RECLAIMING VERMONT'S ENERGY FUTURE

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CARBON ZERO, LLC

December 25th, 2008
5 minute internal dialogue

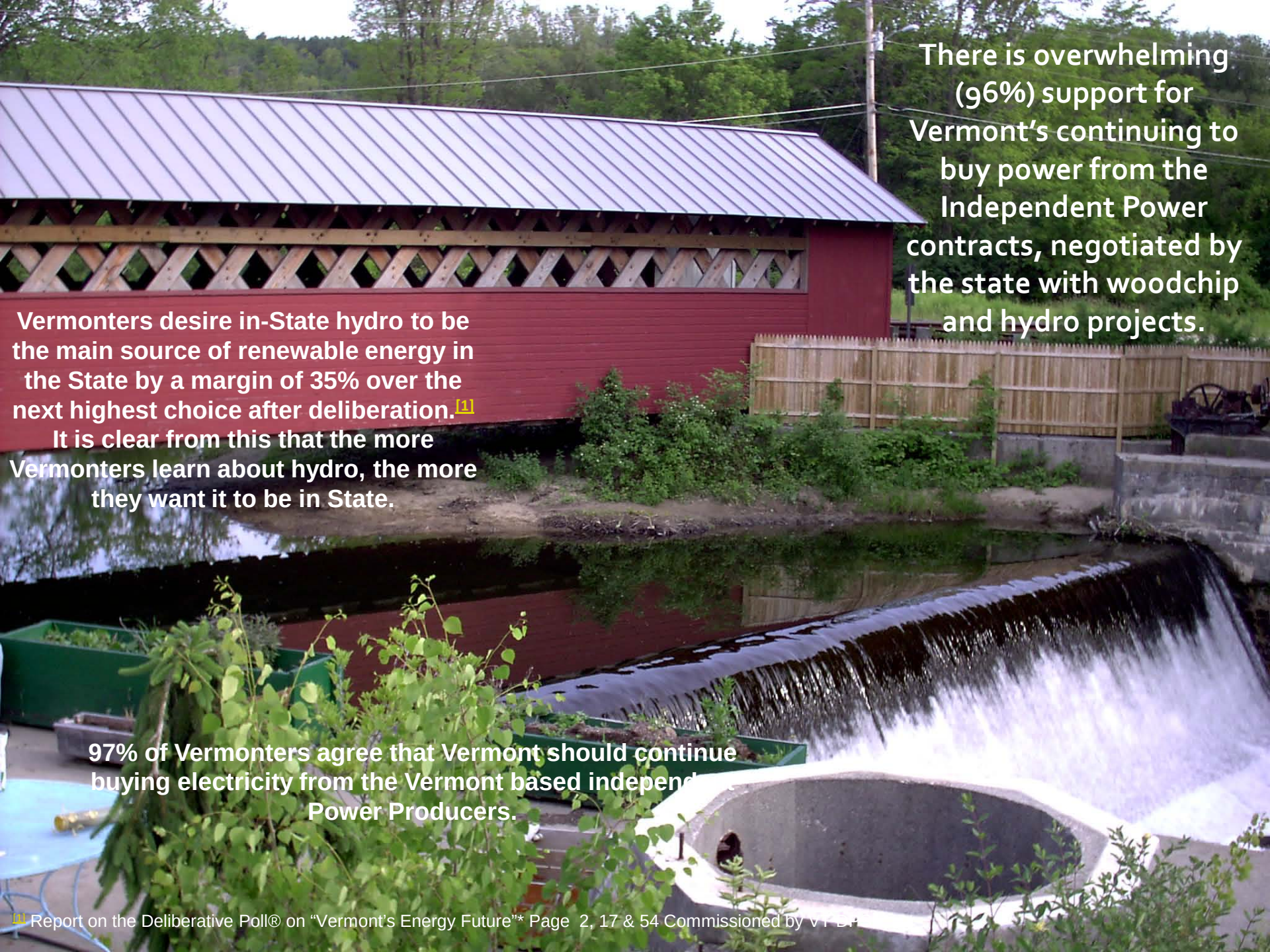
- Situation - NPR is discussing the likelihood of fuel prices reaching $4.58/gal. in the coming months
- Posit – North Bennington is a mill town with 4 dams. Can't we use these sites to generate electricity for heat and transportation?
- Consequence - I need to learn more about hydroelectric
- Result – December 26th 2008, I started a gmail account and began researching hydroelectric and Vermont policy. Carbon Zero was formed in March 2009 . We purchased Vermont Tissue in June 2009. I have helped draft 2 bills and lobbied heavily for two more. We built a group of local, State and Federal stakeholders comprised of both pro and anti hydroelectric development. February 27th, 2013 we were issued a 401 Water Quality Certificate which was the last in a long series of requirements for a Federal Energy Regulatory Commission License to become a power plant. Construction on the project begins in April 2013.
- Conclusion – Vermont can use extant hydropower dams to develop a more fiscally sound energy plan for the State by using one of its oldest technologies thereby reclaiming our energy independence and future.

A bit of history on hydro in Vermont:

- Vermont was at one time 100% hydro powered
- Vermont scores very high in the 3 criteria for hydro:
  - Low population density
  - High annual rainfall
  - Mountainous topography
- There are currently over 1,000 unused dams in Vermont
- When used for hydroelectric grid interconnection, the disbursement of dams throughout the State facilitates a more efficient utility grid
- Vermont has done almost no hydro development in over 30 years

All this begs one question:

WHY?



