010)
 MassGIS Protected and Recreational Open Space
 NHESP Natural Communities
 NHESP Estimated Habitats of Rare Wildlife
 NHESP Priority Habitats of Rare Species
 MADEP Wetlands (Ten Mile River)
 Outstanding Resource Waters
 Areas of Critical Environmental Concern (ACEC)

- Legend**
- NHESP Estimated Habitats of Rare Wildlife
 - OpenSpace: Lands
 - NHESP Natural Communities
 - NHESP Estimated Habitats of Rare Wildlife
 - Wetland Resources (MADEP & RIDEM)
 - NHESP Priority Habitats of Rare Species
 - Area of Critical Environmental Concern (MA)
 - RINHESP Rare Species Occurrences

**Ten Mile River
 Hydropower Feasibility Study
 Natural Resources Inventory**

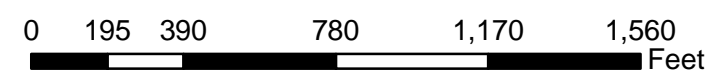


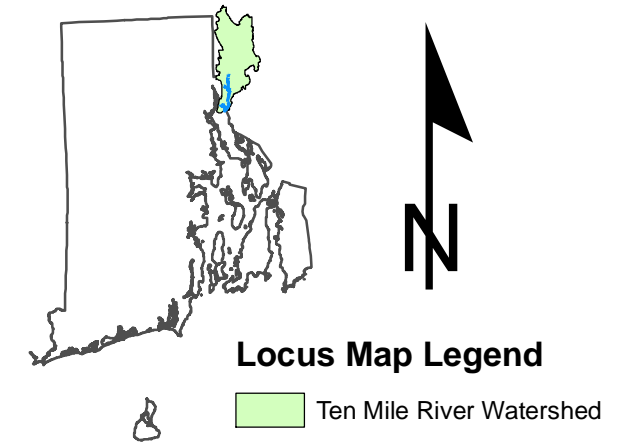


- Digital Reference Layers Reviewed:
- Rhode Island:
 RINHESP Rare Species Occurrences
 RIDEM Wetlands
 CRMC Water Types & Wetland Resources
 FEMA 100-yr Floodplain
- Massachusetts:
 BioCore Mapping (June 2010)
 MassGIS Protected and Recreational Open Space
 NHESP Natural Communities
 NHESP Estimated Habitats of Rare Wildlife
 NHESP Priority Habitats of Rare Species
 MADEP Wetlands (Ten Mile River)
 Outstanding Resource Waters
 Areas of Critical Environmental Concern (ACEC)

- Legend**
- NHESP Estimated Habitats of Rare Wildlife
 - OpenSpace: Lands
 - NHESP Natural Communities
 - NHESP Estimated Habitats of Rare Wildlife
 - Wetland Resources (MADEP & RIDEM)
 - NHESP Priority Habitats of Rare Species
 - Area of Critical Environmental Concern (MA)
 - RINHESP Rare Species Occurrences

**Ten Mile River
 Hydropower Feasibility Study
 Natural Resources Inventory**

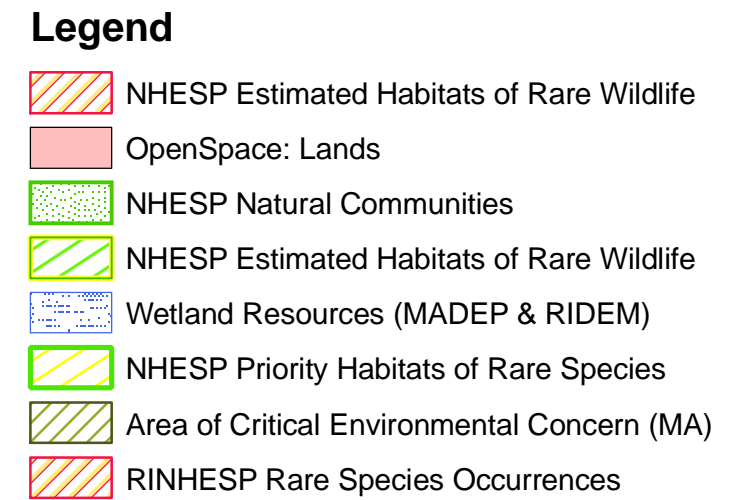




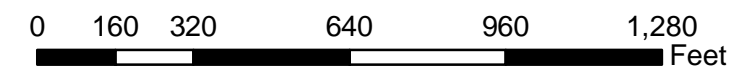
Digital Reference Layers Reviewed:

Rhode Island:
 RINHESP Rare Species Occurrences
 RIDEM Wetlands
 CRMC Water Types & Wetland Resources
 FEMA 100-yr Floodplain

Massachusetts:
 BioCore Mapping (June 2010)
 MassGIS Protected and Recreational Open Space
 NHPSP Natural Communities
 NHPSP Estimated Habitats of Rare Wildlife
 NHPSP Priority Habitats of Rare Species
 MADEP Wetlands (Ten Mile River)
 Outstanding Resource Waters
 Areas of Critical Environmental Concern (ACEC)



**Ten Mile River
 Hydropower Feasibility Study
 Natural Resources Inventory**



TURNER RESERVOIR-OMEGA POND- 2007 CONTINUOUS DISSOLVED OXYGEN MEASUREMENTS

Continuous measurements of dissolved oxygen, temperature, depth, specific conductance, and chlorophyll were collected in Central Pond and the Turner Reservoir from July 30 through Nov 7, 2007. These data were collected using YSI 6-series sondes, deployed at 'surface' and 'depth' locations in Turner Reservoir and a single 'surface' station in Central Pond. Deployments occurred in what was estimated to be the deepest part of each impoundment.

The approximate locations of both sondes are shown in Figure 1. In Turner Reservoir, a 'surface' sonde was deployed approximately 0.6-0.9 meters below the surface and a 'depth' sonde was deployed approximately 0.9 meters off the bottom. In Central Pond, the single 'surface' sonde was located approximately 0.6-0.9 meters below the surface. Total water column depths were approximately 3.5-4.0 meters in the Turner Reservoir and 1.8 meters in Central Pond.

Sondes were secured at fixed vertical depths to nylon marine line which in turn was attached to a 20 lb-anchor. Buoy systems were used to maintain the sondes in a vertical position for the duration of deployment. Sondes were changed every two to three weeks. Independent measurements of the measured parameters were made with an YSI-85 handheld monitor. Chlorophyll samples were collected at the time the sondes were changed and were analyzed by the URI Watershed Watch Laboratory in Kingston, RI.

Figure 1. Approximate Location of 2007 Sonde Deployments.



All data underwent QA-QC by URI GSO staff in 2007. The data collected was found to be of good quality with the exception that sensor/sonde failure produced periods of missing data as listed below:

Central Pond- 9/10/2007-11/07/2007

Turner Reservoir (surface) - 9/10/2007-10/23/2007

Turner Reservoir (depth) – 8/16/2007-10/23/2007

The station results were provided by GSO staff based upon the available data and are as follows using Rhode Island's freshwater warm water fish habitat criteria for dissolved oxygen (Table 1. 8.D: <http://www.dem.ri.gov/pubs/regs/regs/water/h20q09.pdf>)

Central Pond- **no** violations

Lower Turner Reservoir (surface water station)-

4 violations to the daily average (<60% saturation)

95 violations of the instantaneous values (<5 mg/L) using hourly data

Lower Turner Reservoir (bottom water column station)-

2 violations of the 7 day mean (<6 mg/L for a 7 day period)

8 violations of the daily average (<60% saturation)

217 violations of the instantaneous values (<5 mg/L) using hourly data

During the monitoring period a widespread cyanobacteria bloom affected both Central Pond and Turner Reservoir. The bloom appeared in early July and lasted until mid-November. Photographs are provided below. The first image is of Central Pond, the second is of Turner Reservoir. Given the conditions during the survey (see below), hypoxic bottom waters and wide diel swings in surface saturation would not be unexpected and are seen in the data.





TURNER RESERVOIR-OMEGA POND- 2009 CONTINUOUS DISSOLVED OXYGEN MEASUREMENTS

Continuous measurements of dissolved oxygen, temperature, depth, specific conductance, and chlorophyll were collected in Turner Reservoir and Omega Pond from June through Sept 2009. These data were collected using YSI 6-series sondes, deployed at 'surface' and 'depth' locations in the water column in what was estimated to be the deepest part of each impoundment.

The approximate locations of both sondes are shown in Figure 1. At each location, a 'surface' sonde was deployed approximately 0.6-0.9 meters below the surface and a 'depth' sonde was deployed approximately 0.9 meters off the bottom. Total water column depths were approximately 3.5-4.0 meters in the Turner Reservoir and 3.5 meters in Omega Pond.

Sondes were secured at fixed vertical depths to nylon marine line which in turn was attached to a 20 lb-anchor. Buoy systems were used to maintain the sondes in a vertical position for the duration of deployment. Sondes were changed every two to three weeks. Independent measurements of the measured parameters were made with an YSI-85 handheld monitor. Chlorophyll samples were collected for analysis by the URI Watershed Watch Laboratory in Kingston, RI.

Figure 1. Approximate Location of YSI Sonde deployments.



The 2009 data have undergone QA-QC by DEM staff and have been flagged and/or edited where necessary. In general, the data reveal occasional hypoxic conditions at the surface and near anoxic conditions in the bottom waters. The hydrogen sulfide released from sulfur fixing bacteria in the sediments is believed to have affected the bottom sensors' accuracy in measuring dissolved oxygen conditions in the Turner Reservoir with measurements indicating more severe hypoxia/anoxia than possibly exist – thus these data have been flagged and edited from the dataset.

Vertical profiling data obtained with a YSI-85 handheld monitor frequently showed weak to moderate thermal stratification accompanied by near-anoxic conditions in the bottom 0.5 to 1.0 meters of both impoundments. Examination of precipitation and discharge data in conjunction with dissolved oxygen levels obtained from YSI 6-series sondes showed that moderate rainfall events and associated increases in flow flushed out the near-anoxic bottom water in both impoundments and mixed the water column such that dissolved oxygen levels became similar at surface and depth. After these types of events, the impoundments again showed thermal stratification and associated decreases in bottom water dissolved oxygen levels. The continuous dissolved oxygen data obtained in 2007 from the Turner Reservoir show similar near-anoxic conditions in the bottom waters of the Turner Reservoir, adding credibility to the 2009 'near-bottom' datasets.

Rhode Island's freshwater warm water fish habitat criteria for dissolved oxygen are given in Table 1. 8.D of the States' Water Quality Regulations:

<http://www.dem.ri.gov/pubs/regs/regs/water/h20q09.pdf>

Both Turner Reservoir and Omega Pond are listed on the State's 2010 303(d) List of Impaired Waters for dissolved oxygen, based on the 2007 and 2009 datasets.

Stream Name/Station No.: Ten Mile River/9.b.19
 Station Location Road/Town: Hunts Mill Rd.-Pawtucket Ave./
 East Providence
 Sample Date: 28 Aug 00
 Sampling Duration (s): 5704
 Station Length(m)/Width(m): 265/14
 Land Use/Percent Canopy: Suburban/25
 Temperature (°C) Air/H2O: 23/24.2
 DO (mg/l): 8.07 pH: 8.29 Conductivity (uS/cm): 442
 Dominate Substrate Types (%):
 bedrock (20), boulder (20), cobble (20), gravel (20)

<u>Species</u>	<u>N</u>	<u>Total Length (mm)</u>	
		<u>Mean (Range)</u>	
bluegill	100	134	(84-204)
largemouth bass	85	86	(46-425)
white perch	75	174	(152-189)
American eel	65	295	(139-550)
pumpkinseed	34	105	(75-161)
white catfish	15	163	(63-208)
golden shiner	13	140	(96-203)
yellow bullhead	5	145	(103-165)

Pond Name/Station No.: Turner Reservoir/9.b.20
 Station Location: East Providence
 Sample Date: 23 Apr 01
 Sampling Duration (s): 5088
 Land Use: Suburban
 Temperature (°C) Air/H2O: 13/16.5
 DO (mg/l): 13.23 pH: 8.30 Conductivity (uS/cm): 355
 Dominate Substrate Types (%):
 Unknown because of high turbidity.

<u>Species</u>	<u>N</u>	<u>Total Length (mm)</u>	
		<u>Mean (Range)</u>	
white perch	206	223	(186-255)
bluegill	98	149	(37-213)
pumpkinseed	94	140	(45-193)
yellow perch	43	166	(94-240)
largemouth bass	28	299	(165-462)
black crappie	4	206	(198-211)
white sucker	3	412	(280-497)
white catfish	2	282	(281-282)
yellow bullhead	1	250	
goldfish	*	132	

* Collected during supplemental sampling.

Pond Name/Station No.: Central Pond/9.b.21
 Station Location: East Providence
 Sample Date: 25 Apr 01
 Sampling Duration (s): 5817
 Land Use: Suburban
 Temperature (°C) Air/H2O: 10.5/17.5
 DO (mg/l): 11.47 pH: 7.54 Conductivity (uS/cm): 387
 Dominate Substrate Types (%):
 Unknown because of high turbidity.

<u>Species</u>	<u>N</u>	<u>Total Length (mm)</u>	
		<u>Mean (Range)</u>	
yellow perch	111	193	(112-271)
white perch	96	224	(105-268)
bluegill	60	160	(83-200)
pumpkinseed	25	151	(94-195)
largemouth bass	17	334	(82-562)
yellow bullhead	2	199	(182-215)
brown bullhead	1	270	
golden shiner	1	210	
white catfish	1	310	

Stream Name/Station No.: Ten Mile River/9.b.37
 Station Location Road/Town: Slater Memorial Park/Pawtucket
 Sample Date: 31 Jul 01
 Sampling Duration (s): 6446
 Station Length(m)/Width(m): 465/12.4
 Land Use/Percent Canopy: Suburban/10
 Temperature (°C) Air/H2O: 22/20.5
 DO (mg/l): 8.64 pH: 6.81 Conductivity (uS/cm): 571
 Dominate Substrate Types (%):
 sand (40), gravel (30)

<u>Species</u>	<u>N</u>	<u>Total Length (mm)</u>	
		<u>Mean (Range)</u>	
white sucker	39	55	(35-75)
largemouth bass	35	91	(42-375)
yellow perch	35	212	(160-253)
yellow bullhead	29	129	(30-232)
bluegill	22	167	(37-202)
pumpkinseed	6	100	(78-143)
tessellated darter	4	54	(47-60)
white perch	3	189	(160-205)
redfin pickerel	2	133	(125-140)

Pond Name/Station No.: Omega Pond/9.b.43
 Station Location: East Providence
 Sample Date: 17 May 02
 Sampling Duration (s): 4213
 Land Use: Urban
 Temperature (°C) Air/H2O: --/17
 DO (mg/l): 9.56 pH: 7.19 Conductivity (uS/cm): 310
 Dominate Substrate Types (%):
 Unknown because of high turbidity.

<u>Species</u>	<u>N</u>	<u>Total Length (mm)</u>	
		<u>Mean (Range)</u>	
bluegill	64	156	(43-205)
pumpkinseed	27	132	(90-200)
white perch	22	154	(96-246)
largemouth bass	18	306	(103-490)
yellow perch	16	185	(100-266)
golden shiner	8	172	(92-212)
black crappie	6	221	(190-254)
alewife	5	272	(255-286)
gizzard shad	4	455	(414-477)
white sucker	2	444	(442-445)
American eel	1	320	
white catfish	1	310	

APPENDIX E

Economic Analysis

Energy Modeling Results

Results w/ Instream Flows

ID	Site	D.A. (SqMi)	Gross Head (ft)	Hyd.Cap (cfs)	Installed Capacity (kw)	Net Annual Energy (MWH)	Capacity Factor	Runner Dia Meters	Penstk Dia Ft.	Equipment Configuration
A	Turners Reservoir Dam	48	14.5	213	205	715	40%	1.25	5.82	Horz Tube
B	Turner - Hunt's Mill	48	22	114	156	456	33%	0.90	4.26	Horz Tube
C	Turner - Hunt's Mill 2	48	38	114	288	831	33%	0.90	4.26	Vert Kaplan
C-2	Turner - Hunt's Mill 2 (Repowered Francis)	48	38	114	282	743	30%	0.92	4.26	Vert Francis
D	Hunt's Mill Dam	53	8.5	213	112	400	40%	1.25	5.82	Horz Tube
E	Hunt's Mill Dam 2	53	23.5	114	184	524	33%	0.90	4.26	Horz Tube
E-2	Hunt's Mill Dam 2 (Repowered Francis)	53	23.5	114	178	464	30%	0.90	4.26	Vert Francis
E-3	Hunt's Mill Dam 2 (Restored Francis)	53	23.5	84	110	335	35%	0.81	3.66	Vert Francis
F	Omega Pond Dam	56	8	213	104	374	40%	1.25	5.82	Horz Tube

Results w. 1/2 Instream Flows

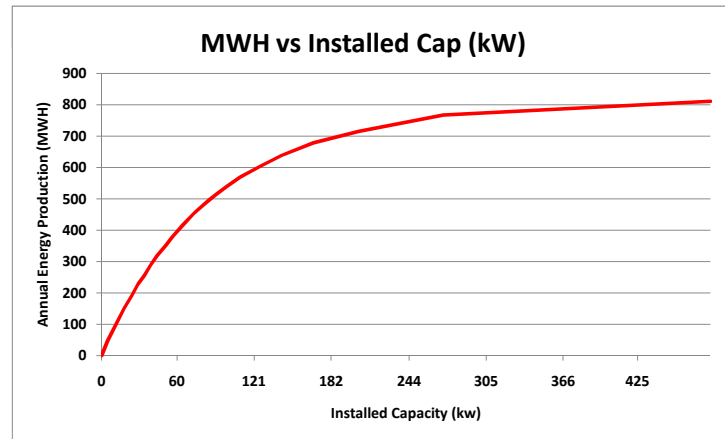
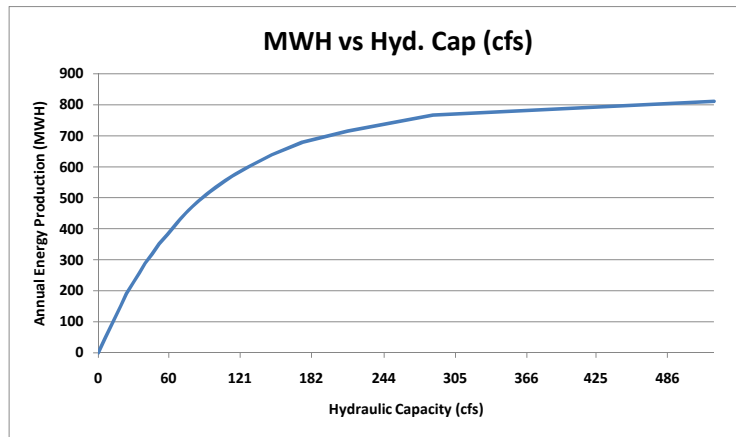
ID	Site	D.A. (SqMi)	Gross Head (ft)	Hyd.Cap (cfs)	Installed Capacity (kw)	Net Annual Energy (MWH)	Capacity Factor	Runner Dia Meters	Penstk Dia Ft.	Equipment Configuration
B	Turner - Hunt's Mill	48	22	130	176	626	41%	0.95	4.55	Horz Tube
C	Turner - Hunt's Mill 2	48	38	130	326	1,137	40%	0.95	4.55	Vert Kaplan
E	Hunt's Mill Dam 2	53	23.5	130	209	717	39%	0.95	4.55	Horz Tube