There is overwhelming (96%) support for Vermont's continuing to buy power from the Independent Power contracts, negotiated by the state with woodchip and hydro projects.

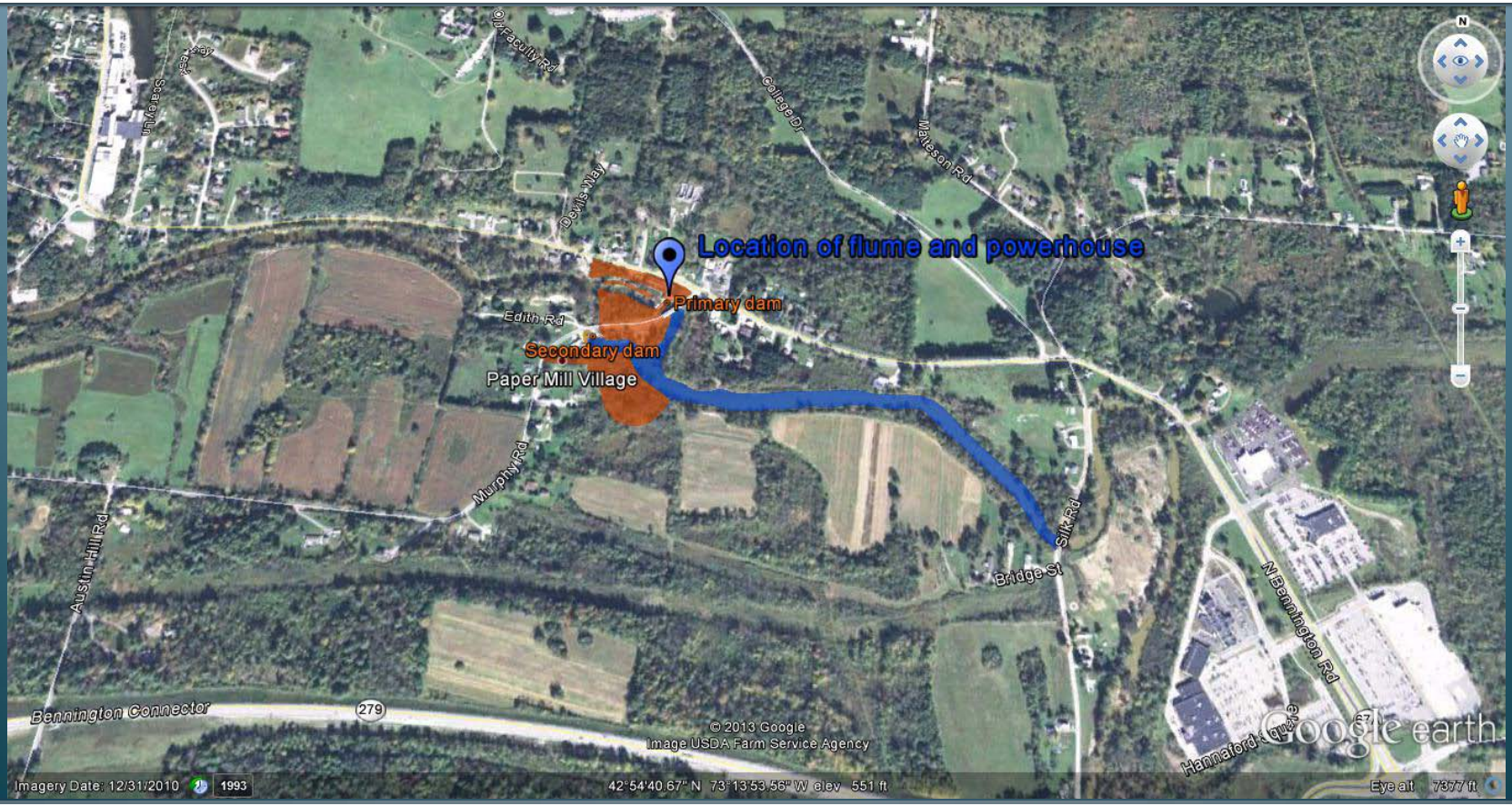
Vermonters desire in-State hydro to be the main source of renewable energy in the State by a margin of 35% over the next highest choice after deliberation.[1] It is clear from this that the more Vermonters learn about hydro, the more they want it to be in State.

97% of Vermonters agree that Vermont should continue buying electricity from the Vermont based independent Power Producers.

[1] Report on the Deliberative Poll® on "Vermont's Energy Future"* Page 2, 17 & 54 Commissioned by VT DPS

VERMONT TISSUE PAPER MILL ON THE WALOOMSAC RIVER

Extant structures circa 1887 (brick portion) and 1907 (cast reinforced concrete building , dam and hydroelectric works)