Results w. No Instream Flows

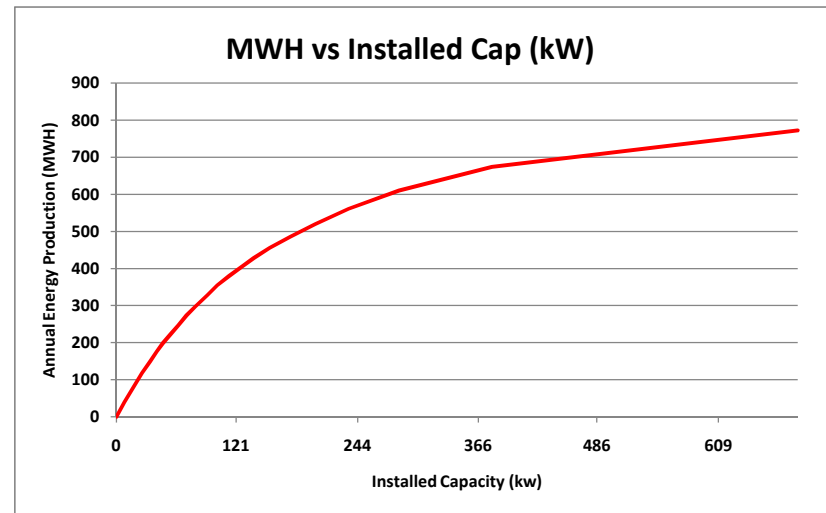
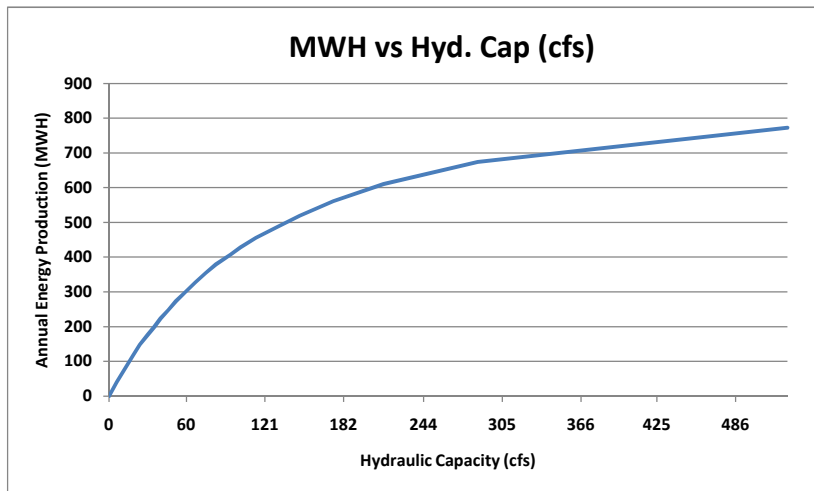
ID	Site	D.A. (SqMi)	Gross Head (ft)	Hyd.Cap (cfs)	Installed Capacity (kw)	Net Annual Energy (MWH)	Capacity Factor	Runner Dia Meters	Penstk Dia Ft.	Equipment Configuration
B	Turner - Hunt's Mill	48	22	213	288	1,050	42%	1.25	5.82	Horz Tube
C	Turner - Hunt's Mill 2	48	38	213	534	1,889	40%	1.25	5.82	Vert Kaplan
E	Hunt's Mill Dam 2	53	23.5	213	341	1,184	40%	1.25	5.82	Horz Tube
E-2	Hunt's Mill 2 (Repowered Francis)	53	23.5	174	271	815	38%	1.12	5.21	Vert Francis



% Exceedance	Max Turbine Flow (CFS)	Head for Installed capacity (FT)											Alternative			
													A	D	F	
													14.5	8.5	8.0	
		Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)	Installed Capacity (kW)	Installed Capacity (kW)
		5	6	8.0	8.5	10	Head (FT)					16				
							11	12	13	14	14.5	16				
100%	6	14	18	25	27	30	34	38	41	45	49	52	93%	6	3	3
95%	19	44	55	78	84	95	106	118	129	140	152	163	91%	19	11	10
90%	25	55	70	98	105	120	134	148	163	177	191	206	89%	24	14	13
85%	30	66	83	117	126	143	160	177	194	211	228	245	87%	30	17	15
80%	35	75	94	132	142	161	180	199	218	237	257	276	85%	34	19	18
75%	41	84	106	149	160	181	203	224	246	267	289	310	83%	40	22	21
70%	46	93	117	165	176	200	224	248	271	295	319	343	81%	45	25	23
65%	53	103	129	182	195	221	247	273	300	326	352	378	78%	51	28	26
60%	59	112	141	198	212	240	269	297	325	354	382	411	76%	58	32	30
55%	67	123	154	217	232	263	294	325	356	387	418	450	73%	66	36	34
50%	76	133	167	234	251	284	318	351	385	418	452	485	70%	74	41	38
45%	84	143	178	250	268	303	339	375	410	446	482	517	67%	82	45	42
40%	94	153	191	267	286	324	362	401	439	477	515	553	64%	92	51	47
35%	102	160	200	280	300	340	380	419	459	499	539	579	62%	99	55	51
30%	114	170	212	296	317	359	401	443	485	527	569	611	59%	111	61	57
25%	130	181	225	314	337	381	426	470	515	559	604	648	55%	126	69	65
20%	149	192	239	333	357	404	451	498	545	592	639	686	51%	143	79	73
15%	174	204	254	354	379	429	479	529	579	629	679	729	46%	168	92	86
10%	213	216	269	374	400	453	505	558	610	663	715	768	40%	205	112	104
5%	286	232	288	401	429	485	542	598	654	711	767	823	32%	271	147	136
1%	527	243	303	422	452	512	572	632	691	751	811	870	19%	484	254	235

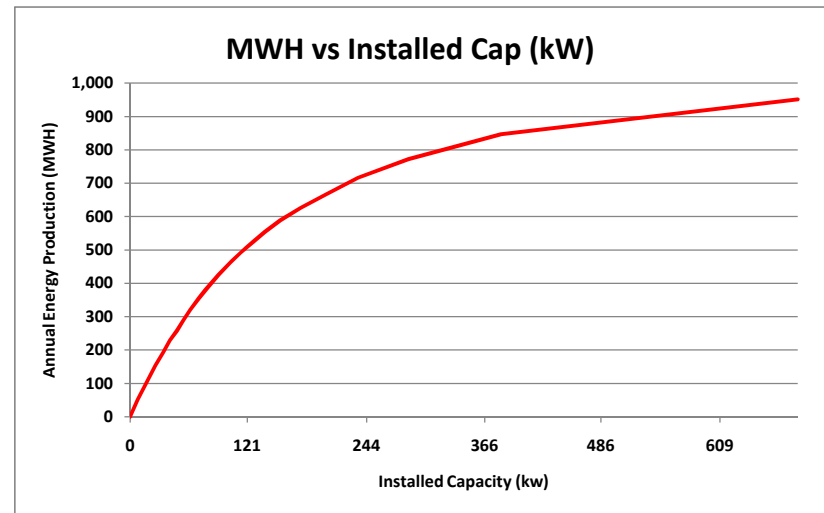
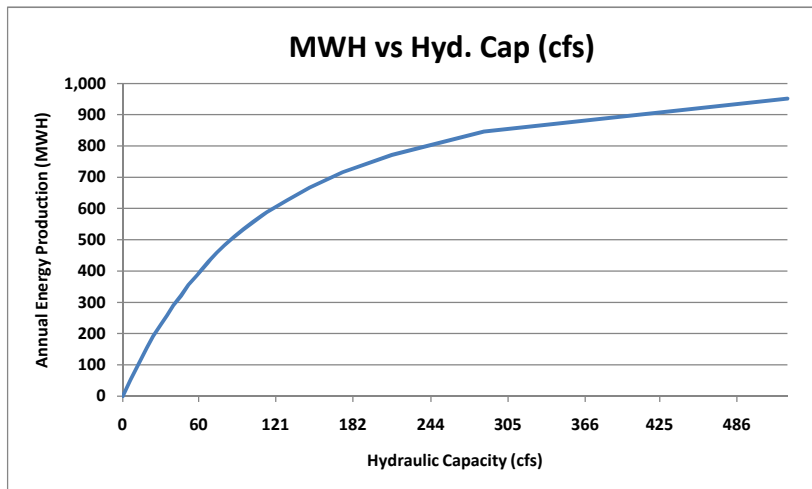


% Exceedance	Max Turbine Flow (CFS)	Head for Installed capacity (FT)											Net Capacity Factor (%)	Installed Capacity (kW)
		Net Energy (MWH)												
		22	24	26	28	30	Head (FT)		34	36.6	38	40		
100%	6	40	44	48	53	57	61	65	71	74	78	82	55%	8
95%	19	118	131	144	156	169	181	194	210	219	231	244	51%	27
90%	25	148	164	180	195	211	227	242	263	274	289	305	50%	34
85%	30	176	195	213	232	251	269	288	312	325	343	362	48%	42
80%	35	198	219	240	261	282	303	324	351	365	386	407	47%	48
75%	41	224	247	271	294	318	341	365	395	412	435	459	46%	55
70%	46	247	273	299	325	351	377	403	437	455	481	507	45%	63
65%	53	274	302	331	360	388	417	446	483	503	532	560	44%	72
60%	59	298	329	360	391	422	454	485	525	547	578	609	42%	81
55%	67	328	362	396	430	464	498	532	577	601	635	669	40%	93
50%	76	355	391	428	465	502	539	576	623	649	686	723	39%	103
45%	84	380	419	458	498	537	576	616	667	694	734	773	38%	114
40%	94	407	449	491	533	575	617	659	714	743	785	828	36%	128
35%	102	428	472	517	561	605	649	693	751	782	826	870	35%	139
30%	114	456	503	549	596	643	690	737	798	831	878	925	33%	156
25%	130	486	536	586	636	686	735	785	850	885	935	985	31%	176
20%	149	520	573	626	679	732	786	839	908	945	998	1,052	29%	201
15%	174	561	618	675	733	790	847	905	979	1,019	1,076	1,134	27%	235
10%	213	611	673	735	797	859	922	984	1,065	1,108	1,170	1,233	24%	287
5%	286	674	743	811	879	947	1,016	1,084	1,173	1,221	1,289	1,357	20%	380
1%	527	772	850	928	1,006	1,083	1,161	1,239	1,340	1,394	1,472	1,550	13%	689



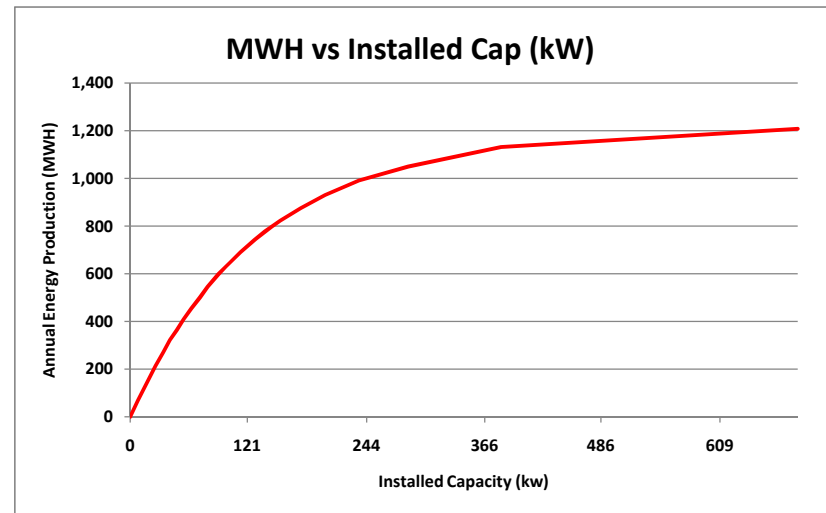
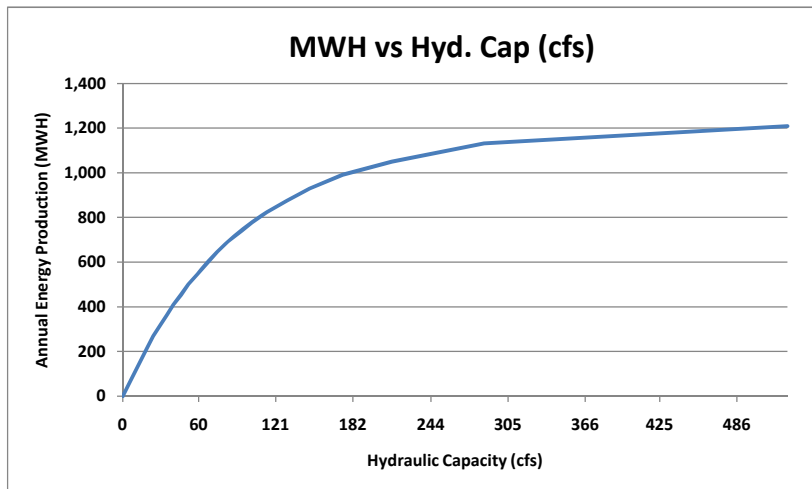
% Exceedance	Max Turbine Flow (CFS)	Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		Head (FT)												
		22	24	26	28	30	32	34	36.6	38	40	42		
100%	6	52	57	63	68	74	79	85	92	96	101	107	71%	8
95%	19	154	170	187	203	219	235	252	273	284	300	317	66%	27
90%	25	192	213	233	253	274	294	314	340	355	375	395	64%	34
85%	30	229	253	277	301	325	349	373	405	421	445	470	63%	42
80%	35	258	285	312	339	366	393	420	456	475	502	529	61%	48
75%	41	291	321	352	382	412	443	473	513	534	565	595	60%	55
70%	46	321	355	388	422	455	489	523	566	590	623	657	58%	63
65%	53	355	392	430	467	504	541	578	626	652	689	726	56%	72
60%	59	388	428	469	509	549	590	630	683	711	752	792	55%	81
55%	67	426	470	515	559	603	647	692	749	780	825	869	53%	92
50%	76	461	509	557	604	652	700	748	810	843	891	939	51%	104
45%	84	492	543	594	645	696	747	798	864	899	950	1,001	49%	114
40%	94	528	582	637	691	745	800	854	925	963	1,017	1,072	47%	129
35%	102	554	611	668	725	782	839	896	970	1,010	1,067	1,124	45%	139
30%	114	589	649	709	770	830	890	951	1,029	1,071	1,132	1,192	43%	156
25%	130	626	690	754	818	882	946	1,010	1,093	1,137	1,201	1,265	41%	176
20%	149	667	734	802	870	938	1,006	1,074	1,162	1,209	1,277	1,345	38%	202
15%	174	716	789	861	934	1,006	1,079	1,151	1,246	1,297	1,369	1,442	35%	235
10%	213	772	850	928	1,006	1,083	1,161	1,239	1,341	1,395	1,473	1,551	31%	288
5%	286	846	932	1,017	1,102	1,187	1,272	1,357	1,468	1,527	1,612	1,697	25%	383
1%	527	951	1,046	1,141	1,235	1,330	1,425	1,520	1,643	1,709	1,804	1,899	16%	689

Head for Installed capacity (FT) 22.0



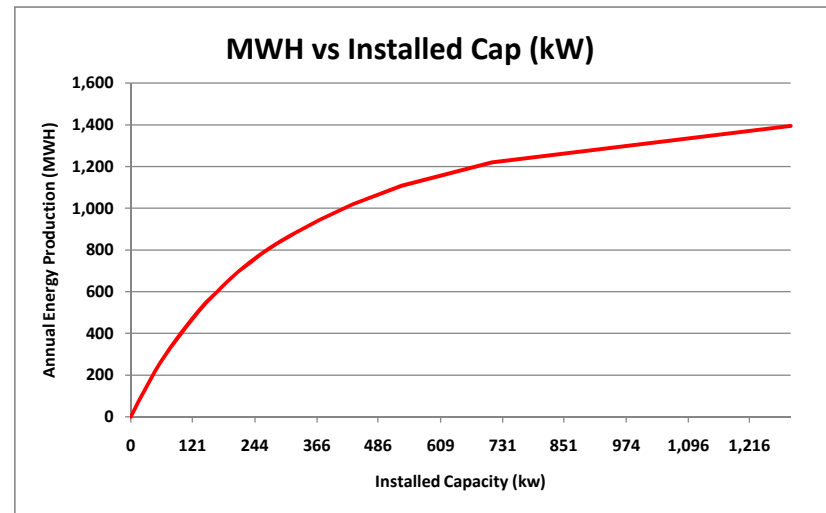
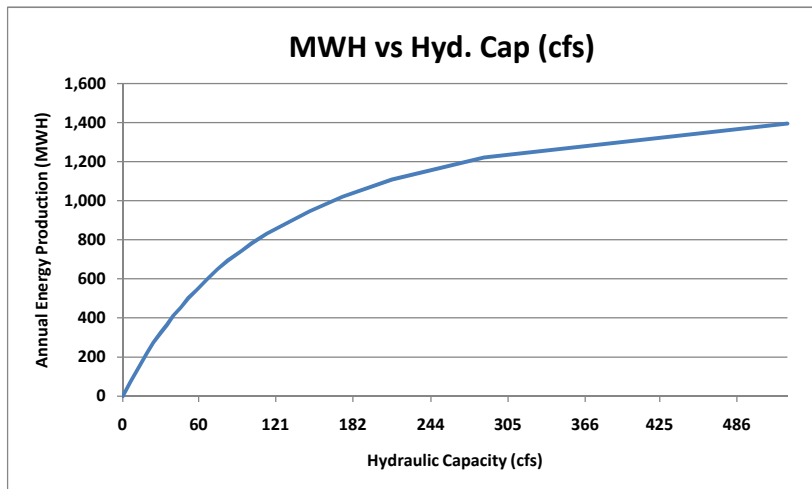
% Exceedance	Max Turbine Flow (CFS)	Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		Head (FT)												
		22	24	26	28	30	32	34	36.6	38	40	42		
100%	6	68	75	83	90	97	104	112	121	126	133	140	93%	8
95%	19	213	236	259	281	304	326	349	378	394	417	439	92%	27
90%	25	270	298	326	355	383	412	440	477	497	525	554	90%	34
85%	30	322	356	390	424	458	492	526	570	594	627	661	88%	42
80%	35	363	401	439	477	516	554	592	641	668	706	744	86%	48
75%	41	410	452	495	538	581	624	666	722	752	795	837	84%	56
70%	46	453	500	548	595	642	689	737	798	831	878	925	82%	63
65%	53	501	553	605	657	709	761	813	881	918	970	1,022	79%	72
60%	59	545	602	658	715	771	828	885	958	998	1,054	1,111	77%	81
55%	67	598	660	722	784	846	907	969	1,050	1,093	1,155	1,217	74%	92
50%	76	647	714	780	847	914	980	1,047	1,134	1,180	1,247	1,314	71%	103
45%	84	691	763	834	905	976	1,047	1,118	1,210	1,260	1,331	1,402	69%	115
40%	94	741	817	893	969	1,045	1,120	1,196	1,295	1,348	1,424	1,500	66%	128
35%	102	777	856	936	1,015	1,095	1,174	1,253	1,357	1,412	1,492	1,571	64%	139
30%	114	823	907	991	1,074	1,158	1,242	1,326	1,435	1,494	1,577	1,661	60%	156
25%	130	875	964	1,053	1,142	1,231	1,319	1,408	1,524	1,586	1,675	1,763	56%	177
20%	149	930	1,024	1,118	1,212	1,306	1,399	1,493	1,615	1,681	1,775	1,869	53%	202
15%	174	991	1,091	1,191	1,290	1,390	1,489	1,589	1,718	1,788	1,888	1,987	48%	236
10%	213	1,050	1,155	1,260	1,364	1,469	1,574	1,679	1,816	1,889	1,994	2,099	42%	288
5%	286	1,131	1,244	1,356	1,469	1,581	1,694	1,806	1,952	2,031	2,143	2,256	34%	383
1%	527	1,209	1,328	1,448	1,567	1,686	1,806	1,925	2,080	2,164	2,283	2,402	20%	689