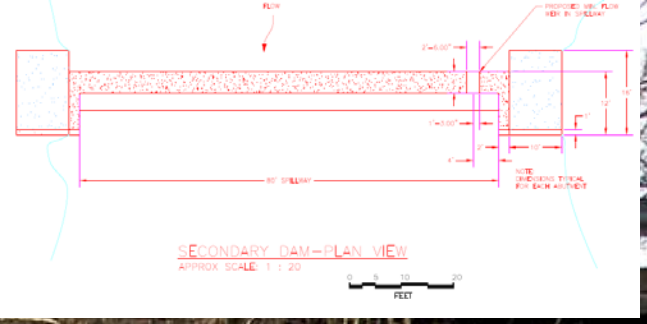


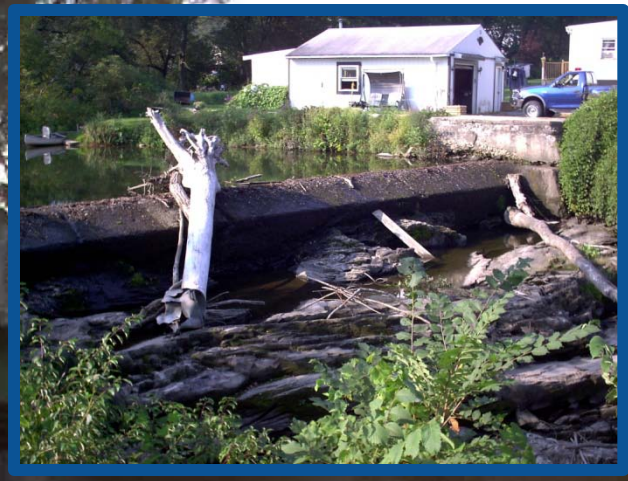
Site details:

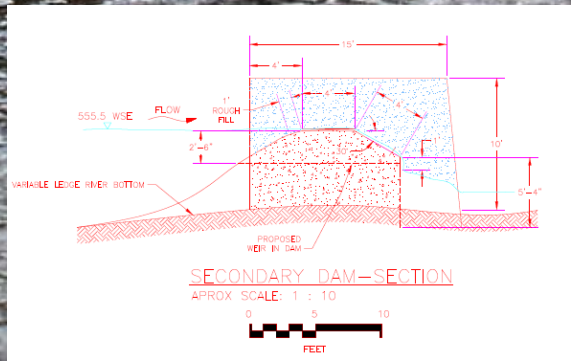
- 6 acre property
- 6.4 acre impoundment
- 85’ primary spillway
- 80’ secondary (or emergency) spillway
- Double bay flume
- Nominal head - 13’ and 17’
- Average discharge – 200 cubic feet per second
- 94.5 square mile watershed

Carbon Zero's proposed redevelopment:

- Install two Ossberger double regulated, full vertical Kaplan turbines paired with two induction generators with a total installed capacity of 360 kW and a flow range of 21 to 347 cubic feet per second
- Use a programmable logic control with pond sensors to control the station as a run of river plant
- Use flashboards to match the two dam heights at 555.33 msl
- Annual generation is estimated at 1.454 GWh
- Add a weir to the secondary spillway converting an ephemeral river to a constantly watered stretch


FLOW
PROPOSED MIN. FLOW WIER IN SPILLWAY
2'-6.00"
1'-3.00"
2'
4'
12'
18"
80' SPILLWAY
NOTE DIMENSIONS TYPICAL FOR EACH ABUTMENT
SECONDARY DAM-PLAN VIEW
APPROX SCALE: 1 : 20
0 5 10 20
FEET



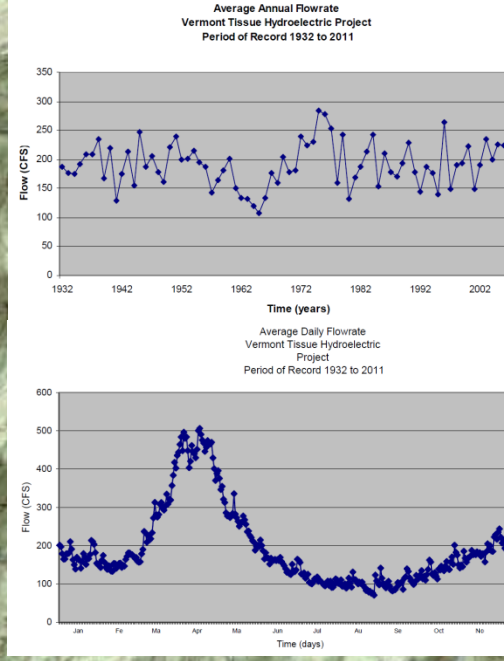

15'
4'
555.5 WSE
FLOW
1'
ROUGH FILL
2'-6"
10'
5'-4"
VARIABLE LEDGE RIVER BOTTOM
PROPOSED WEIR IN DAM
SECONDARY DAM-SECTION
APROX SCALE: 1 : 10
0 5 10
FEET

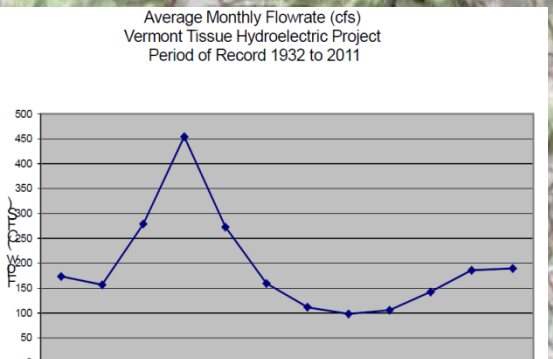
Average Monthly Flow
Period of Record 1931 to 2010
Walloomsac River at Vermont Tissue Dam