Head for Installed capacity (FT) 22.0



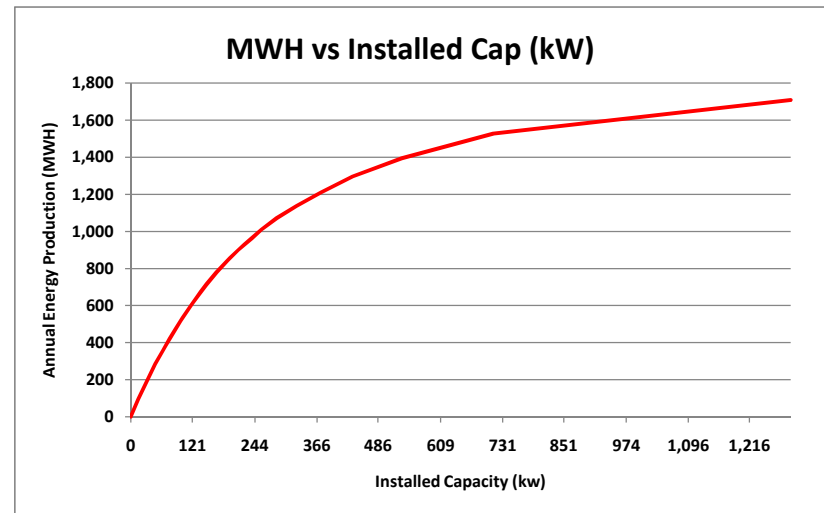
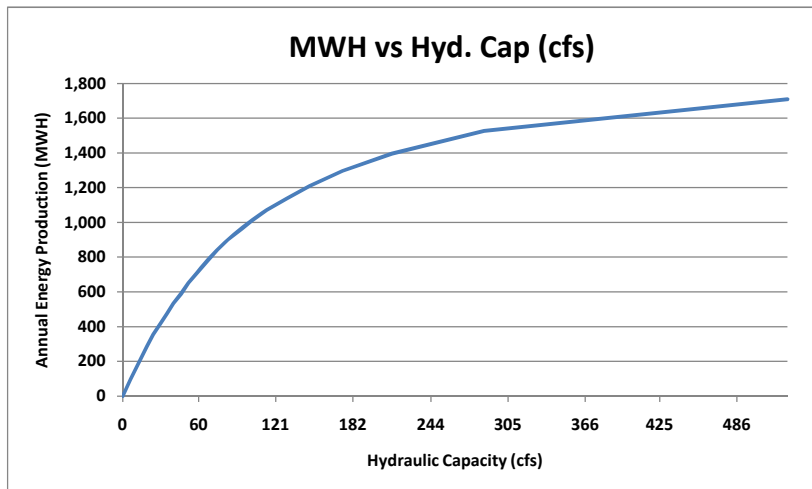
% Exceedance	Max Turbine Flow (CFS)	Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		Head (FT)												
		22	24	26	28	30	32	34	36.6	38	40	42		
100%	6	40	44	48	53	57	61	65	71	74	78	82	55%	15
95%	19	118	131	144	156	169	181	194	210	219	231	244	51%	49
90%	25	148	164	180	195	211	227	242	263	274	289	305	50%	63
85%	30	176	195	213	232	251	269	288	312	325	343	362	48%	77
80%	35	198	219	240	261	282	303	324	351	365	386	407	47%	88
75%	41	224	247	271	294	318	341	365	395	412	435	459	46%	102
70%	46	247	273	299	325	351	377	403	437	455	481	507	44%	117
65%	53	274	302	331	360	388	417	446	483	503	532	560	43%	132
60%	59	298	329	360	391	422	454	485	525	547	578	609	42%	149
55%	67	328	362	396	430	464	498	532	577	601	635	669	40%	171
50%	76	355	391	428	465	502	539	576	623	649	686	723	39%	190
45%	84	380	419	458	498	537	576	616	667	694	734	773	38%	211
40%	94	407	449	491	533	575	617	659	714	743	785	828	36%	237
35%	102	428	472	517	561	605	649	693	751	782	826	870	35%	257
30%	114	456	503	549	596	643	690	737	798	831	878	925	33%	288
25%	130	486	536	586	636	686	735	785	850	885	935	985	31%	326
20%	149	520	573	626	679	732	786	839	908	945	998	1,052	29%	373
15%	174	561	618	675	733	790	847	905	979	1,019	1,076	1,134	27%	437
10%	213	611	673	735	797	859	922	984	1,065	1,108	1,170	1,233	24%	533
5%	286	674	743	811	879	947	1,016	1,084	1,173	1,221	1,289	1,357	20%	710
1%	527	772	850	928	1,006	1,083	1,161	1,239	1,340	1,394	1,472	1,550	12%	1,297

Head for Installed capacity (FT) **38.0**

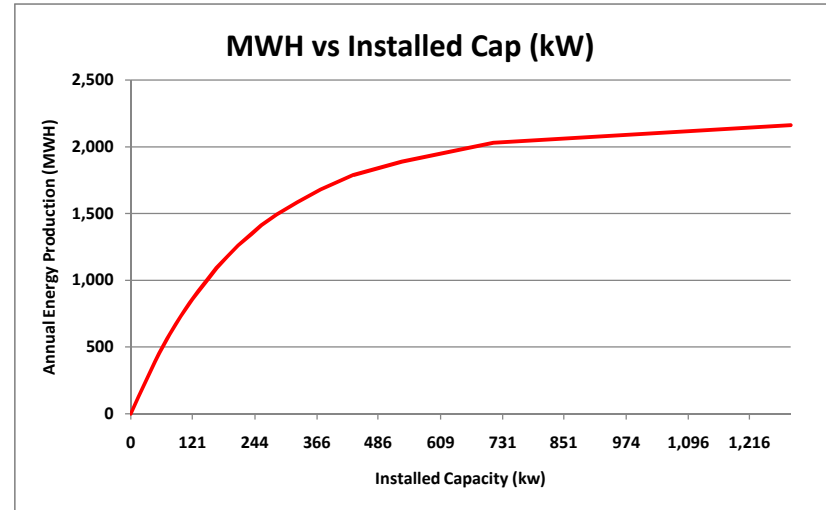
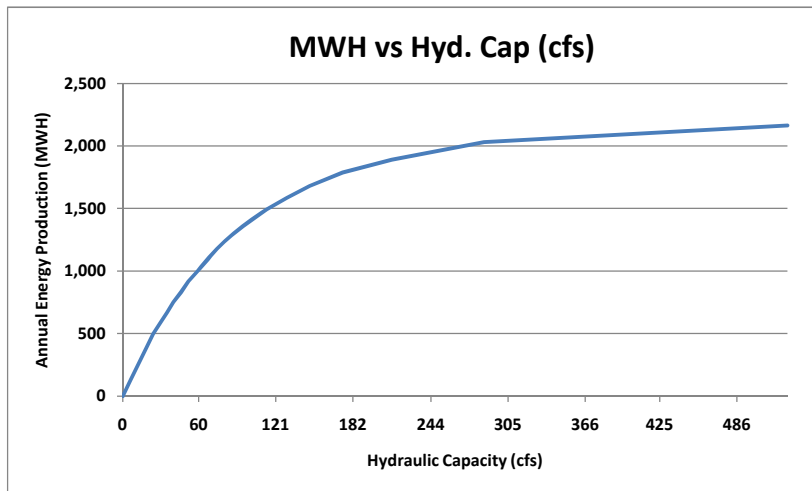


% Exceedance	Max Turbine Flow (CFS)	Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		Head (FT)												
		22	24	26	28	30	32	34	36.6	38	40	42		
100%	6	52	57	63	68	74	79	85	92	96	101	107	71%	15
95%	19	154	170	187	203	219	235	252	273	284	300	317	66%	49
90%	25	192	213	233	253	274	294	314	340	355	375	395	64%	63
85%	30	229	253	277	301	325	349	373	405	421	445	470	63%	77
80%	35	258	285	312	339	366	393	420	456	475	502	529	61%	89
75%	41	291	321	352	382	412	443	473	513	534	565	595	60%	102
70%	46	321	355	388	422	455	489	523	566	590	623	657	58%	116
65%	53	355	392	430	467	504	541	578	626	652	689	726	56%	132
60%	59	388	428	469	509	549	590	630	683	711	752	792	55%	149
55%	67	426	470	515	559	603	647	692	749	780	825	869	52%	170
50%	76	461	509	557	604	652	700	748	810	843	891	939	50%	192
45%	84	492	543	594	645	696	747	798	864	899	950	1,001	49%	211
40%	94	528	582	637	691	745	800	854	925	963	1,017	1,072	46%	238
35%	102	554	611	668	725	782	839	896	970	1,010	1,067	1,124	45%	257
30%	114	589	649	709	770	830	890	951	1,029	1,071	1,132	1,192	43%	288
25%	130	626	690	754	818	882	946	1,010	1,093	1,137	1,201	1,265	40%	326
20%	149	667	734	802	870	938	1,006	1,074	1,162	1,209	1,277	1,345	37%	375
15%	174	716	789	861	934	1,006	1,079	1,151	1,246	1,297	1,369	1,442	34%	437
10%	213	772	850	928	1,006	1,083	1,161	1,239	1,341	1,395	1,473	1,551	30%	534
5%	286	846	932	1,017	1,102	1,187	1,272	1,357	1,468	1,527	1,612	1,697	24%	713
1%	527	951	1,046	1,141	1,235	1,330	1,425	1,520	1,643	1,709	1,804	1,899	15%	1,297

Head for Installed capacity (FT) 38.0

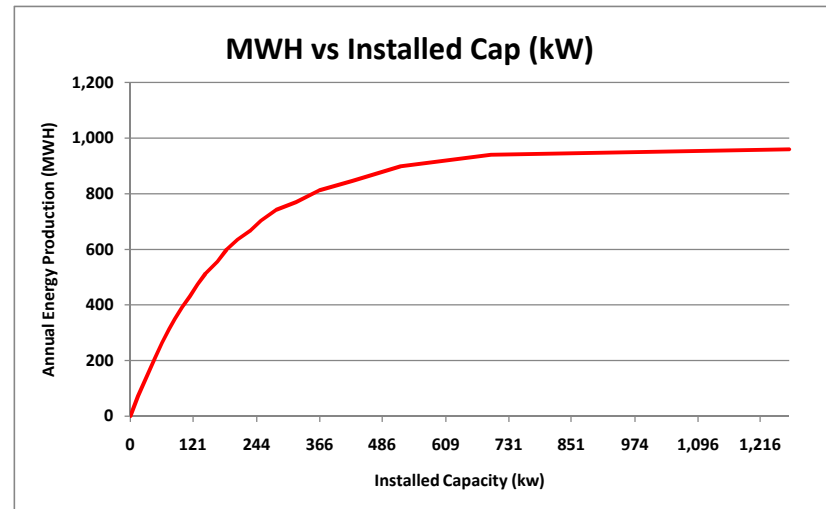
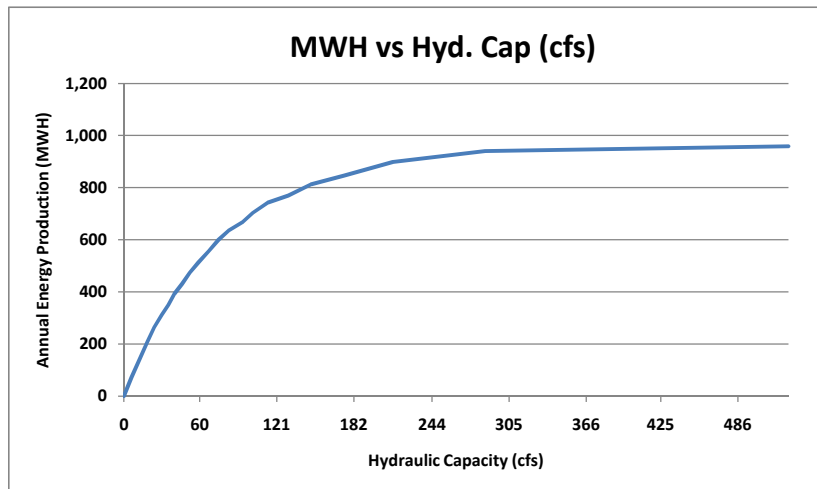


% Exceedance	Max Turbine Flow (CFS)	Head for Installed capacity (FT)											Net Capacity Factor (%)	Installed Capacity (kW)
		Net Energy (MWH)												
		22	24	26	28	30	Head (FT)		34	36.6	38	40		
100%	6	68	75	83	90	97	104	112	121	126	133	140	94%	15
95%	19	213	236	259	281	304	326	349	378	394	417	439	92%	49
90%	25	270	298	326	355	383	412	440	477	497	525	554	90%	63
85%	30	322	356	390	424	458	492	526	570	594	627	661	88%	77
80%	35	363	401	439	477	516	554	592	641	668	706	744	86%	89
75%	41	410	452	495	538	581	624	666	722	752	795	837	84%	102
70%	46	453	500	548	595	642	689	737	798	831	878	925	82%	116
65%	53	501	553	605	657	709	761	813	881	918	970	1,022	79%	133
60%	59	545	602	658	715	771	828	885	958	998	1,054	1,111	76%	149
55%	67	598	660	722	784	846	907	969	1,050	1,093	1,155	1,217	74%	170
50%	76	647	714	780	847	914	980	1,047	1,134	1,180	1,247	1,314	71%	191
45%	84	691	763	834	905	976	1,047	1,118	1,210	1,260	1,331	1,402	68%	212
40%	94	741	817	893	969	1,045	1,120	1,196	1,295	1,348	1,424	1,500	65%	237
35%	102	777	856	936	1,015	1,095	1,174	1,253	1,357	1,412	1,492	1,571	63%	257
30%	114	823	907	991	1,074	1,158	1,242	1,326	1,435	1,494	1,577	1,661	59%	288
25%	130	875	964	1,053	1,142	1,231	1,319	1,408	1,524	1,586	1,675	1,763	55%	327
20%	149	930	1,024	1,118	1,212	1,306	1,399	1,493	1,615	1,681	1,775	1,869	51%	373
15%	174	991	1,091	1,191	1,290	1,390	1,489	1,589	1,718	1,788	1,888	1,987	47%	438
10%	213	1,050	1,155	1,260	1,364	1,469	1,574	1,679	1,816	1,889	1,994	2,099	40%	534
5%	286	1,131	1,244	1,356	1,469	1,581	1,694	1,806	1,952	2,031	2,143	2,256	33%	713
1%	527	1,209	1,328	1,448	1,567	1,686	1,806	1,925	2,080	2,164	2,283	2,402	19%	1,297



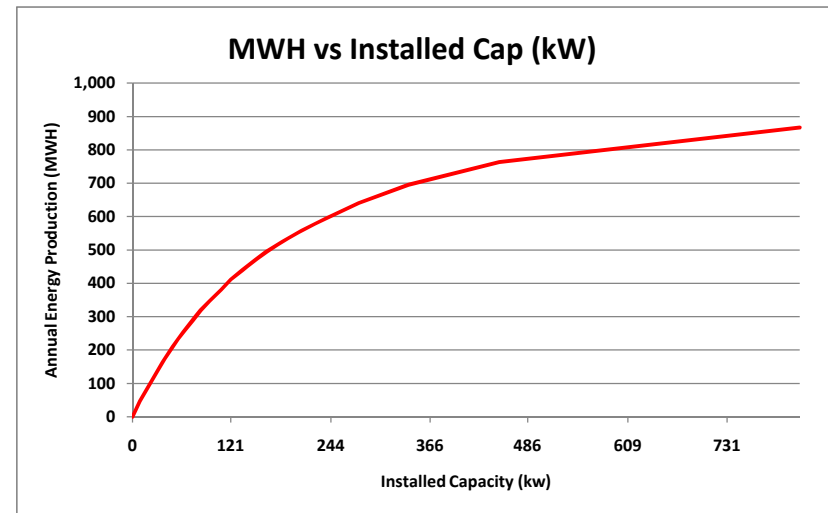
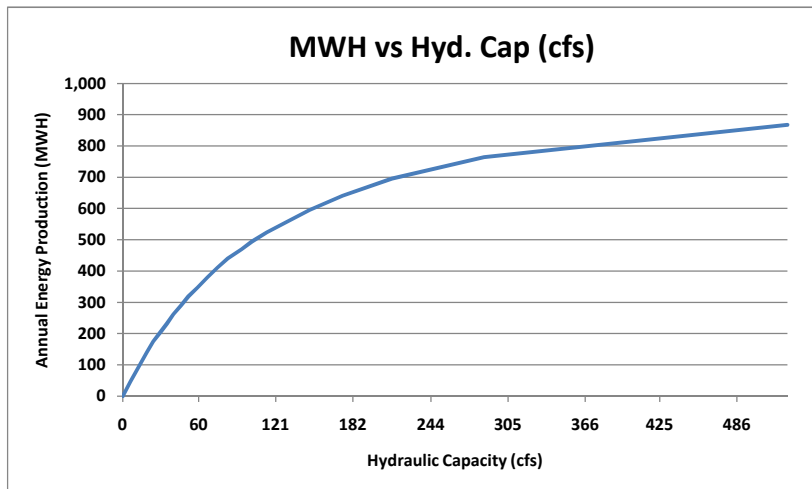
% Exceedance	Max Turbine Flow (CFS)	Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		Head (FT)												
		22	24	26.2	28	30	32	34	36.6	38	40	42		
100%	6	38	42	47	51	55	59	64	69	72	76	81	55%	15
95%	19	111	124	137	149	161	173	186	202	211	223	236	50%	48
90%	25	139	155	172	186	202	217	233	253	264	279	295	49%	62
85%	30	165	184	204	220	239	257	276	300	312	331	349	47%	75
80%	35	185	206	229	247	268	288	309	336	350	371	391	46%	87
75%	41	208	231	257	277	300	324	347	377	393	416	439	45%	100
70%	46	228	253	281	304	329	354	380	412	430	455	481	43%	115
65%	53	251	279	310	335	363	390	418	454	474	502	529	42%	130
60%	59	273	303	336	363	393	423	453	492	513	543	573	40%	146
55%	67	296	328	364	393	426	459	491	533	556	589	621	38%	168
50%	76	320	355	393	425	460	495	530	576	600	635	670	37%	187
45%	84	339	376	417	450	487	524	561	609	635	672	709	35%	207
40%	94	356	395	438	473	512	551	590	640	667	706	745	33%	232
35%	102	376	417	462	498	539	580	621	674	703	744	785	32%	253
30%	114	398	441	488	527	570	613	656	712	743	786	829	30%	282
25%	130	412	457	506	546	591	636	681	739	770	815	860	27%	320
20%	149	435	483	534	577	624	671	718	779	812	859	907	25%	366
15%	174	453	502	556	601	650	699	748	812	846	895	944	23%	428
10%	213	482	534	591	638	690	742	794	862	899	951	1,003	20%	522
5%	286	505	559	619	668	723	777	831	902	940	995	1,049	15%	697
1%	527	515	570	631	682	737	793	848	920	959	1,015	1,070	9%	1,272

Head for Installed capacity (FT) 38.0

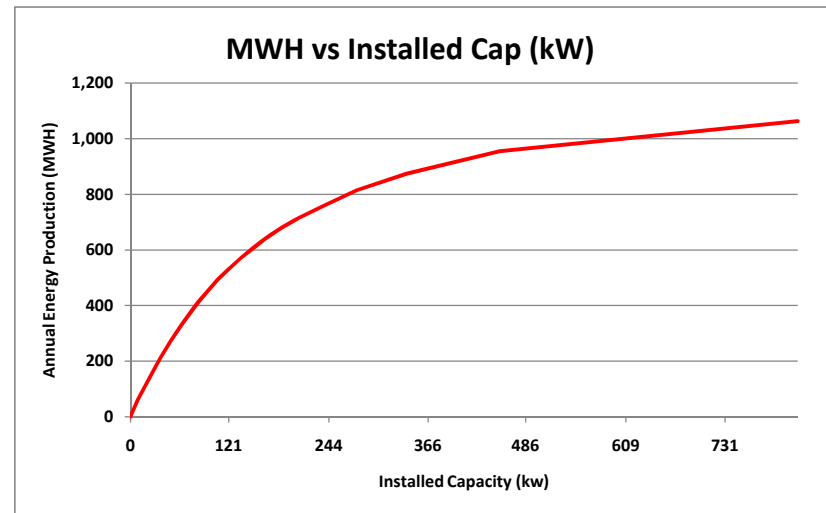
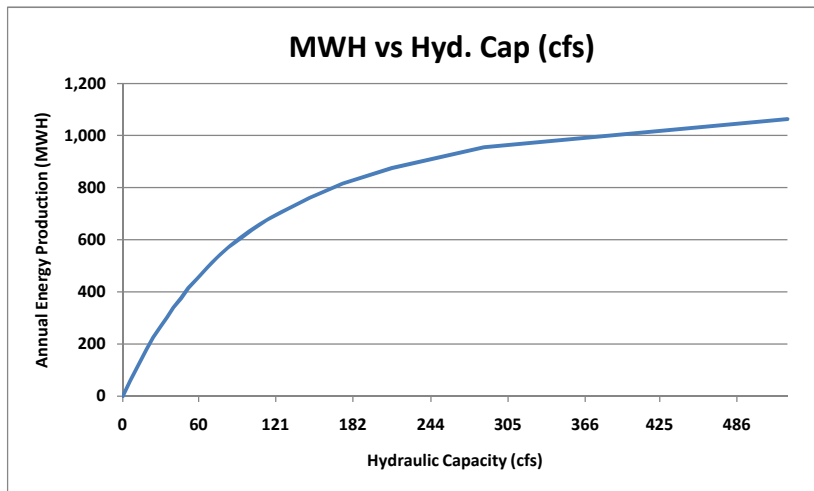


% Exceedance	Max Turbine Flow (CFS)	Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		Head (FT)												
		22	23.5	26.0	28	30	32	34	36	38	40	42		
100%	6	44	47	52	57	61	65	69	74	78	82	86	55%	10
95%	19	130	139	155	168	180	193	205	218	230	243	255	51%	31
90%	25	163	174	194	210	225	241	257	272	288	304	319	49%	40
85%	30	193	207	230	249	267	286	304	323	341	360	379	48%	49
80%	35	217	233	259	280	300	321	342	363	384	405	426	47%	57
75%	41	244	262	291	315	338	362	385	409	432	456	479	46%	66
70%	46	269	289	321	347	373	399	425	451	477	503	529	44%	75
65%	53	298	319	355	384	412	441	470	498	527	556	584	43%	85
60%	59	324	347	386	417	448	479	510	542	573	604	635	42%	95
55%	67	355	381	423	458	492	526	560	594	628	662	696	40%	109
50%	76	383	411	457	494	531	568	604	641	678	715	752	39%	122
45%	84	410	439	488	528	567	607	646	685	725	764	803	37%	135
40%	94	438	470	522	565	607	649	691	733	775	817	859	35%	151
35%	102	461	494	549	593	637	682	726	770	814	859	903	34%	165
30%	114	489	524	583	630	677	724	770	817	864	911	958	33%	184
25%	130	520	558	620	670	720	770	820	870	919	969	1,019	31%	209
20%	149	555	595	661	715	768	821	874	927	981	1,034	1,087	29%	238
15%	174	598	640	712	769	827	884	941	998	1,056	1,113	1,170	26%	279
10%	213	649	695	773	835	898	960	1,022	1,084	1,146	1,209	1,271	23%	340
5%	286	713	764	849	917	986	1,054	1,122	1,191	1,259	1,327	1,396	19%	451
1%	527	809	867	965	1,042	1,120	1,198	1,276	1,353	1,431	1,509	1,587	12%	821

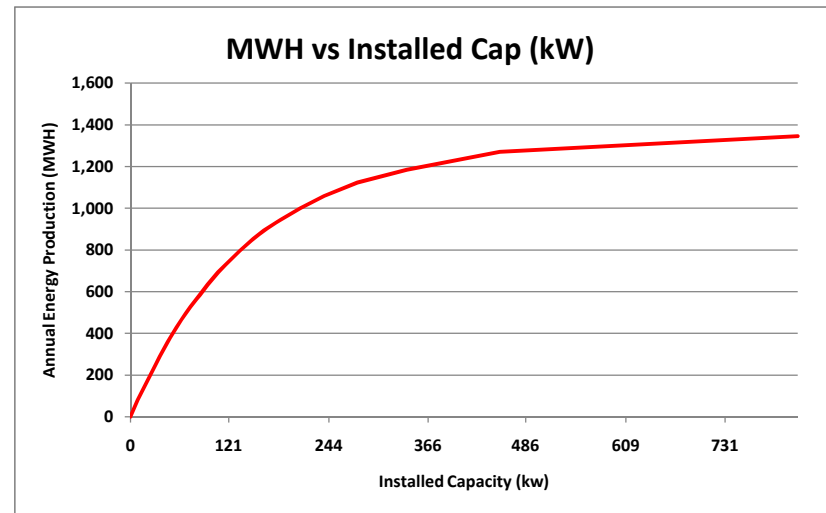
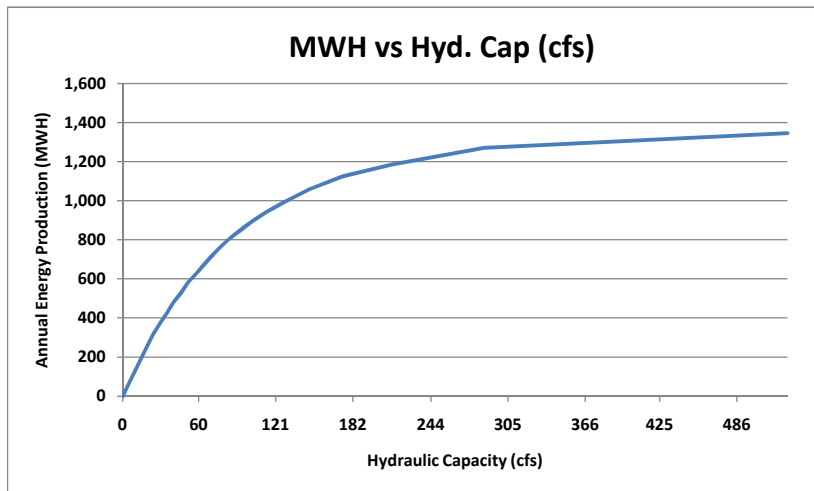
Head for Installed capacity (FT) 23.5



% Exceedance	Max Turbine Flow (CFS)	Head for Installed capacity (FT)											Net Capacity Factor (%)	Installed Capacity (kW)	
		Net Energy (MWH)													
		22	23.5	26.0	28	30	Head (FT)		34	36	38	40			42
100%	6	57	61	68	73	79	84		90	95	101	106	112	71%	10
95%	19	169	181	202	218	234	250		267	283	299	315	332	66%	31
90%	25	211	226	251	272	292	312		333	353	373	393	414	64%	41
85%	30	250	268	299	323	347	371		395	419	443	467	491	62%	49
80%	35	282	302	336	363	390	417		444	471	499	526	553	61%	57
75%	41	317	340	378	408	439	469		500	530	561	591	622	59%	66
70%	46	350	375	417	451	484	518		551	585	618	652	686	57%	74
65%	53	387	414	461	498	535	572		609	646	683	721	758	56%	85
60%	59	421	452	502	542	583	623		664	704	745	785	825	54%	95
55%	67	462	495	550	595	639	683		727	772	816	860	904	52%	109
50%	76	499	534	594	642	690	737		785	833	881	929	976	50%	123
45%	84	531	569	633	684	735	786		836	887	938	989	1,040	48%	135
40%	94	568	609	677	731	786	840		895	949	1,003	1,058	1,112	46%	152
35%	102	595	638	709	766	823	880		937	994	1,051	1,108	1,165	44%	165
30%	114	631	676	752	812	872	933		993	1,053	1,114	1,174	1,234	42%	184
25%	130	669	717	797	861	925	989		1,053	1,117	1,181	1,245	1,309	39%	209
20%	149	710	761	846	914	982	1,050		1,117	1,185	1,253	1,321	1,389	36%	239
15%	174	760	815	906	978	1,051	1,123		1,196	1,268	1,341	1,413	1,486	33%	279
10%	213	817	875	972	1,050	1,128	1,206		1,284	1,362	1,440	1,518	1,596	29%	341
5%	286	892	956	1,062	1,147	1,232	1,317		1,402	1,487	1,573	1,658	1,743	24%	454
1%	527	992	1,063	1,182	1,276	1,371	1,466		1,561	1,655	1,750	1,845	1,940	15%	821

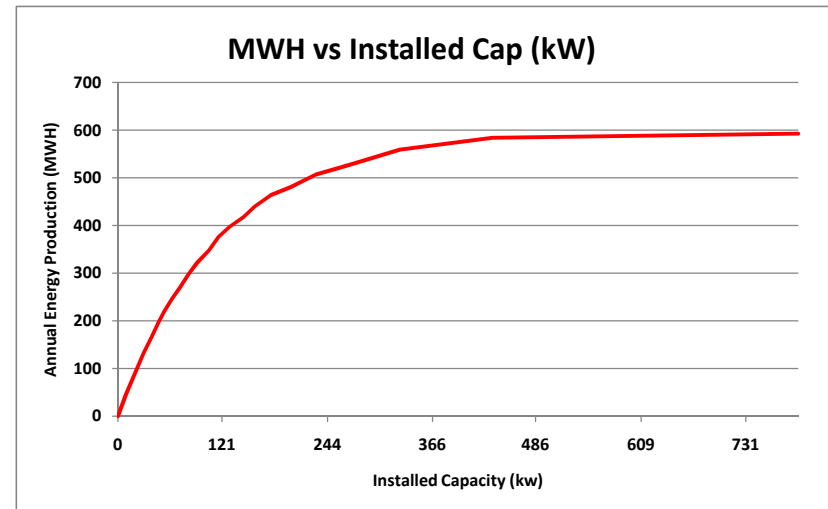
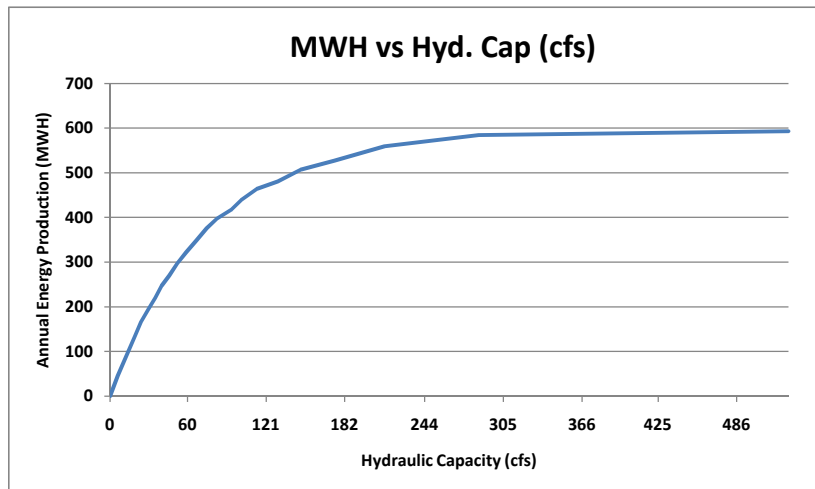


% Exceedance	Max Turbine Flow (CFS)	Head for Installed capacity (FT)											Net Capacity Factor (%)	Installed Capacity (kW)		
		Net Energy (MWH)														
		22	23.5	26.0	28	30	Head (FT)		34	36	38	40			42	
100%	6	75	81	90	97	104	32		111	119	126	133	140	148	93%	10
95%	19	235	252	280	303	325	348		370	393	416	438	461	484	92%	31
90%	25	296	317	353	381	410	438		467	495	524	552	580	608	90%	40
85%	30	353	379	421	455	489	523		557	591	624	658	692	726	88%	49
80%	35	397	426	473	511	549	587		626	664	702	740	778	816	86%	57
75%	41	447	479	532	575	618	661		704	746	789	832	875	918	83%	66
70%	46	493	529	588	635	682	730		777	824	871	918	966	1,013	81%	75
65%	53	544	583	649	701	753	805		857	909	961	1,013	1,065	1,117	78%	85
60%	59	591	634	704	761	818	874		931	987	1,044	1,100	1,157	1,214	76%	96
55%	67	647	694	771	833	895	956		1,018	1,080	1,142	1,204	1,266	1,328	73%	109
50%	76	698	749	832	899	965	1,032		1,099	1,165	1,232	1,299	1,365	1,432	70%	122
45%	84	745	798	887	958	1,029	1,101		1,172	1,243	1,314	1,385	1,456	1,527	67%	136
40%	94	796	853	948	1,024	1,100	1,176		1,252	1,328	1,404	1,480	1,555	1,631	64%	152
35%	102	833	893	992	1,072	1,151	1,230		1,310	1,389	1,469	1,548	1,627	1,706	62%	165
30%	114	880	943	1,048	1,132	1,216	1,300		1,383	1,467	1,551	1,635	1,719	1,803	58%	184
25%	130	933	1,000	1,111	1,200	1,289	1,378		1,466	1,555	1,644	1,733	1,822	1,911	55%	209
20%	149	988	1,058	1,176	1,270	1,364	1,458		1,551	1,645	1,739	1,833	1,927	2,021	51%	238
15%	174	1,049	1,124	1,248	1,348	1,448	1,547		1,647	1,746	1,846	1,946	2,045	2,145	46%	280
10%	213	1,106	1,184	1,316	1,420	1,525	1,630		1,735	1,840	1,945	2,050	2,155	2,260	40%	341
5%	286	1,186	1,270	1,411	1,523	1,635	1,748		1,860	1,973	2,085	2,198	2,310	2,423	32%	454
1%	527	1,256	1,346	1,495	1,614	1,733	1,853		1,972	2,091	2,211	2,330	2,449	2,569	19%	821

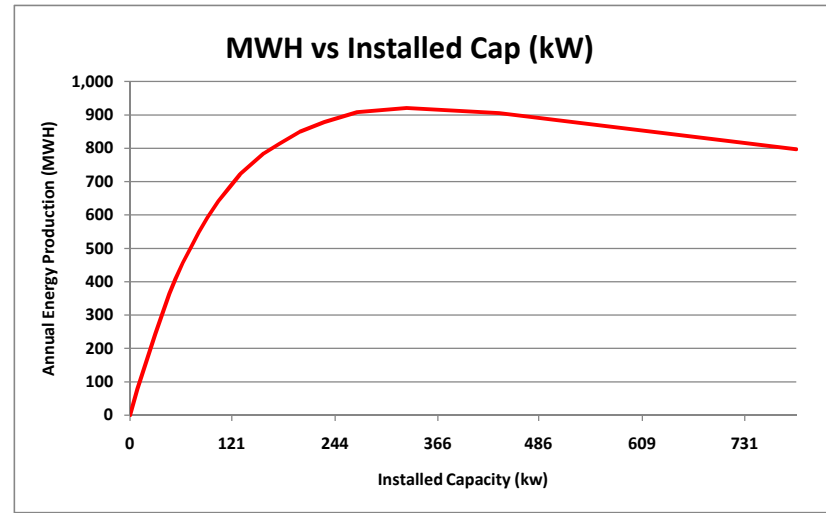
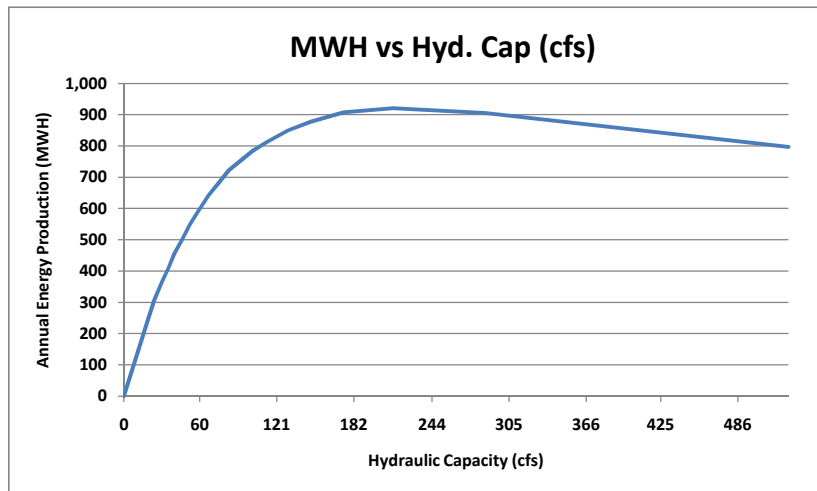