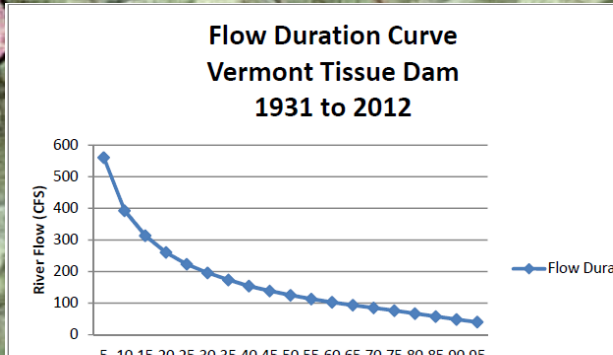
Month	Average Flow CFS
1	181
2	286
3	369
4	308
5	175
6	115
7	123
8	113
9	142
10	173
11	191
12	163

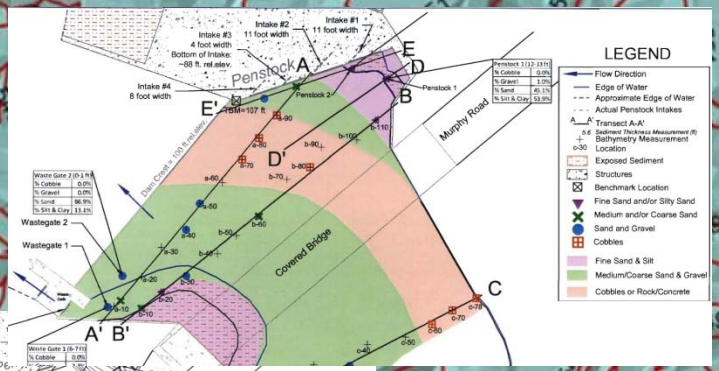
Average Monthly Flow
Period of 1939 to 2010
Walloomsac River at Vermont Tissue Dam

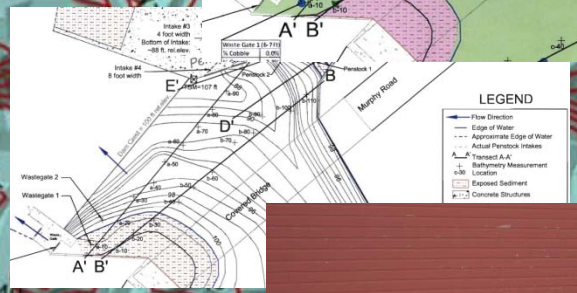
Percent Year Exceeded	Flow CFS
5	560
10	392
15	313
20	261
25	223
30	196
35	174
40	154
45	139
50	125
55	113
60	103
65	94
70	85
75	77
80	67
85	58
90	49
95	40