% Exceedance	Max Turbine Flow (CFS)	Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		Head (FT)												
		22	23.5	26.2	28	30	32	34	36.6	38	40	42		
100%	6	42	45	51	55	59	64	68	73	76	81	85	54%	10
95%	19	123	133	149	161	173	185	198	214	223	235	248	50%	30
90%	25	154	166	187	201	216	232	247	268	279	294	310	48%	39
85%	30	182	196	221	238	256	274	293	317	330	348	366	47%	48
80%	35	204	220	248	266	287	307	328	355	369	390	410	46%	55
75%	41	229	247	278	299	322	345	368	398	414	437	460	44%	63
70%	46	251	270	304	327	352	377	403	435	453	478	504	42%	73
65%	53	276	297	335	360	387	415	443	479	499	526	554	41%	82
60%	59	299	322	362	389	420	450	480	519	540	570	600	40%	92
55%	67	324	349	392	422	454	487	519	562	584	617	650	37%	106
50%	76	349	376	423	455	490	525	560	605	630	665	700	36%	118
45%	84	370	398	448	481	518	555	592	640	666	703	740	35%	131
40%	94	388	418	470	505	544	583	622	672	700	739	778	33%	146
35%	102	409	440	495	532	572	613	654	707	736	777	818	31%	159
30%	114	432	464	522	561	604	647	690	746	777	820	863	30%	178
25%	130	447	481	541	581	626	671	716	774	805	850	895	27%	202
20%	149	471	507	570	613	660	707	754	815	848	895	943	25%	230
15%	174	490	527	594	638	687	736	785	849	883	932	981	22%	270
10%	213	520	560	630	677	729	781	833	901	937	989	1,042	19%	328
5%	286	543	584	658	707	761	815	870	941	979	1,033	1,088	15%	436
1%	527	551	593	668	718	774	829	885	957	996	1,051	1,107	9%	792

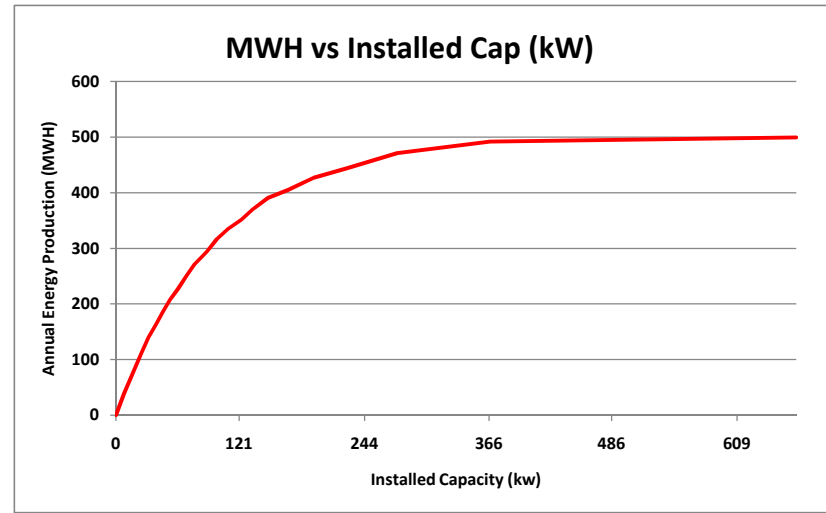
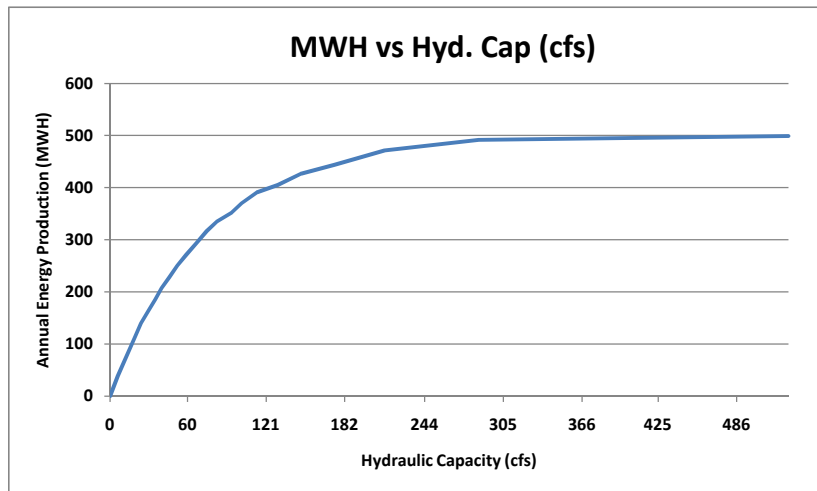
Head for Installed capacity (FT) 23.5



% Exceedance	Max Turbine Flow (CFS)	Head for Installed capacity (FT)											23.5	
		Net Energy (MWH)											Net Capacity Factor (%)	Installed Capacity (kW)
		22	23.5	26.2	28	30	Head (FT)		34	36.6	38	40		
100%	6	72	78	88	94	102	109	116	126	131	138	146	93%	10
95%	19	226	243	274	295	317	340	363	393	409	431	454	91%	30
90%	25	285	306	345	371	399	428	456	494	514	542	571	90%	39
85%	30	339	365	410	441	475	509	543	587	611	645	679	87%	48
80%	35	380	408	459	494	532	570	608	657	684	722	760	85%	55
75%	41	424	456	513	552	594	637	679	734	764	806	849	82%	64
70%	46	465	500	563	605	651	698	744	805	837	884	930	79%	72
65%	53	510	548	617	663	714	765	816	882	917	968	1,019	76%	83
60%	59	552	593	667	716	771	826	881	953	991	1,046	1,101	73%	93
55%	67	597	642	722	776	835	895	954	1,032	1,073	1,133	1,192	70%	105
50%	76	634	682	767	824	887	950	1,013	1,095	1,139	1,203	1,266	66%	118
45%	84	672	722	812	872	939	1,006	1,072	1,159	1,206	1,273	1,340	63%	131
40%	94	705	758	853	916	986	1,056	1,126	1,217	1,266	1,336	1,406	59%	147
35%	102	730	784	882	948	1,020	1,093	1,165	1,259	1,310	1,382	1,455	56%	159
30%	114	758	815	916	984	1,059	1,134	1,210	1,307	1,360	1,435	1,510	52%	178
25%	130	791	850	955	1,026	1,104	1,183	1,261	1,363	1,418	1,496	1,574	48%	202
20%	149	818	878	987	1,060	1,141	1,222	1,303	1,408	1,464	1,545	1,626	43%	232
15%	174	845	908	1,021	1,096	1,179	1,263	1,346	1,455	1,513	1,597	1,680	38%	271
10%	213	857	920	1,034	1,110	1,195	1,280	1,364	1,474	1,533	1,618	1,702	32%	329
5%	286	843	906	1,018	1,093	1,177	1,260	1,343	1,452	1,510	1,594	1,677	24%	439
1%	527	742	797	897	964	1,038	1,112	1,186	1,282	1,334	1,408	1,482	11%	792



% Exceedance	Max Turbine Flow (CFS)	Head for Installed capacity (FT)											Net Capacity Factor (%)	Installed Capacity (kW)		
		Net Energy (MWH)														
		22	23.5	26.2	28	30	Head (FT)		34	36	38	40			42	
100%	6	36	38	43	46	50	32		53	57	61	64	68	71	54%	8
95%	19	104	112	126	135	146	32		156	167	177	188	198	209	50%	26
90%	25	130	140	157	169	182	32		195	208	221	235	248	261	48%	33
85%	30	154	165	186	200	216	32		231	247	262	278	293	308	47%	40
80%	35	172	185	209	224	242	32		259	276	294	311	328	346	46%	46
75%	41	193	208	234	251	271	32		290	310	329	349	368	387	44%	53
70%	46	211	227	256	275	296	32		318	339	360	382	403	424	42%	61
65%	53	233	250	282	303	326	32		350	373	396	420	443	467	41%	69
60%	59	252	271	305	328	353	32		379	404	429	455	480	505	40%	78
55%	67	273	293	330	355	383	32		410	437	465	492	520	547	37%	89
50%	76	294	316	356	383	412	32		442	471	501	530	560	589	36%	99
45%	84	311	335	377	405	436	32		467	499	530	561	592	623	35%	110
40%	94	327	352	396	425	458	32		491	524	556	589	622	655	33%	123
35%	102	344	370	417	448	482	32		517	551	585	620	654	689	31%	134
30%	114	363	391	440	472	509	32		545	581	618	654	690	727	30%	150
25%	130	377	405	456	490	527	32		565	603	640	678	716	753	27%	170
20%	149	397	427	480	516	556	32		595	635	675	714	754	794	25%	194
15%	174	413	444	500	537	578	32		620	661	702	744	785	826	22%	227
10%	213	438	471	530	570	614	32		658	702	745	789	833	877	19%	277
5%	286	458	492	554	595	641	32		687	733	778	824	870	916	15%	367
1%	527	464	499	563	605	651	32		698	745	792	839	885	932	9%	667



	1	2	3	4	5
Net Head (FT)	Turbine Discharge (% Q Max)	Turbine Discharge (CFS)	Kaplan Turbine Eff (%)	Francis Turbine Eff (%)	Turbine Output (KW)
14.0	0.050	14	45.2%	5.8%	8
14.0	0.075	21	59.0%	14.2%	15
14.0	0.100	29	72.7%	22.7%	25
14.0	0.150	43	80.9%	35.9%	41
14.0	0.200	57	85.4%	47.6%	58
14.0	0.250	72	87.7%	55.8%	74
14.0	0.300	86	89.1%	63.0%	91
14.0	0.350	100	90.1%	69.0%	107
14.0	0.400	114	90.9%	74.2%	123
14.0	0.450	129	91.6%	78.7%	140
14.0	0.500	143	92.2%	82.5%	156
14.0	0.550	157	92.6%	85.6%	173
14.0	0.600	172	92.7%	88.1%	189
14.0	0.623	178	92.8%	89.0%	196
14.0	0.650	186	92.8%	89.9%	205
14.0	0.700	200	92.6%	91.2%	220
14.0	0.750	215	92.3%	92.0%	235
14.0	0.800	229	91.9%	92.5%	249
14.0	0.833	238	91.6%	92.8%	259
14.0	0.850	243	91.5%	92.6%	264
14.0	0.900	257	90.9%	92.3%	278
14.0	0.950	272	90.3%	91.6%	291
14.0	0.956	274	90.3%	91.5%	293
14.0	1.000	286	89.7%	90.6%	304

Cost Estimates

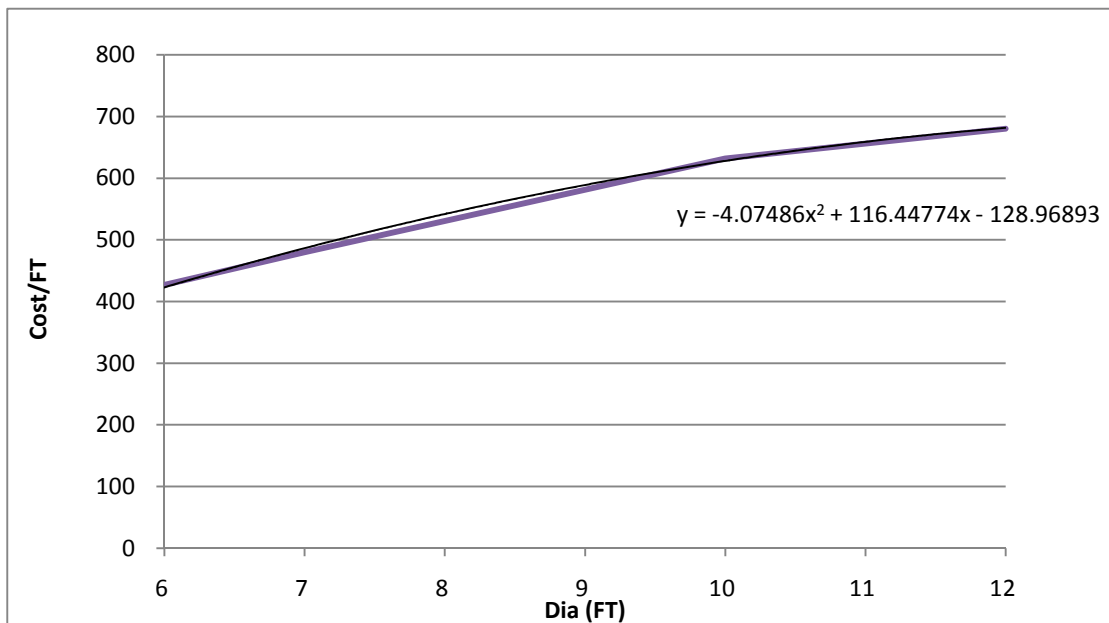
Source	Length (FT)	Diameter (FT)	Cost (FOB)	2010 Cost	Cost/FT
DB Cotton, Apr 2009	300	6	125,000	128,125	427
Val, July 2011	300	7	144,000	144,000	480
DB Cotton, Apr 2009	1,500	8	520,000	533,000	355
DB Cotton, Apr 2009	300	10	185,000	189,625	632
Val, July 2010	300	12	204,000	204,000	680

Values for Formula

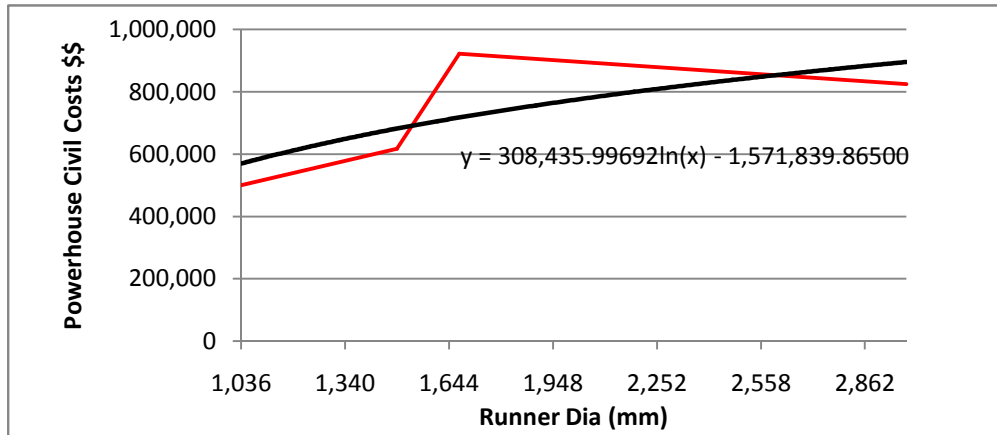
					Cost/FT	Eq
DB Cotton, Apr 2009	300	6	125,000	128,125	427	423
Val, July 2011	300	7	144,000	144,000	480	486
DB Cotton, Apr 2009	300	10	185,000	189,625	632	628
Val, July 2010	300	12	204,000	204,000	680	682

Values for East Providence

Dia (FT)	Material \$/FT	Length FT	Material	Transp and Install	Total 2010 Costs
3.7	246	1	246	123	\$369
4.3	296	1	296	148	\$445
4.7	328	1	328	164	\$492
4.6	317	1	317	158	\$475
5.8	409	1	409	205	\$614
5.2	367	1	367	184	\$551
7.0	486	1	486	243	\$730
8.0	542	1	542	271	\$813



	Runner Diameter (mm)	Powerhouse Civil (items 2c-i)	2010 Civil Cost	Formula
Pawtuxet	1,050	488,279	500,486	573,809
Pawtuxet	1,500	602,419	617,480	683,821
Cargill Falls	1,700	899,967	922,466	722,425
Blackstone R.	3,000	805,200	825,330	897,612



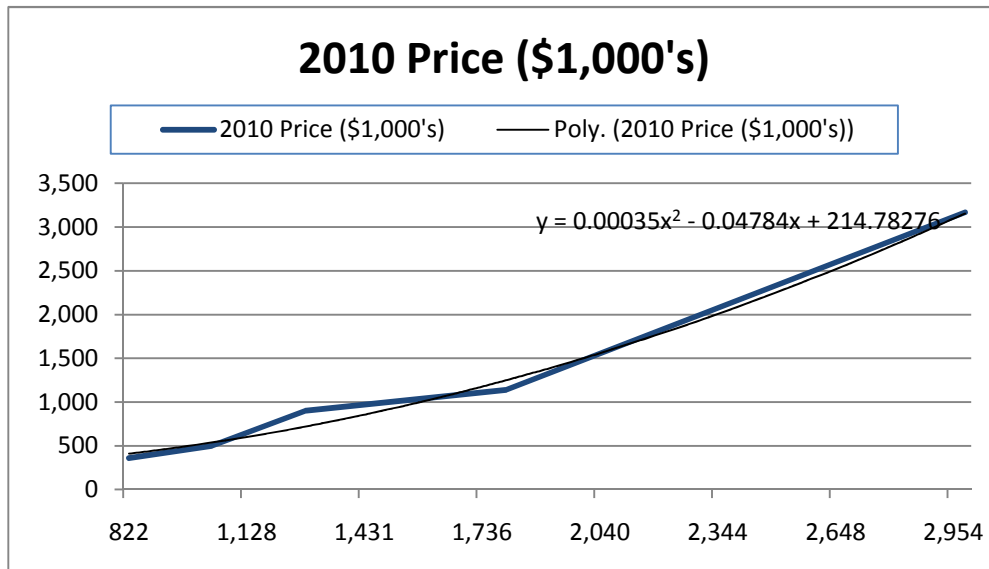
Case	Runner Diameter (mm)	Runner Diameter (FT)	2010 Civil Cost Formula + \$50k for intake
B,C, E; w/ Qmin	900	2.95	576,264
C2, E2, E3	920	3.02	583,043
B,C, E; 1/2 Qmin	950	3.12	592,940
A, F; and B,C, E; no Qmin	1,250	4.10	677,586

No	Description	2009	2010	
1	Mavel 0.85M Bulb, Dbl Reg	350		
2	Mavel 1.29M Vert Kapl	450		
3	Mavel 1.05M Bulb, Dbl Reg	490		
4	Mavel 1.8M Vert Kapl	1,125		
5	Mavel 0.85M Vert Kapl	400	650	mm 0.00035185
6	Mavel 1.29 Bulb, Dbl Reg		900	bb 60
7	Mavel 1.8 Bulb, Dbl Reg		1,140	b= 293 m= 0.471
		Dia	Price	Eq
	Dbl Reg Bulbs (esc 2009 by 2.5%)	850	359	693 314
		1,050	502	787 448
		1,290	900	900 646
		1,500	999	999 852
		1,800	1,140	1,140 1,200
		3,000	3,167	1,705 3,227
			1,900	
			2,533	

Cost Calculator

Input Diameter Bulb **1,250** 702 2010 Price (\$1,000's)