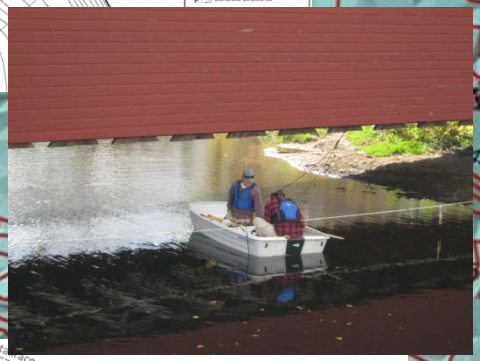


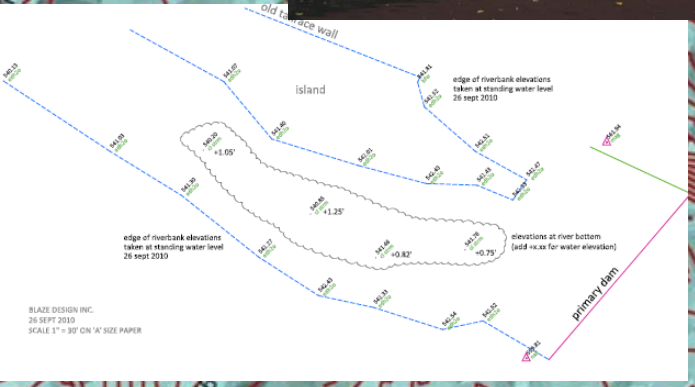






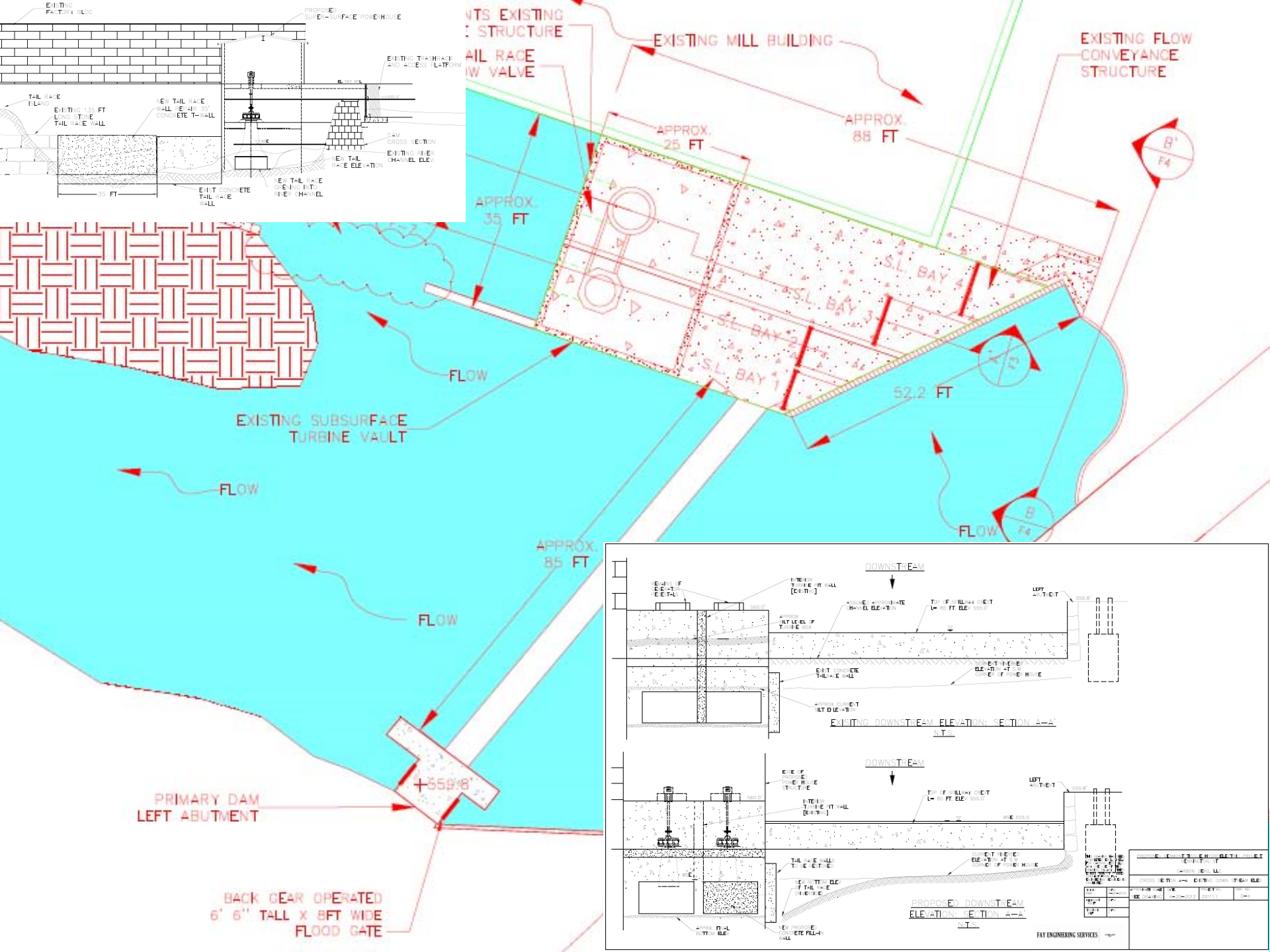


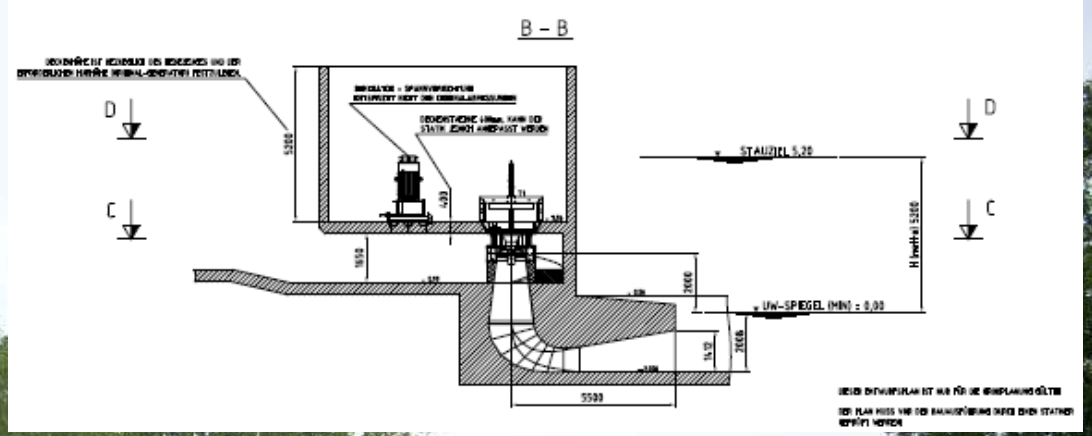


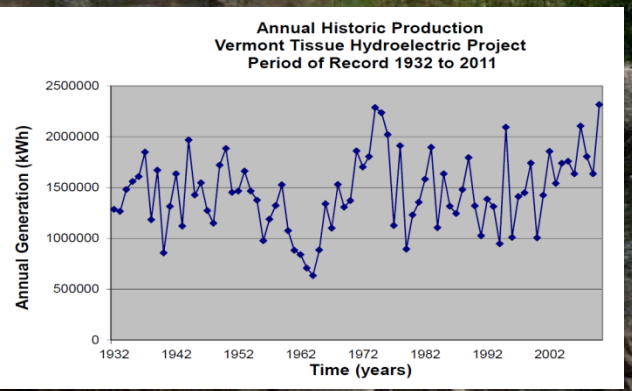


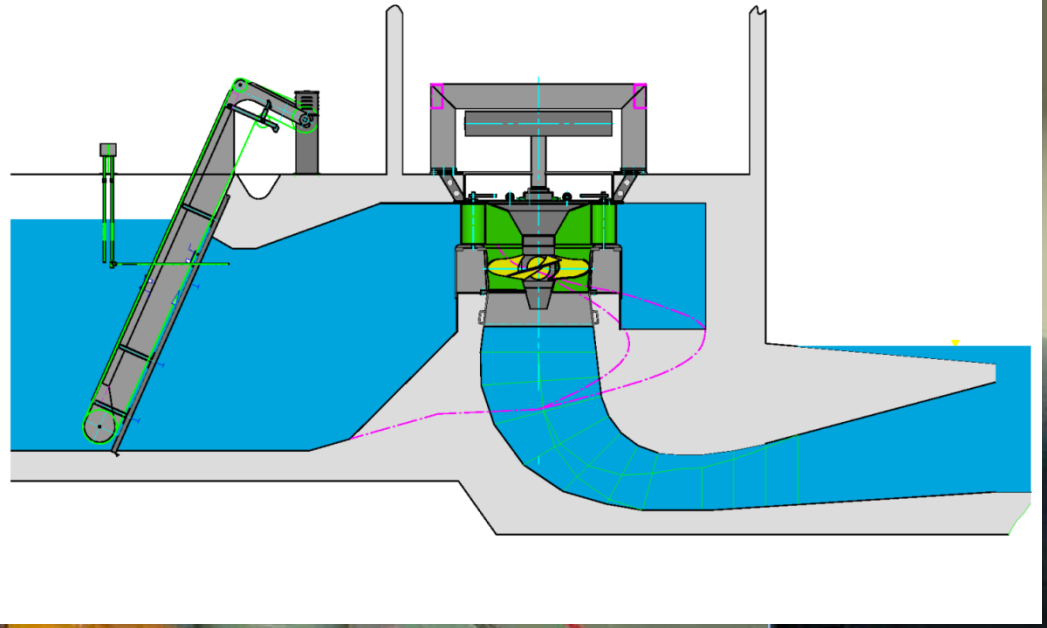
1 inch = 50 feet

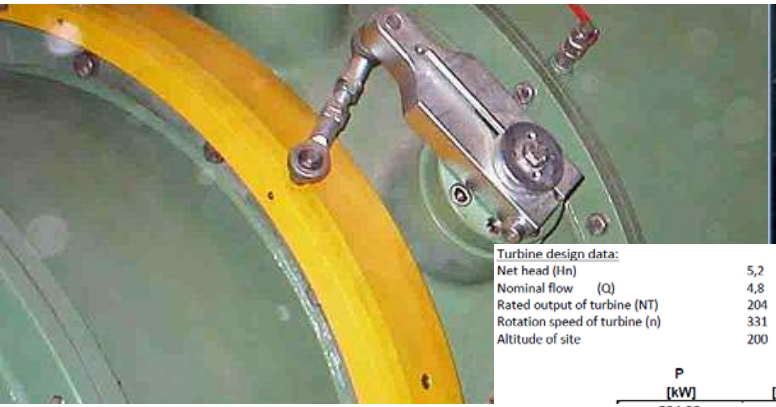
0 50 100 200 Feet

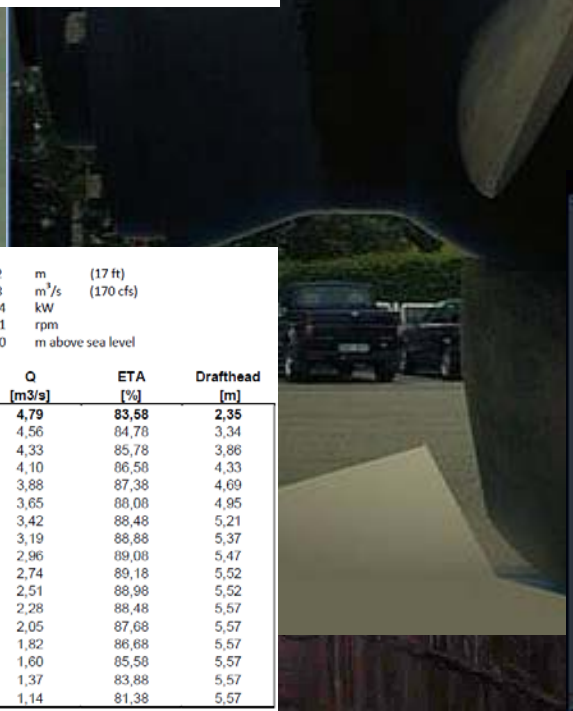

EXISTING MILL BUILDING
EXISTING FLOW CONVEYANCE STRUCTURE
APPROX. 25 FT
APPROX. 88 FT
APPROX. 35 FT
S.L. BAY 4
S.L. BAY 3
S.L. BAY 2
S.L. BAY 1
52.2 FT
FLOW
EXISTING SUBSURFACE TURBINE VAULT
APPROX. 85 FT
PRIMARY DAM LEFT ABUTMENT
+559.8'
BACK GEAR OPERATED 6' 6" TALL X 8FT WIDE FLOOD GATE
EXISTING FACTORY BLDG
PROPOSED SURFACE POWERHOUSE
EXISTING TRASHRACK AND ACCESS PLATFORM
TAIL RACE ISLAND
EXISTING 135 FT LONG STONE TAIL RACE WALL
NEW TAIL RACE WALL (EXIST) 75' CONCRETE T-WALL
DAM CROSS SECTION
EXISTING RIVER CHANNEL ELEV.
NEW TAIL RACE ELEVATION
NEW TAIL RACE OPENING INTO RIVER CHANNEL
EXIST CONCRETE TAIL RACE WALL
35 FT
DOWNSTREAM
EXISTING DOWNSTREAM ELEVATION: SECTION A—A'
N.T.S.
PROPOSED DOWNSTREAM ELEVATION: SECTION A—A'
N.T.S.
FAY ENGINEERING SERVICES