Runner Diameter (mm)	Cost	
810	406	405,667
900	455	455,227
920	467	467,010
950	485	485,210
1250	702	701,858



Licensing & Permitting Summary

Alternatives	Key Regulatory Drivers	Consultations (yrs)	Studies (yrs)	Costs (\$1,000's)
A, D, F	Minimal Env. Impacts (bypass, stream flows & wetlands)	2	0.5	\$288
B, E	Bypass, Wetland Impacts, Standard ABF	2	2	\$400
C	Longer Bypass, More Wetland Impacts, Standard ABF	3	2	\$450
B, E	Bypass, Wetland Impacts, Modified ABF	3	2.5	\$488
C	Longer Bypass, More Wetland Impacts, Modified ABF	3	3	\$525

Dam	Repair Costs	General Maintenance Costs	TOTAL (\$1,000's)
Omega	10,000	10,000	20
Hunt's Mill	40,000	10,000	50
Turner Reservoir	30,000	10,000	40

*Repair estimates from Phase I Inspection Rpt (MBP Consulting, 11/10)
General Maintenance costs are catch-up allowances*

ITEM / DESCRIPTION	INTERCONNECTION TO NATIONAL GRID											
	Turner Reservoir (Single Circuit)				Hunt's Mill (Single Circuit)				Omega Pond (Single Circuit)			
	Qty	Units	Unit Price	Total Price	Qty	Units	Unit Price	Total Price	Qty	Units	Unit Price	Total Price
1 13.8 kV Overhead Distribution Line	0.33	mi.	\$100,000	\$33,000	0.52	mi.	\$100,000	\$52,000	0.15	mi.	\$100,000	\$15,000
2 13.8 kv Sectionalizers	1	ea	\$10,000	\$10,000	1	ea	\$10,000	\$10,000	1	ea	\$10,000	\$10,000
3 13.8 kV Pole-Mounted Distribution Transformers	3	ea	\$10,000	\$30,000	3	ea	\$10,000	\$30,000	3	ea	\$10,000	\$30,000
4 3-Phase Fused Disconnecting Switch	1	ea	\$10,000	\$10,000	1	ea	\$10,000	\$10,000	1	ea	\$10,000	\$10,000
5 Service Switchgear - Main disconnecting switch - Branch circuit breakers	1	ea	\$20,000	\$20,000	1	ea	\$20,000	\$20,000	1	ea	\$20,000	\$20,000
Total				\$103,000				\$122,000				\$85,000

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1 General						
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	0.5	8,000	4	Allowance
d	E&S Control	ft.	100	10	1	Allowance
e	Dam Repairs		1	40,000	40	From Phase I Dam Repair Costs (MBP Consulting 2010)
f	Subtotal, General				80	
2 Powerhouse/Intake						
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	677,586	678	Includes: intake, powerhouse, tailrace and trashrake
k	Sluice gate		1	20,000	20	
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Other		0		0	
q	Subtotal, Powerhouse				838	
3 Equipment						
a	Turbine, generator, & governor		1	701,858	702	Runner 1.25m, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	163,372	163	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Engineering (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow compliance
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				980	
8 PM&E Measures						
a	Water Quality		1	20,000	20	Allowance
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	0.5	60,000	30	Allowance
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				78	
9 Licensing & Permitting						
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	0.5	75,000	38	Allowance
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				288	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1		0	
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				20	
11	Interconnection					
a	Clear & Grub	acre	0.5	8,000	4	Allowance
b	New Line		1	33,000	33	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				117	
12	Indirect Costs					
a	A/E		1	191,985	192	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				372	
	Totals					
1	General				80	
2	Powerhouse/Intake				838	
3	Equipment				980	
8	PM&E Measures				78	
9	Licensing & Permitting				288	
10	Land & Land Rights				20	
11	Interconnection				117	
	Subtotal, Directs				2,400	
12	Indirect Costs				372	
	Subtotal				2,772	
13	Contingency		\$2,771,801	20%	554	
	Grand Total				3,326	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1 General						
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	8,000	32	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	90,000	90	From Phase I Dam Repair Costs (MBP Consulting 2010)
f	Subtotal, General				177	
2 Powerhouse/Intake						
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	576,264	576	Includes: intake, powerhouse, tailrace and trashrack
k	Penstock	ft.	2000	445	889	4.3' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p		cy			0	
q	Subtotal, Powerhouse/Intake				1,606	
3 Equipment						
a	Turbine, generator, & governor		1	455,227	455	900mm runner, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	114,045	114	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				684	
8 PM&E Measures						
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from penstock alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				158	
9 Licensing & Permitting						
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	2	75,000	150	Allowance; assumes acceptance of standard instream flow settings
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				400	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	256,198	256	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				436	
Totals						
1	General				177	
2	Powerhouse/Intake				1,606	
3	Equipment				684	
8	PM&E Measures				158	
9	Licensing & Permitting				400	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				3,202	
12	Indirect Costs				436	
	Subtotal				3,639	
13	Contingency		\$3,638,670	20%	728	
	Grand Total				4,366	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	8,000	32	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	90,000	90	From Phase I Dam Repair Costs (MBP Consulting 2010)
f	Subtotal, General				177	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	592,940	593	Includes: intake, powerhouse, tailrace and trashrack
k	Penstock	ft.	2000	475	950	Assumes 4.6' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				1,682	
3	Equipment					
a	Turbine, generator, & governor		1	485,210	485	Runner 950mm, Estimated costs developed from recent projects
b	Shipping Handling & Installation		1	120,042	120	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				720	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from penstock alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				158	
9	Licensing & Permitting					
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	2.5	75,000	188	Allowance; assumes instream flow studies
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				488	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10 Land & Land Rights						
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11 Interconnection						
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12 Indirect Costs						
a	A/E		1	272,233	272	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				452	
Totals						
1	General				177	
2	Powerhouse/Intake				1,682	
3	Equipment				720	
8	PM&E Measures				158	
9	Licensing & Permitting				488	
10	Land & Land Rights				40	
11	Interconnection				138	
Subtotal, Directs					3,403	
12 Indirect Costs					452	
Subtotal					3,855	
13	Contingency		\$3,855,150	20%	771	
Grand Total					4,626	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	8,000	32	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	90,000	90	From Phase I Dam Repair Costs (MBP Consulting 2010)
f	Subtotal, General				177	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	677,586	678	Includes: intake, powerhouse, tailrace and trashrake
k	Penstock	ft.	2000	614	1,228	5.8' diameter penstock. Includes: material, transportation and installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxiliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				2,046	
3	Equipment					
a	Turbine, generator, & governor		1	701,858	702	Runner 1.25m, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	163,372	163	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				980	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from penstock alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				158	
9	Licensing & Permitting					
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	2.5	75,000	188	Allowance; assumes instream flow studies
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				488	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	322,085	322	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				502	
Totals						
1	General				177	
2	Powerhouse/Intake				2,046	
3	Equipment				980	
8	PM&E Measures				158	
9	Licensing & Permitting				488	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				4,026	
12	Indirect Costs				502	
	Subtotal				4,528	
13	Contingency					
			\$4,528,149	20%	906	
Grand Total					5,434	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	8,000	32	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	90,000	90	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				177	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	576,264	576	Includes: intake, powerhouse, tailrace and trashrake
k	Penstock	ft.	2300	445	1,023	4.3' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				1,739	
3	Equipment					
a	Turbine, generator, & governor		1	455,227	455	900mm runner, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	114,045	114	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				684	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	3	60,000	180	Allowance for impacts from penstock and tailrace alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				248	
9	Licensing & Permitting					
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	2	75,000	150	Allowance; assumes acceptance of standard instream flow settings
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				450	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	278,069	278	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				458	
Totals						
1	General				177	
2	Powerhouse/Intake				1,739	
3	Equipment				684	
8	PM&E Measures				248	
9	Licensing & Permitting				450	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				3,476	
12	Indirect Costs				458	
	Subtotal				3,934	
13	Contingency		\$3,933,926	20%	787	
	Grand Total				4,721	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	8,000	32	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	90,000	90	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				177	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	592,940	593	Includes: intake, powerhouse, tailrace and trashrake
k	Penstock	ft.	2300	475	1,092	Assumes 4.6' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				1,825	
3	Equipment					
a	Turbine, generator, & governor		1	485,210	485	950mm, Costs developed from recent projects
b	Shipping Handling & Installation		1	120,042	120	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				720	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	3	60,000	180	Allowance for impacts from penstock and tailrace alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				248	
9	Licensing & Permitting					
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	3	75,000	225	Allowance; assumes instream flow studies
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				525	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10 Land & Land Rights						
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11 Interconnection						
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12 Indirect Costs						
a	A/E		1	293,828	294	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				474	
Totals						
1	General				177	
2	Powerhouse/Intake				1,825	
3	Equipment				720	
8	PM&E Measures				248	
9	Licensing & Permitting				525	
10	Land & Land Rights				40	
11	Interconnection				138	
Subtotal, Directs					3,673	
12 Indirect Costs					474	
Subtotal					4,147	
13	Contingency		\$4,146,674	20%	829	
Grand Total					4,976	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	8,000	32	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	90,000	90	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				177	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	677,586	678	Includes: intake, powerhouse, tailrace and trashrake
k	Penstock	ft.	2300	614	1,412	5.8' diameter penstock. Includes: material, transportation and installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxiliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxiliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				2,230	
3	Equipment					
a	Turbine, generator, & governor		1	701,858	702	Runner 1.25m, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	163,372	163	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				980	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	3	60,000	180	Allowance for impacts from penstock and tailrace alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				248	
9	Licensing & Permitting					
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	3	75,000	225	Allowance; assumes instream flow studies
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				525	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	347,022	347	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				527	
Totals						
1	General				177	
2	Powerhouse/Intake				2,230	
3	Equipment				980	
8	PM&E Measures				248	
9	Licensing & Permitting				525	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				4,338	
12	Indirect Costs				527	
	Subtotal				4,865	
13	Contingency		\$4,864,793	20%	973	
	Grand Total				5,838	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	8,000	32	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	90,000	90	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				177	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	100,000	100	Includes: intake, trashracks & powerhouse repairs
k	Penstock	ft.	2300	445	1,023	4.3' diameter penstock. Includes: material, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxiliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxiliary electrical		1	5,000	5	Allowance
p	Trashrake		1	150,000	150	
q	Subtotal, Powerhouse/Intake				1,413	
3	Equipment					
a	Turbine, generator, & governor		1	400,000	400	Allowance
b	Shipping Handling & Installation		1	103,000	103	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				618	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	3	60,000	180	Allowance for impacts from penstock and tailrace alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				248	
9	Licensing & Permitting					
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	2	75,000	150	Allowance; assumes acceptance of standard instream flow settings
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				450	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	246,666	247	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				427	
	Totals					
1	General				177	
2	Powerhouse/Intake				1,413	
3	Equipment				618	
8	PM&E Measures				248	
9	Licensing & Permitting				450	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				3,083	
12	Indirect Costs				427	
	Subtotal				3,510	
13	Contingency		\$3,509,988	20%	702	
	Grand Total				4,212	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	0.5	8,000	4	Allowance
d	E&S Control	ft.	100	10	1	Allowance
e	Dam Repairs		1	50,000	50	Phase I Dam Repair Cost Est. (MBP Consulting 2010)
f	Subtotal, General				90	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	677,586	678	Includes: intake, powerhouse, tailrace and trashrake
k	Sluice gate		1	20,000	20	
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				838	
3	Equipment					
a	Turbine, generator, & governor		1	701,858	702	Runner 1.25m, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	163,372	163	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				980	
8	PM&E Measures					
a	Water Quality		1	20,000	20	Allowance
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	0.5	60,000	30	Allowance
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				78	
9	Licensing & Permitting					
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	0.5	75,000	38	Allowance
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				288	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10 Land & Land Rights						
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1		0	
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				20	
11 Interconnection						
a	Clear & Grub	acre	0.5	8,000	4	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				136	
12 Indirect Costs						
a	A/E		1	194,305	194	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				374	
Totals						
1	General				90	
2	Powerhouse/Intake				838	
3	Equipment				980	
8	PM&E Measures				78	
9	Licensing & Permitting				288	
10	Land & Land Rights				20	
11	Interconnection				136	
Subtotal, Directs					2,429	
12 Indirect Costs					374	
Subtotal					2,803	
13	Contingency		\$2,803,121	20%	561	
Grand Total					3,364	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1 General						
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	6,200	25	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	50,000	50	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				130	
2 Powerhouse/Intake						
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	576,264	576	Includes: intake, powerhouse, tailrace and trashrake
k	Penstock	ft.	300	445	133	4.3' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p		ea			0	
q	Subtotal, Powerhouse/Intake				850	
3 Equipment						
a	Turbine, generator, & governor		1	455,227	455	900 mm runner, Estimated costs developed from recent projects
b	Shipping Handling & Installation		1	114,045	114	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				684	
8 PM&E Measures						
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from tailrace
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				158	
9 Licensing & Permitting						
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	2	75,000	150	Allowance; assumes acceptance of standard instream flow settings
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				400	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Fostiak Eng. (2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	191,954	192	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				372	
	Totals					
1	General				130	
2	Powerhouse/Intake				850	
3	Equipment				684	
8	PM&E Measures				158	
9	Licensing & Permitting				400	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				2,399	
12	Indirect Costs				372	
	Subtotal				2,771	
13	Contingency		\$2,771,375	20%	554	
	Grand Total				3,326	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	6,200	25	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	50,000	50	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				130	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	592,940	593	Includes: intake, powerhouse, tailrace and trashrake
k	Penstock	ft.	300	475	142	Assumes 4.6' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				875	
3	Equipment					
a	Turbine, generator, & governor		1	485,210	485	950mm runner, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	120,042	120	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				720	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from tailrace alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				158	
9	Licensing & Permitting					
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	2.5	75,000	188	Allowance; assumes instream flow studies
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				488	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10 Land & Land Rights						
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11 Interconnection						
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Fostiak Eng. (2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12 Indirect Costs						
a	A/E		1	203,890	204	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				384	
Totals						
1	General				130	
2	Powerhouse/Intake				875	
3	Equipment				720	
8	PM&E Measures				158	
9	Licensing & Permitting				488	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				2,549	
12	Indirect Costs				384	
	Subtotal				2,933	
13	Contingency		\$2,932,510	20%	587	
	Grand Total				3,519	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1 General						
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	6,200	25	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	50,000	50	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				130	
2 Powerhouse/Intake						
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	677,586	678	Includes: intake, powerhouse, tailrace and trashrake
k	Penstock	ft.	300	614	184	5.8' diameter penstock. Includes: material, transportation and installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Other	ea			0	
q	Subtotal, Powerhouse/Intake				1,002	
3 Equipment						
a	Turbine, generator, & governor		1	701,858	702	Runner 1.25m, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	163,372	163	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				980	
8 PM&E Measures						
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from tailrace alignment
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				158	
9 Licensing & Permitting						
a	Consultations	year	3	50,000	150	Allowance
b	Studies	year	2.5	75,000	188	Allowance; assumes instream flow studies
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				488	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Fostiak Eng. (2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	234,802	235	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				415	
Totals						
1	General				130	
2	Powerhouse/Intake				1,002	
3	Equipment				980	
8	PM&E Measures				158	
9	Licensing & Permitting				488	
10	Land & Land Rights				40	
11	Interconnection				138	
Subtotal, Directs					2,935	
12 Indirect Costs					415	
Subtotal					3,350	
13	Contingency		\$3,349,825	20%	670	
Grand Total					4,020	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1 General						
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	6,200	25	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	40,000	40	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				120	
2 Powerhouse/Intake						
a	Coffer dam, Pond				100	Allowance
b	Tailrace (cofferdam and excavation)				25	Allowance
c	Powerhouse Civil		1	100,000	100	Allowance for intake, trashracks and powerhouse repairs
k	Penstock	ft.	300	445	133	Assumes 4.3' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Trash Rake	ea	1	150,000	150	Allowance
q	Subtotal, Powerhouse				538	
3 Equipment						
a	Turbine, generator, & governor		1	400,000	400	Allowance
b	Shipping Handling & Installation		1	103,000	103	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				618	
8 PM&E Measures						
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		1	5,000	5	Allowance
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from tailrace alignment
e	Recreation		1	25,000	25	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				168	
9 Licensing & Permitting						
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	2	75,000	150	Allowance; assumes acceptance of standard instream flow settings
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				400	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10 Land & Land Rights						
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11 Interconnection						
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12 Indirect Costs						
a	A/E		1	161,751	162	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				342	
Totals						
1	General				120	
2	Powerhouse/Intake				538	
3	Equipment				618	
8	PM&E Measures				168	
9	Licensing & Permitting				400	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				2,022	
12	Indirect Costs				342	
	Subtotal				2,364	
13	Contingency		\$2,363,636	20%	473	
	Grand Total				2,836	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	6,200	25	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	40,000	40	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				120	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Tailrace (cofferdam and excavation)				25	Allowance
c	Powerhouse Civil		1	100,000	100	Allowance for intake, trashracks and powerhouse repairs
k	Penstock	ft.	300	551	165	Assumes 5.21' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	Trash Rake	ea	1	150,000	150	Allowance
q	Subtotal, Powerhouse				570	
3	Equipment					
a	Turbine, generator, & governor		1	475,000	475	Allowance for repowering 1.12m diameter Francis runner
b	Shipping Handling & Installation		1	118,000	118	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				708	
8	PM&E Measures					
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		1	5,000	5	Allowance
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from tailrace alignment
e	Recreation		1	25,000	25	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				168	
9	Licensing & Permitting					
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	2	75,000	150	Allowance; assumes acceptance of standard instream flow settings
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				400	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	171,504	172	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				352	
Totals						
1	General				120	
2	Powerhouse/Intake				570	
3	Equipment				708	
8	PM&E Measures				168	
9	Licensing & Permitting				400	
10	Land & Land Rights				40	
11	Interconnection				138	
Subtotal, Directs					2,144	
12 Indirect Costs					352	
Subtotal					2,495	
13	Contingency		\$2,495,304	20%	499	
Grand Total					2,994	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1 General						
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	4	6,200	25	Allowance, includes penstock alignment
d	E&S Control	ft.	2000	10	20	Allowance, includes penstock alignment
e	Dam Repairs		1	40,000	40	Phase I Dam Repair Cost (MBP Consulting)
f	Subtotal, General				120	
2 Powerhouse/Intake						
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	100,000	100	Allowance for intake, trashracks and powerhouse repairs
k	Penstock	ft.	300	369	111	Assumes 3.7' diameter penstock. Includes: materials, shipping & installation
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxilliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxilliary electrical		1	5,000	5	Allowance
p	TrashRake	ea	1	150,000	150	Allowance
q	Subtotal, Powerhouse				501	
3 Equipment						
a	Turbine, generator, & governor		1	350,000	350	Estimated costs for restoration of 0.81 m diameter Francis runner
b	Shipping Handling & Installation		1	93,000	93	20% of equipment costs
c	Switchgear		1	20,000	20	Fostiak Eng. (2010)
d	Instrumentation & Controls		1	50,000	50	Allowance
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				558	
8 PM&E Measures						
a	Water Quality		1	40,000	40	Allowance for monitoring
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		1	5,000	5	Allowance
d	Wetlands	acre	1.5	60,000	90	Allowance for impacts from tailrace restoration
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				163	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
9	Licensing & Permitting					
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	2	75,000	150	Allowance; assumes acceptance of standard instream flow settings
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				400	
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1	20,000	20	Allowance for penstock alignment
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				40	
11	Interconnection					
a	Clear & Grub	acre	1	6,200	6	Allowance
b	New Line		1	52,000	52	Fostiak Eng. (2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Fostiak Eng. (2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				138	
12	Indirect Costs					
a	A/E		1	153,540	154	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				334	
	Totals					
1	General				120	
2	Powerhouse/Intake				501	
3	Equipment				558	
8	PM&E Measures				163	
9	Licensing & Permitting				400	
10	Land & Land Rights				40	
11	Interconnection				138	
	Subtotal, Directs				1,919	
12	Indirect Costs				334	
	Subtotal				2,253	
13	Contingency		\$2,252,786	20%	451	
	Grand Total				2,703	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
1	General					
a	Mob/Demob		1	25,000	25	Allowance
b	Site Prep		1	10,000	10	Allowance
c	Clear & Grub	acre	0.5	8,000	4	Allowance
d	E&S Control	ft.	100	10	1	Allowance
e	Dam Repairs		1	20,000	20	From Phase I Dam Repair Costs (MBP Consulting 2010)
f	Subtotal, General				60	
2	Powerhouse/Intake					
a	Coffer dam, Pond				100	Allowance
b	Cofferdam, Tailrace				10	Allowance
c	Powerhouse Civil		1	677,586	678	Includes: intake, powerhouse, tailrace and trashrake
k	Sluice gate		1	20,000	20	
l	Misc. metals		1	5,000	5	Allowance
m	HVAC		1	10,000	10	Allowance
n	Auxiliary Mechanical		1	10,000	10	Allowance
o	Lighting, auxiliary electrical		1	5,000	5	Allowance
p	Other				0	
q	Subtotal, Powerhouse/Intake				838	
3	Equipment					
a	Turbine, generator, & governor		1	701,858	702	Runner 1.25m, estimated costs developed from recent projects
b	Shipping Handling & Installation		1	163,372	163	20% of equipment costs
c	Switchgear		1	20,000	20	From Interconnection Costs (Fostiak Eng. 2010)
d	Instrumentation & Controls		1	50,000	50	Allowance, includes license min flow verification
e	Station Service, MCC		1	20,000	20	Allowance
f	Protection		1	25,000	25	Allowance
g	Subtotal, Equipment				980	
8	PM&E Measures					
a	Water Quality		1	20,000	20	Allowance
b	D/S fish passage		0	20,000	0	Assumes installed by others
c	Min flow verification		0	5,000	0	Included in Instrumentation & Controls
d	Wetlands	acre	0.5	60,000	30	Allowance
e	Recreation		1	20,000	20	Allowance
f	Cultural		1	7,500	8	Allowance
g	Subtotal, PM&E				78	
9	Licensing & Permitting					
a	Consultations	year	2	50,000	100	Allowance
b	Studies	year	0.5	75,000	38	Allowance
c	Draft FERC Application		1	50,000	50	Allowance
d	Final FERC Application		1	25,000	25	Allowance
e	Legal review		1	25,000	25	Allowance
f	Non-FERC Permits		1	50,000	50	Allowance for: WQC, Wetlands, S. 106, S. 404, CZM, etc.
g	Subtotal, Lic. & Permitting				288	