B – B
D
C
STAUZIEL 5,20
UW-SPIEGEL (MIN) = 0,00
5500


Annual Historic Production
Vermont Tissue Hydroelectric Project
Period of Record 1932 to 2011
Annual Generation (kWh)
2500000
2000000
1500000
1000000
500000
0
1932
1942
1952
1962
1972
1982
1992
2002
Time (years)





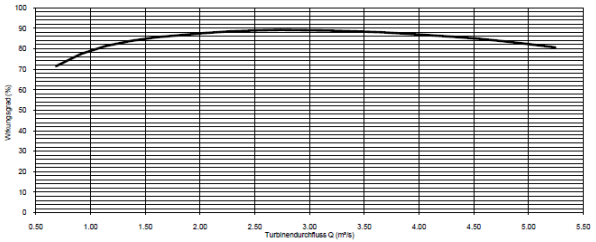


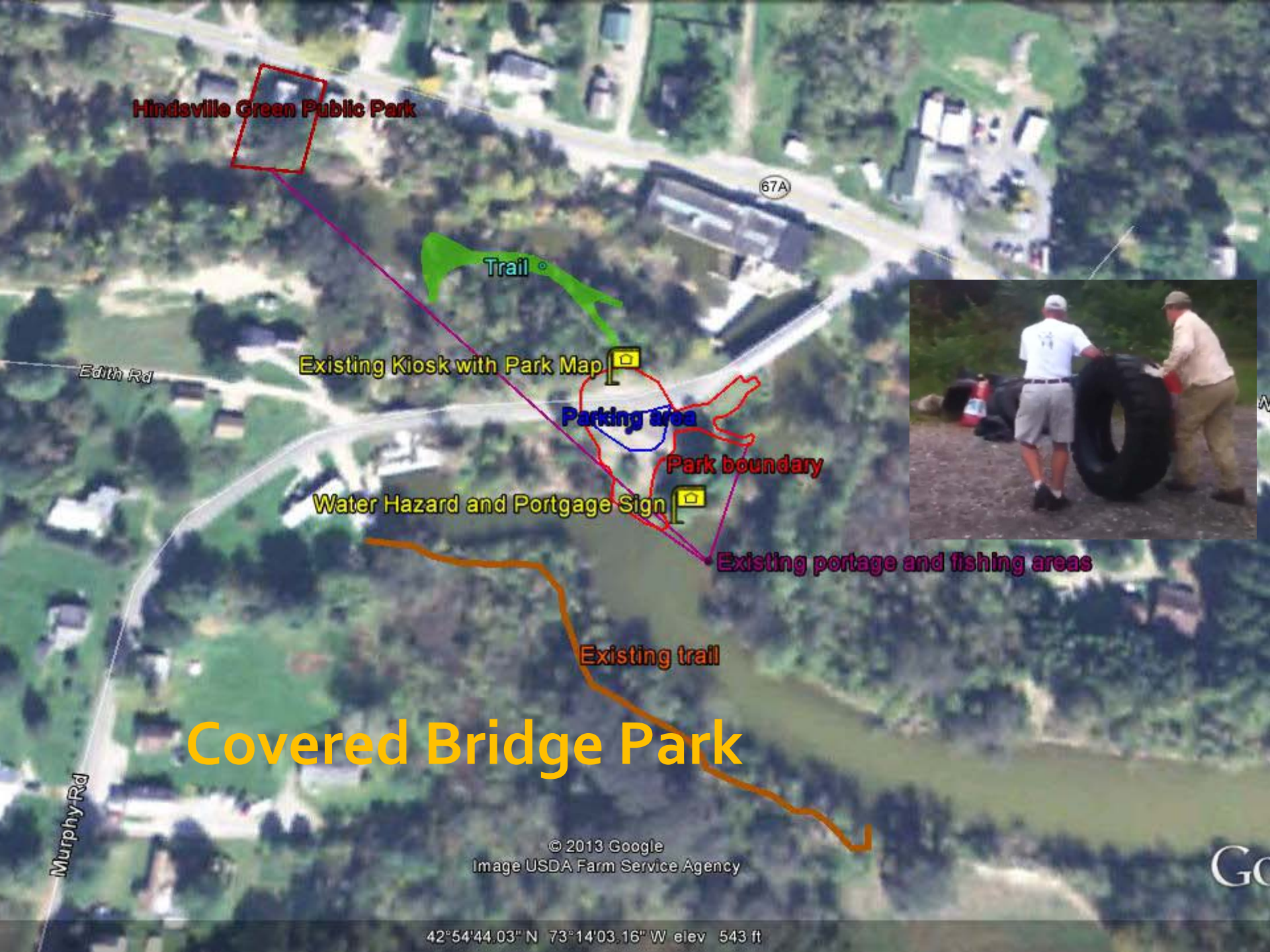
Turbine design data:

Net head (Hn)	5,2	m	(17 ft)
Nominal flow (Q)	4,8	m^3/s	(170 cfs)
Rated output of turbine (NT)	204	kW	
Rotation speed of turbine (n)	331	rpm	
Altitude of site	200	m above sea level	

P [kW]	Q [m3/s]	ETA [%]	Drafthead [m]
204,00	**4,79**	**83,58**	**2,35**
197,23	4,56	84,78	3,34
189,58	4,33	85,78	3,86
181,28	4,10	86,58	4,33
172,79	3,88	87,38	4,69
163,93	3,65	88,08	4,95
154,38	3,42	88,48	5,21
144,74	3,19	88,88	5,37
134,70	2,96	89,08	5,47
124,48	2,74	89,18	5,52
113,85	2,51	88,98	5,52
102,92	2,28	88,48	5,57
91,79	2,05	87,68	5,57
80,66	1,82	86,68	5,57
69,68	1,60	85,58	5,57
58,64	1,37	83,88	5,57
47,33	1,14	81,38	5,57

KAPLANTURBINE
HGI TD4

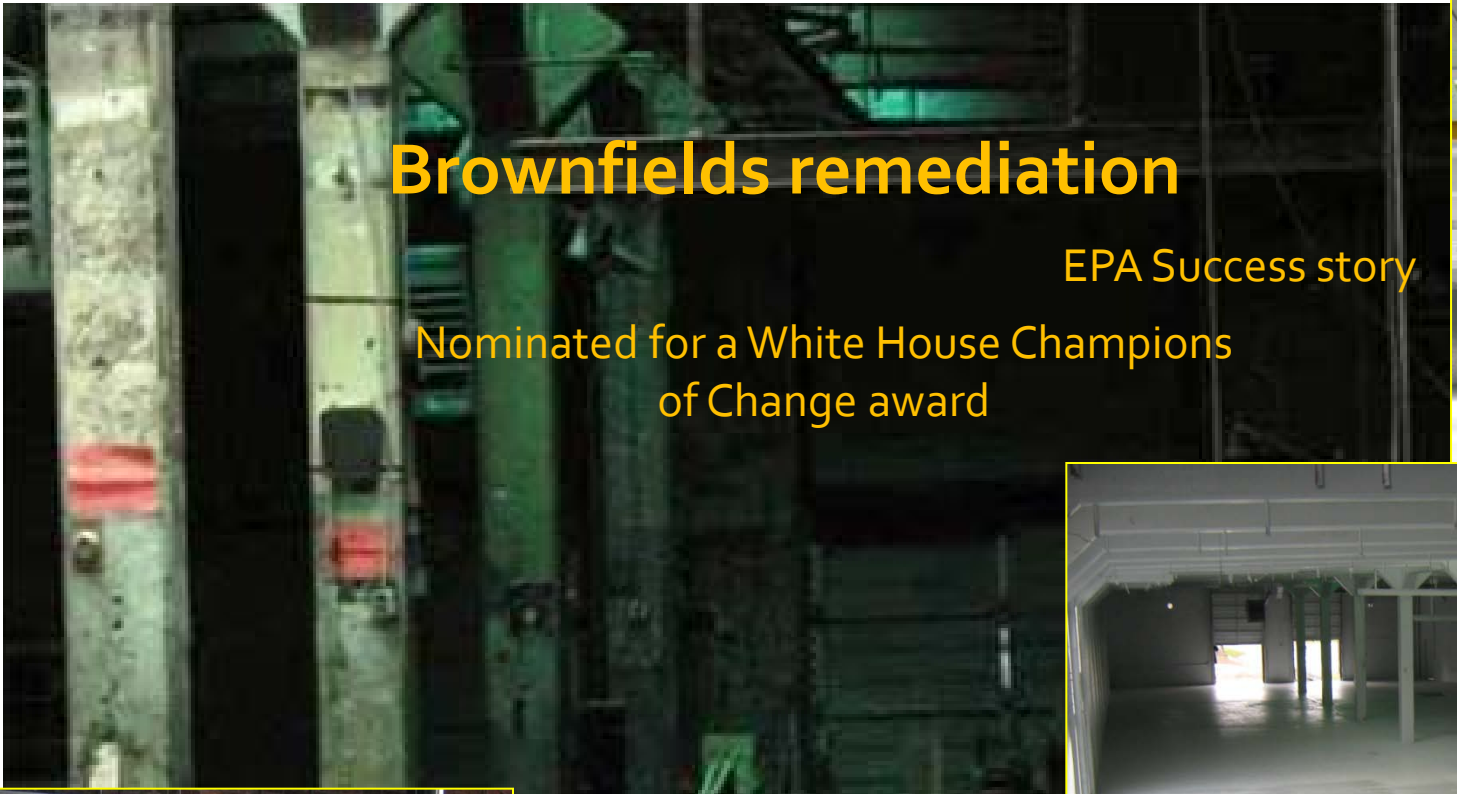



Hindsville Green Public Park
67A
Trail
Existing Kiosk with Park Map
Edith Rd
Parking area
Park boundary
Water Hazard and Portgage Sign
Existing portage and fishing areas
Existing trail
Covered Bridge Park
Murphy Rd
© 2013 Google
Image USDA Farm Service Agency
42°54'44.03" N 73°14'03.16" W elev 543 ft

Brownfields remediation

EPA Success story

Nominated for a White House Champions of Change award



Outcome

Net result from the Vermont Tissue hydroelectric plant offsets 1,026 metric tons of carbon dioxide every year

The persistent actions of individuals tend to be the greatest forces of change