No.	Item	Unit	Qty	Rate	Amount (\$1,000's)	Comments
10	Land & Land Rights					
a	Flowage rights		1	5,000	5	Allowance
b	Project works, land in fee		1		0	
c	Interconnection R.O.W.		1	5,000	5	Allowance
d	Legal		1	10,000	10	Allowance
e	Other				0	
f	Subtotal, Land				20	
11	Interconnection					
a	Clear & Grub	acre	0.5	8,000	4	Allowance
b	New Line		1	15,000	15	From Interconnection Costs (Fostiak Eng. 2010)
c	Metering		1	10,000	10	Allowance
c	Switchyard		1	50,000	50	Includes: sectionalizers, transformers, disconnect switch. From Interconnection Costs (Fostiak Eng. 2010)
d	Consultations		1	20,000	20	Allowance
f	Subtotal, Interconnection				99	
12	Indirect Costs					
a	A/E		1	188,945	189	8% of Direct Costs
b	Construction Management		1	25,000	25	Allowance
c	Testing		1	20,000	20	geo-tech, concrete
d	FERC submittals		1	35,000	35	Design Report, Status Reports
e	Owner's Admin & Overhead		1	100,000	100	Allowance
f	Other				0	
g	Subtotal, Indirects				369	
Totals						
1	General				60	
2	Powerhouse/Intake				838	
3	Equipment				980	
8	PM&E Measures				78	
9	Licensing & Permitting				288	
10	Land & Land Rights				20	
11	Interconnection				99	
	Subtotal, Directs				2,362	
12	Indirect Costs				369	
	Subtotal				2,731	
13	Contingency		\$2,730,761	20%	546	
Grand Total					3,277	

Pre-Tax, Cash on Cash Proformas

ID	Project / Description		
A	Turner Reservoir		
B	Turner - Hunt's Mill		
C	Turner - Hunt's Mill 2	C-2	w/ repowered unit
D	Hunt's Mill		
E	Hunt's Mill 2	E-2	w/ repowered unit
F	Omega Pond	E-3	w/ restored unit

All Alts

Escalation Rate	2.5%
REC's (\$/MWH)	\$25

Discount Rate	5%
Term (Yrs)	20

Denotes cells for user input

Results With Instream Flows

Alt	Installed Cost (\$1,000's)	Installed Capacity (kW)	Installed Costs (\$/kw)	Energy (MWH)	RI Grants	Fed Grant	Energy Rate \$/MWH	IRR (%)	NPV (\$1,000s)
A	3,326	205	16,265	715	25%	15%	\$125	3%	(665)
B	4,366	156	28,059	456	25%	15%	\$125		(3,073)
C	4,721	288	16,411	831	25%	15%	\$125	-1%	(1,858)
C-2	4,212	282	14,922	743	25%	15%	\$125	-1%	(1,675)
D	3,364	112	30,128	400	25%	15%	\$125		(2,314)
E	3,326	184	18,066	524	25%	15%	\$125		(1,707)
E-2	2,836	178	15,930	464	25%	15%	\$125		(1,397)
E-3	2,703	110	24,568	335	25%	15%	\$125		(1,875)
F	3,277	104	31,536	374	25%	15%	\$125		(2,294)

Results with 1/2 Instream Flows

Alt	Installed Cost (\$1,000's)	Installed Capacity (kW)	Installed Costs (\$/kw)	Energy (MWH)	RI Grants	Fed Grant	Energy Rate \$/MWH	IRR	NPV (\$1,000s)
B	4,626	176	26,244	626	25%	15%	\$125		(2,852)
C	4,976	326	15,244	1,137	25%	15%	\$125	4%	(559)
E	3,519	209	16,866	717	25%	15%	\$125	2%	(909)

Results with No Instream Flows

Alt	Installed Cost (\$1,000's)	Installed Capacity (kW)	Installed Costs (\$/kw)	Energy (MWH)	RI Grants	Fed Grant	Energy Rate \$/MWH	IRR	NPV (\$1,000s)
B	5,434	288	18,887	1,050	25%	15%	\$125	1%	(1,597)
C	5,838	534	10,939	1,889	25%	15%	\$125	9%	2,450
E	4,020	341	11,797	1,184	25%	15%	\$125	7%	985
E-2	2,994	271	11,064	815	25%	15%	\$125	6%	246

Notes:

- 1 RI (State) Grants: defined % of Direct Costs
- 2 Fed Grant: Assumes extension of Investment Tax Credit (ITC) & associated muni. benefit of partnership with outside tax investor
- 3 Energy Rate: assumes pricing for distributed renewable energy
- 4 IRR: Internal Rate of Return
- 5 NPV (Net Present Value): values given represent NPV at end of study period
- 6 Estimates based on 20 year study period.
- 7 REC (Renewable Energy Certificate): additional commodity value for energy derived from qualified renewable sources



No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	3,326																				
b	O&M		11	11	12	12	12	12	13	13	13	14	14	14	15	15	16	16	16	17	17	18
c	Major Maintenance						57					128					72					164
d	Insurance		9	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	13	14
e	Payment in lieu of Property Taxes		51	52	54	55	56	58	59	61	62	64	65	67	69	70	72	74	76	78	80	82
f																						
g	Subtotal, Costs	3,326	71	72	74	76	135	80	82	84	86	216	90	93	95	97	172	102	105	108	110	277
2	Revenues (\$1,000's)																					
a	State Grants	832																				
b	Federal Grants	499																				
c	Energy		92	94	96	99	101	104	106	109	112	114	117	120	123	126	130	133	136	139	143	147
d	Recs		18	19	19	20	20	21	21	22	22	23	23	24	25	25	26	27	27	28	29	29
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					2,515
h	Subtotal, Revenues	1,330	110	113	116	118	121	124	128	131	134	137	141	144	148	152	155	159	163	167	172	2,691
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(1,996)	39	40	41	42	(13)	45	46	47	48	(79)	50	52	53	54	(17)	57	58	60	61	2,414
b	NPV	(1,996)	37	37	36	35	(10)	33	32	32	31	(48)	29	29	28	27	(8)	26	25	25	24	910
c	Cum NPV	(1,996)	(1,958)	(1,922)	(1,886)	(1,851)	(1,861)	(1,828)	(1,796)	(1,764)	(1,733)	(1,782)	(1,752)	(1,723)	(1,695)	(1,668)	(1,676)	(1,650)	(1,625)	(1,600)	(1,575)	(665)
Proforma Inputs			Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	715		Max KW	205		State Grants	832		Fed Grants	499			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results					PreTax, Cash on Cash IRR	2.5%		Cum NPV	(665)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	4,366																				
b	O&M		7	7	7	8	8	8	8	8	9	9	9	9	9	10	10	10	10	11	11	11
c	Major Maintenance						57					128					72					164
d	Insurance		11	11	12	12	12	13	13	13	14	14	14	15	15	15	16	16	17	17	17	18
e	Payment in lieu of Property Taxes		67	69	71	72	74	76	78	80	82	84	86	88	90	93	95	97	100	102	105	107
f																						
g	Subtotal, Costs	4,366	85	87	90	92	151	97	99	101	104	235	109	112	115	118	193	124	127	130	133	300
2	Revenues (\$1,000's)																					
a	State Grants	1,092																				
b	Federal Grants	655																				
c	Energy		58	60	61	63	64	66	68	69	71	73	75	77	79	80	82	85	87	89	91	93
d	Recs		12	12	12	13	13	13	14	14	14	15	15	15	16	16	16	17	17	18	18	19
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					0
h	Subtotal, Revenues	1,747	70	72	74	75	77	79	81	83	85	87	90	92	94	97	99	101	104	107	109	112
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(2,620)	(15)	(16)	(16)	(16)	(73)	(17)	(18)	(18)	(19)	(147)	(20)	(20)	(21)	(21)	(94)	(22)	(23)	(23)	(24)	(188)
b	NPV	(2,620)	(15)	(14)	(14)	(14)	(58)	(13)	(13)	(12)	(12)	(90)	(11)	(11)	(11)	(11)	(45)	(10)	(10)	(10)	(9)	(71)
c	Cum NPV	(2,620)	(2,634)	(2,649)	(2,662)	(2,676)	(2,733)	(2,746)	(2,759)	(2,771)	(2,783)	(2,874)	(2,885)	(2,896)	(2,907)	(2,918)	(2,963)	(2,973)	(2,983)	(2,992)	(3,002)	(3,073)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	456		Max KW	156		State Grants	1,092		Fed Grants	655			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR		#DIV/0!		Cum NPV	(3,073)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
 Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	5,434																				
b	O&M		16	17	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	25	25	26
c	Major Maintenance						57					128					72					164
d	Insurance		14	14	15	15	15	16	16	17	17	17	18	18	19	19	20	20	21	21	22	22
e	Payment in lieu of Property Taxes		84	86	88	90	92	95	97	99	102	104	107	110	112	115	118	121	124	127	130	134
f																						
g	Subtotal, Costs	5,434	114	116	119	122	182	129	132	135	138	270	145	149	153	157	233	165	169	173	177	345
2	Revenues (\$1,000's)																					
a	State Grants	1,358																				
b	Federal Grants	815																				
c	Energy		135	138	141	145	148	152	156	160	164	168	172	176	181	185	190	195	200	205	210	215
d	Recs		27	28	28	29	30	30	31	32	33	34	34	35	36	37	38	39	40	41	42	43
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					3,056
h	Subtotal, Revenues	2,174	161	165	170	174	178	183	187	192	197	202	207	212	217	222	228	234	240	246	252	3,314
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(3,260)	48	49	50	51	(4)	54	55	57	58	(68)	61	63	64	66	(5)	69	71	73	75	2,969
b	NPV	(3,260)	46	44	43	42	(3)	40	39	38	38	(42)	36	35	34	33	(2)	32	31	30	30	1,119
c	Cum NPV	(3,260)	(3,215)	(3,170)	(3,127)	(3,085)	(3,088)	(3,047)	(3,008)	(2,969)	(2,932)	(2,974)	(2,938)	(2,903)	(2,869)	(2,836)	(2,838)	(2,806)	(2,775)	(2,745)	(2,716)	(1,597)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	1,050		Max KW	288		State Grants	1,358		Fed Grants	815			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR	0.9%			Cum NPV	(1,597)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
 Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	4,626																				
b	O&M		10	10	10	10	11	11	11	11	12	12	12	13	13	13	14	14	14	15	15	15
c	Major Maintenance						57					128					72					164
d	Insurance		12	12	12	13	13	13	14	14	14	15	15	16	16	16	17	17	18	18	18	19
e	Payment in lieu of Property Taxes		71	73	75	77	79	80	82	85	87	89	91	93	96	98	101	103	106	108	111	114
f																						
g	Subtotal, Costs	4,626	93	95	97	100	159	105	107	110	113	244	119	122	125	128	203	134	137	141	144	312
2	Revenues (\$1,000's)																					
a	State Grants	1,157																				
b	Federal Grants	694																				
c	Energy		80	82	84	86	89	91	93	95	98	100	103	105	108	111	113	116	119	122	125	128
d	Recs		16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	26
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					232
h	Subtotal, Revenues	1,850	96	99	101	104	106	109	112	114	117	120	123	126	129	133	136	139	143	146	150	386
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(2,776)	4	4	4	4	(53)	4	4	4	4	(123)	5	5	5	5	(67)	5	5	6	6	74
b	NPV	(2,776)	3	3	3	3	(41)	3	3	3	3	(76)	3	3	3	3	(32)	2	2	2	2	28
c	Cum NPV	(2,776)	(2,772)	(2,769)	(2,766)	(2,762)	(2,804)	(2,800)	(2,797)	(2,795)	(2,792)	(2,867)	(2,865)	(2,862)	(2,860)	(2,857)	(2,889)	(2,887)	(2,885)	(2,882)	(2,880)	(2,852)
Proforma Inputs			Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	626		Max KW	176		State Grants	1,157		Fed Grants	694			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR		#DIV/0!		Cum NPV	(2,852)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	4,721																				
b	O&M		13	13	13	14	14	14	15	15	16	16	16	17	17	18	18	19	19	19	20	20
c	Major Maintenance						57					128					72					164
d	Insurance		12	12	13	13	13	14	14	14	15	15	15	16	16	17	17	18	18	18	19	19
e	Payment in lieu of Property Taxes		73	74	76	78	80	82	84	86	88	91	93	95	98	100	103	105	108	110	113	116
f																						
g	Subtotal, Costs	4,721	97	100	102	105	164	110	113	116	119	250	125	128	131	134	210	141	145	148	152	320
2	Revenues (\$1,000's)																					
a	State Grants	1,180																				
b	Federal Grants	708																				
c	Energy		106	109	112	115	118	120	123	127	130	133	136	140	143	147	150	154	158	162	166	170
d	Recs		21	22	22	23	24	24	25	25	26	27	27	28	29	29	30	31	32	32	33	34
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					1,937
h	Subtotal, Revenues	1,888	128	131	134	138	141	145	148	152	156	160	164	168	172	176	181	185	190	194	199	2,142
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(2,832)	30	31	32	33	(23)	34	35	36	37	(90)	39	40	41	42	(30)	44	45	46	47	1,822
b	NPV	(2,832)	29	28	27	27	(18)	26	25	24	24	(55)	23	22	22	21	(14)	20	20	19	19	687
c	Cum NPV	(2,832)	(2,804)	(2,775)	(2,748)	(2,721)	(2,739)	(2,714)	(2,689)	(2,664)	(2,640)	(2,696)	(2,673)	(2,651)	(2,629)	(2,608)	(2,623)	(2,602)	(2,583)	(2,564)	(2,545)	(1,858)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	831		Max KW	288		State Grants	1,180		Fed Grants	708			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results					PreTax, Cash on Cash IRR	-1.2%		Cum NPV	(1,858)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	5,838																				
b	O&M		29	30	31	31	32	33	34	35	35	36	37	38	39	40	41	42	43	44	45	46
c	Major Maintenance						57				128					72						164
d	Insurance		15	15	16	16	17	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24
e	Payment in lieu of Property Taxes		90	92	94	97	99	102	104	107	109	112	115	118	121	124	127	130	133	137	140	143
f																						
g	Subtotal, Costs	5,838	134	137	141	144	204	151	155	159	163	295	171	176	180	184	261	194	199	204	209	378
2	Revenues (\$1,000's)																					
a	State Grants	1,459																				
b	Federal Grants	876																				
c	Energy		242	248	254	261	267	274	281	288	295	302	310	318	325	334	342	351	359	368	377	387
d	Recs		48	50	51	52	53	55	56	58	59	60	62	64	65	67	68	70	72	74	75	77
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					10,018
h	Subtotal, Revenues	2,335	290	298	305	313	321	329	337	345	354	363	372	381	391	400	410	421	431	442	453	10,483
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(3,503)	157	161	165	169	116	177	182	186	191	68	201	206	211	216	149	227	233	238	244	10,105
b	NPV	(3,503)	149	146	142	139	91	132	129	126	123	42	117	114	112	109	72	104	101	99	97	3,808
c	Cum NPV	(3,503)	(3,353)	(3,208)	(3,066)	(2,927)	(2,836)	(2,703)	(2,574)	(2,448)	(2,325)	(2,284)	(2,166)	(2,052)	(1,940)	(1,831)	(1,759)	(1,655)	(1,554)	(1,455)	(1,358)	2,450
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	1,889		Max KW	534		State Grants	1,459		Fed Grants	876			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results					PreTax, Cash on Cash IRR	8.7%		Cum NPV	2,450					Discounted Pay Back	19						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
 Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	4,976																				
b	O&M		17	18	18	19	19	20	20	21	21	22	22	23	24	24	25	25	26	27	27	28
c	Major Maintenance						57					128					72					164
d	Insurance		13	13	13	14	14	14	15	15	16	16	16	17	17	18	18	18	19	19	20	20
e	Payment in lieu of Property Taxes		77	78	80	82	84	87	89	91	93	96	98	100	103	105	108	111	114	116	119	122
f																						
g	Subtotal, Costs	4,976	107	109	112	115	174	121	124	127	130	261	137	140	144	147	223	155	158	162	166	335
2	Revenues (\$1,000's)																					
a	State Grants	1,244																				
b	Federal Grants	708																				
c	Energy		146	149	153	157	161	165	169	173	178	182	187	191	196	201	206	211	216	222	227	233
d	Recs		29	30	31	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	47
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					4,357
h	Subtotal, Revenues	1,952	175	179	184	188	193	198	203	208	213	218	224	229	235	241	247	253	260	266	273	4,637
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(3,024)	68	70	72	73	19	77	79	81	83	(43)	87	89	92	94	24	99	101	104	106	4,302
b	NPV	(3,024)	65	63	62	60	15	58	56	55	54	(26)	51	50	49	47	11	45	44	43	42	1,622
c	Cum NPV	(3,024)	(2,959)	(2,896)	(2,834)	(2,773)	(2,759)	(2,701)	(2,645)	(2,590)	(2,537)	(2,563)	(2,512)	(2,462)	(2,414)	(2,366)	(2,355)	(2,310)	(2,266)	(2,222)	(2,180)	(559)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	1,137		Max KW	326		State Grants	1,244		Fed Grants	708			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results					PreTax, Cash on Cash IRR	3.7%		Cum NPV	(559)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
 Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	4,212																				
b	O&M		11	12	12	12	13	13	13	14	14	14	15	15	15	16	16	17	17	17	18	18
c	Major Maintenance						57					128				72						164
d	Insurance		11	11	11	12	12	12	13	13	13	13	14	14	15	15	15	16	16	16	17	17
e	Payment in lieu of Property Taxes		65	66	68	70	71	73	75	77	79	81	83	85	87	89	92	94	96	99	101	104
f																						
g	Subtotal, Costs	4,212	87	89	91	94	153	98	101	103	106	237	111	114	117	120	195	126	129	132	136	303
2	Revenues (\$1,000's)																					
a	State Grants	1,053																				
b	Federal Grants	632																				
c	Energy		95	98	100	102	105	108	110	113	116	119	122	125	128	131	134	138	141	145	148	152
d	Recs		19	20	20	20	21	22	22	23	23	24	24	25	26	26	27	28	28	29	30	30
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					1,739
h	Subtotal, Revenues	1,685	114	117	120	123	126	129	132	136	139	143	146	150	154	157	161	165	169	174	178	1,922
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(2,527)	27	28	29	29	(27)	31	32	32	33	(94)	35	36	37	37	(34)	39	40	41	42	1,619
b	NPV	(2,527)	26	25	25	24	(21)	23	22	22	21	(58)	20	20	19	19	(16)	18	18	17	17	610
c	Cum NPV	(2,527)	(2,501)	(2,476)	(2,451)	(2,427)	(2,448)	(2,425)	(2,403)	(2,381)	(2,359)	(2,417)	(2,397)	(2,377)	(2,357)	(2,339)	(2,355)	(2,337)	(2,319)	(2,302)	(2,285)	(1,675)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	743		Max KW	282		State Grants	1,053		Fed Grants	632			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results					PreTax, Cash on Cash IRR	-1.2%		Cum NPV	(1,675)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
 Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	3,364																				
b	O&M		6	6	6	7	7	7	7	7	7	8	8	8	8	8	9	9	9	9	10	10
c	Major Maintenance						57					128					72					164
d	Insurance		9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	14
e	Payment in lieu of Property Taxes		52	53	54	56	57	59	60	61	63	65	66	68	70	71	73	75	77	79	81	83
f																						
g	Subtotal, Costs	3,364	66	68	70	72	130	75	77	79	81	211	85	87	89	92	166	96	99	101	104	270
2	Revenues (\$1,000's)																					
a	State Grants	841																				
b	Federal Grants	505																				
c	Energy		51	53	54	55	57	58	59	61	62	64	66	67	69	71	72	74	76	78	80	82
d	Recs		10	11	11	11	11	12	12	12	12	13	13	13	14	14	14	15	15	16	16	16
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					0
h	Subtotal, Revenues	1,345	62	63	65	66	68	70	71	73	75	77	79	81	83	85	87	89	91	94	96	98
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(2,018)	(5)	(5)	(5)	(5)	(62)	(6)	(6)	(6)	(6)	(134)	(6)	(7)	(7)	(7)	(79)	(7)	(7)	(8)	(8)	(172)
b	NPV	(2,018)	(5)	(5)	(5)	(4)	(49)	(4)	(4)	(4)	(4)	(82)	(4)	(4)	(4)	(3)	(38)	(3)	(3)	(3)	(3)	(65)
c	Cum NPV	(2,018)	(2,023)	(2,028)	(2,032)	(2,037)	(2,085)	(2,089)	(2,094)	(2,098)	(2,101)	(2,184)	(2,188)	(2,191)	(2,195)	(2,198)	(2,236)	(2,240)	(2,243)	(2,246)	(2,249)	(2,314)
Proforma Inputs			Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	400		Max KW	112		State Grants	841		Fed Grants	505			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR		#DIV/0!		Cum NPV	(2,314)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	3,326																				
b	O&M		8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13
c	Major Maintenance						57					128					72					164
d	Insurance		9	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	13	14
e	Payment in lieu of Property Taxes		51	52	54	55	56	58	59	61	62	64	65	67	69	70	72	74	76	78	80	82
f																						
g	Subtotal, Costs	3,326	68	69	71	73	131	77	79	80	83	213	87	89	91	93	168	98	101	103	106	272
2	Revenues (\$1,000's)																					
a	State Grants	831																				
b	Federal Grants	499																				
c	Energy		67	69	71	72	74	76	78	80	82	84	86	88	90	93	95	97	100	102	105	107
d	Recs		13	14	14	14	15	15	16	16	16	17	17	18	18	19	19	19	20	20	21	21
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					824
h	Subtotal, Revenues	1,330	81	83	85	87	89	91	93	96	98	101	103	106	108	111	114	117	120	123	126	952
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(1,995)	13	13	14	14	(42)	15	15	15	16	(112)	16	17	17	18	(54)	19	19	20	20	680
b	NPV	(1,995)	12	12	12	11	(33)	11	11	10	10	(69)	10	9	9	9	(26)	9	8	8	8	256
c	Cum NPV	(1,995)	(1,983)	(1,971)	(1,959)	(1,948)	(1,981)	(1,970)	(1,960)	(1,949)	(1,939)	(2,008)	(1,998)	(1,989)	(1,980)	(1,971)	(1,997)	(1,988)	(1,980)	(1,972)	(1,964)	(1,707)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	524		Max KW	184		State Grants	831		Fed Grants	499			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR		#NUM!		Cum NPV	(1,707)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	4,020																				
b	O&M		18	19	19	20	20	21	21	22	22	23	23	24	24	25	26	26	27	28	28	29
c	Major Maintenance						57					128					72					164
d	Insurance		10	11	11	11	11	12	12	12	13	13	13	14	14	14	15	15	15	16	16	16
e	Payment in lieu of Property Taxes		62	63	65	67	68	70	72	73	75	77	79	81	83	85	87	90	92	94	96	99
f																						
g	Subtotal, Costs	4,020	90	93	95	97	156	102	105	107	110	241	116	119	121	125	200	131	134	137	141	308
2	Revenues (\$1,000's)																					
a	State Grants	1,005																				
b	Federal Grants	603																				
c	Energy		152	156	159	163	168	172	176	180	185	190	194	199	204	209	214	220	225	231	237	243
d	Recs		30	31	32	33	34	34	35	36	37	38	39	40	41	42	43	44	45	46	47	49
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					5,870
h	Subtotal, Revenues	1,608	182	187	191	196	201	206	211	216	222	227	233	239	245	251	257	264	270	277	284	6,161
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(2,412)	92	94	96	99	45	104	106	109	112	(13)	118	120	123	127	57	133	136	140	143	5,853
b	NPV	(2,412)	87	85	83	81	35	78	76	74	72	(8)	69	67	65	64	28	61	59	58	57	2,206
c	Cum NPV	(2,412)	(2,324)	(2,239)	(2,156)	(2,074)	(2,039)	(1,962)	(1,886)	(1,812)	(1,740)	(1,748)	(1,680)	(1,613)	(1,547)	(1,483)	(1,456)	(1,395)	(1,335)	(1,277)	(1,221)	985
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	1,184		Max KW	341		State Grants	1,005		Fed Grants	603			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR	7.3%		Cum NPV	985					Discounted Pay Back	19							

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
 Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	3,519																				
b	O&M		11	11	12	12	12	12	13	13	13	14	14	14	15	15	16	16	16	17	17	18
c	Major Maintenance						57					128					72					164
d	Insurance		9	9	9	10	10	10	10	11	11	11	12	12	12	12	13	13	13	14	14	14
e	Payment in lieu of Property Taxes		54	55	57	58	60	61	63	64	66	68	69	71	73	75	76	78	80	82	84	86
f																						
g	Subtotal, Costs	3,519	74	76	78	80	138	84	86	88	90	221	95	97	100	102	177	107	110	113	116	282
2	Revenues (\$1,000's)																					
a	State Grants	880																				
b	Federal Grants	528																				
c	Energy		92	94	97	99	101	104	107	109	112	115	118	121	124	127	130	133	136	140	143	147
d	Recs		18	19	19	20	20	21	21	22	22	23	24	24	25	25	26	27	27	28	29	29
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					2,309
h	Subtotal, Revenues	1,408	110	113	116	119	122	125	128	131	134	138	141	145	148	152	156	160	164	168	172	2,485
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(2,111)	36	37	38	39	(17)	41	42	43	44	(83)	46	47	49	50	(21)	52	54	55	56	2,202
b	NPV	(2,111)	34	34	33	32	(13)	30	30	29	28	(51)	27	26	26	25	(10)	24	23	23	22	830
c	Cum NPV	(2,111)	(2,077)	(2,043)	(2,011)	(1,979)	(1,992)	(1,961)	(1,932)	(1,903)	(1,874)	(1,925)	(1,898)	(1,872)	(1,846)	(1,821)	(1,831)	(1,807)	(1,784)	(1,761)	(1,739)	(909)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	717		Max KW	209		State Grants	880		Fed Grants	528			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR	1.6%			Cum NPV	(909)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	2,836																				
b	O&M		7	7	7	8	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11
c	Major Maintenance						57					128					72					164
d	Insurance		7	7	8	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12
e	Payment in lieu of Property Taxes		44	45	46	47	48	49	51	52	53	54	56	57	59	60	62	63	65	66	68	70
f																						
g	Subtotal, Costs	2,836	58	59	61	62	121	66	67	69	71	200	74	76	78	80	154	84	86	88	90	257
2	Revenues (\$1,000's)																					
a	State Grants	709																				
b	Federal Grants	425																				
c	Energy		59	61	62	64	66	67	69	71	72	74	76	78	80	82	84	86	88	90	93	95
d	Recs		12	12	12	13	13	13	14	14	14	15	15	16	16	16	17	17	18	18	19	19
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					852
h	Subtotal, Revenues	1,135	71	73	75	77	79	81	83	85	87	89	91	94	96	98	101	103	106	109	111	966
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(1,702)	13	14	14	14	(42)	15	15	16	16	(111)	17	17	18	18	(54)	19	20	20	21	709
b	NPV	(1,702)	13	12	12	12	(33)	11	11	11	10	(68)	10	10	9	9	(26)	9	9	8	8	267
c	Cum NPV	(1,702)	(1,689)	(1,677)	(1,665)	(1,653)	(1,686)	(1,674)	(1,663)	(1,653)	(1,642)	(1,711)	(1,701)	(1,691)	(1,681)	(1,672)	(1,698)	(1,689)	(1,680)	(1,672)	(1,664)	(1,397)
Proforma Inputs			Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	464		Max KW	178		State Grants	709		Fed Grants	425			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR		#NUM!		Cum NPV	(1,397)				Discounted Pay Back	20							

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	2,994																				
b	O&M		13	13	13	13	14	14	15	15	15	16	16	16	17	17	18	18	19	19	20	20
c	Major Maintenance						57					128					72					164
d	Insurance		8	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12
e	Payment in lieu of Property Taxes		46	47	48	50	51	52	53	55	56	57	59	60	62	63	65	67	68	70	72	74
f																						
g	Subtotal, Costs	2,994	66	68	70	71	130	75	77	79	81	211	85	87	89	91	166	96	98	101	103	270
2	Revenues (\$1,000's)																					
a	State Grants	709																				
b	Federal Grants	425																				
c	Energy		104	107	110	112	115	118	121	124	127	130	134	137	140	144	147	151	155	159	163	167
d	Recs		21	21	22	22	23	24	24	25	25	26	27	27	28	29	29	30	31	32	33	33
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					3,774
h	Subtotal, Revenues	1,135	125	128	132	135	138	142	145	149	153	156	160	164	168	173	177	181	186	191	195	3,974
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(1,860)	59	60	62	64	9	67	68	70	72	(54)	76	77	79	81	11	85	88	90	92	3,704
b	NPV	(1,860)	56	55	54	52	7	50	49	47	46	(33)	44	43	42	41	5	39	38	37	36	1,396
c	Cum NPV	(1,860)	(1,804)	(1,749)	(1,695)	(1,643)	(1,636)	(1,586)	(1,538)	(1,490)	(1,444)	(1,477)	(1,433)	(1,390)	(1,348)	(1,307)	(1,301)	(1,262)	(1,224)	(1,187)	(1,150)	246
Proforma Inputs			Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	815		Max KW	271		State Grants	709		Fed Grants	425			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR	5.8%		Cum NPV	246					Discounted Pay Back	19							

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	2,703																				
b	O&M		5	5	5	6	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8
c	Major Maintenance						57					128					72					164
d	Insurance		7	7	7	7	8	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11
e	Payment in lieu of Property Taxes		42	43	44	45	46	47	48	49	51	52	53	55	56	57	59	60	62	63	65	66
f																						
g	Subtotal, Costs	2,703	54	55	56	58	116	61	62	64	65	195	69	70	72	74	148	78	80	82	84	250
2	Revenues (\$1,000's)																					
a	State Grants	676																				
b	Federal Grants	406																				
c	Energy		43	44	45	46	47	49	50	51	52	54	55	56	58	59	61	62	64	65	67	69
d	Recs		9	9	9	9	9	10	10	10	10	11	11	11	12	12	12	12	13	13	13	14
e	Avoided Distribution																					
f	Capacity/Demand		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	Residual Value																					0
h	Subtotal, Revenues	1,081	51	53	54	55	57	58	60	61	63	64	66	68	69	71	73	75	76	78	80	82
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(1,622)	(2)	(2)	(2)	(2)	(59)	(2)	(3)	(3)	(3)	(131)	(3)	(3)	(3)	(3)	(75)	(3)	(3)	(3)	(3)	(167)
b	NPV	(1,622)	(2)	(2)	(2)	(2)	(46)	(2)	(2)	(2)	(2)	(80)	(2)	(2)	(2)	(2)	(36)	(1)	(1)	(1)	(1)	(63)
c	Cum NPV	(1,622)	(1,624)	(1,626)	(1,628)	(1,630)	(1,676)	(1,678)	(1,680)	(1,681)	(1,683)	(1,763)	(1,765)	(1,767)	(1,768)	(1,770)	(1,806)	(1,807)	(1,809)	(1,810)	(1,811)	(1,875)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	335		Max KW	110		State Grants	676		Fed Grants	406			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results				PreTax, Cash on Cash IRR		#DIV/0!		Cum NPV	(1,875)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
Denotes cell input linked to Individual Cost Tabs

No.	Item/ Study Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs (\$1,000's)																					
a	Initial Investment	3,277																				
b	O&M		6	6	6	6	6	7	7	7	7	7	7	8	8	8	8	8	9	9	9	9
c	Major Maintenance						57					128					72					164
d	Insurance		8	9	9	9	9	10	10	10	10	10	11	11	11	12	12	12	12	13	13	13
e	Payment in lieu of Property Taxes		50	52	53	54	56	57	58	60	61	63	64	66	68	69	71	73	75	77	79	81
f																						
g	Subtotal, Costs	3,277	65	66	68	69	128	73	75	77	79	209	83	85	87	89	164	93	96	98	101	267
2	Revenues (\$1,000's)																					
a	State Grants	819																				
b	Federal Grants	492																				
c	Energy		48	49	50	52	53	54	56	57	58	60	61	63	64	66	68	69	71	73	75	77
d	Recs		10	10	10	10	11	11	11	11	12	12	12	13	13	13	14	14	14	15	15	15
e	Avoided Distribution																					
f	Capacity/Demand																					
g	Residual Value																					0
h	Subtotal, Revenues	1,311	57	59	60	62	63	65	67	68	70	72	74	75	77	79	81	83	85	87	90	92
3	Cashflows (\$1,000's)																					
a	Nominal Dollars	(1,966)	(7)	(7)	(7)	(8)	(64)	(8)	(8)	(8)	(9)	(137)	(9)	(9)	(9)	(10)	(82)	(10)	(10)	(11)	(11)	(175)
b	NPV	(1,966)	(7)	(7)	(6)	(6)	(50)	(6)	(6)	(6)	(6)	(84)	(5)	(5)	(5)	(5)	(40)	(5)	(5)	(4)	(4)	(66)
c	Cum NPV	(1,966)	(1,973)	(1,979)	(1,986)	(1,992)	(2,043)	(2,048)	(2,054)	(2,060)	(2,066)	(2,150)	(2,155)	(2,160)	(2,165)	(2,170)	(2,210)	(2,214)	(2,219)	(2,223)	(2,228)	(2,294)
	Proforma Inputs		Esc. Rate	2.5%		Disc. Rate	5.0%		MWH	374		Max KW	104		State Grants	819		Fed Grants	492			
			Energy Rate	125	\$/MWH	Avg. Power		KW	Rec Rate	25	\$/MWH	Demand	0	\$/KW-mos	Distribution		\$/MWH					
	Results					PreTax, Cash on Cash IRR	#DIV/0!		Cum NPV	(2,294)					Discounted Pay Back	20						

Assumptions

- 1 O&M: 1.5¢/KWH escalated at defined rate (see summary sheet)
- 2 Major maintenance: \$50k in years 5 & 15, \$125k in years 10 & 20
- 3 Payment in Lieu of Property taxes: 1.5% of initial investment, escalated
- 4 Insurance: 0.25% of initial investment, escalated
- 5 Residual Value: calculated growth rate of year 19 revenues (only if positive cashflows)

Denotes cell input linked to Summary Tab
 Denotes cell input linked to Individual Cost Tabs