AR-2016

Vol 1 of 4

Merrimack Station

RESERVE CONF. ROOM.

(1)

Things to do

- Read Brayton literature
- " Kendall
- Find out what stock assessments have been done for merrimack, etc
- Read up on perch - talk w/ freshwater fish biologists
- " " " fish bio re: gamete development, gonadal growth

} Northeast MA, VT.

☆ Get specs on intake structure -

- Read up on new 316 b regs. — PROVISIONS IN CWA RE: EXISTING FACILITIES, DATA, ETC...
- Build up reference library on thermal affects - check EPRI doc.

- Check D.O. data, character of plume over distance.
- review all studies on plankton & inverts
- ~~FA~~ AERIAL THERMAL IMAGES OF PLUME? - MUSTARD STUDY

* RELATIVE IMPORTANCE OF YELLOW PERCH

* LARGE BIOMASS IN SYSTEM HISTORICALLY / SPORT FISHERY.

* OTHER IMPACTS - ACID RAIN? PH LEVELS.

(?) WERE LENGTHS TAKEN DURING FYKE & ELECTROFISH STUDIES?

MIXING ZONE - WHAT PERCENTAGE OF H. POOL INFLUENCED BY PLUME? S, S, F, W?

SURFACE?  ENTIRE WATER COLUMN?

WATER @ 4°C IS MORE DENSE THAN COLDER WATER 0-3°C

SPAWNING,

FISH EGGS, FRY > most SENSITIVE

what was basis for building a new 1200m discharge canal & 54 spray modules.

* - WHEN WAS NEW CANAL DUG? (1972)

A - impingement monitoring FLOW DROPS < 900 CFS - STUDIES INDICATE IMPINGEMENT GREATEST DURING HIGH FLOW

check on PH monitoring

- Where does outfall 004 discharge?

* for John → mean tidal range under hydrology – 101.1 – 110.6

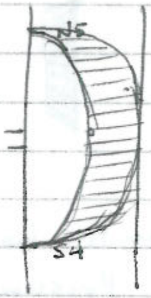
[(*) addressing all concerns is not a basis for not consulting.]

Discharge

1. MIXING ZONE

WIDTH

LENGTH



THE PROBLEM

RESIDENT SPECIES.
ANADROMOUS "
INVERTS
PLANKTON

Need Full description of hooksett pool length, tribs, other discharges, dams.

State classification –
NCCW reg.
efforts to restore anadromous fish ru[n]
existing permit language – re: temp. limi[t]

Question for attorneys:
316(a) – since no limit had been previously established – does 316(a) apply?

Questions for NH guys.
- 7910
- impingement monitoring reqt's – < 900 cfs.
- at 004 discharge?
- mixing zone ~ historic. [S4 – N5] + river / 50%? ΔT 1.5
- Condition for minimizing contact w/shore.
- det. max T & ΔT
  min ΔT — cold shock literature?
- river surveys – current ~ continuous ~ long time series.

(*) Ask Ralph & Al about literature on surface use.

For Thursday

* proposed changes to permit — Temp limits, mixing zone

CWIS - fish return, power spray (low press), approach velocity, traveling screens?

- blocking access to discharge canal.

"ΔT"

* arguments anticipated. → ind. population has changed sig. — fishing is good.
  - passage is not blocked.
  - ~~new~~ upgrades to CWIS not justified based on impingement/entrainment studies.

IMPINGEMENT EVENTS

DATE	TIME	UNIT #	SPECIES	# FISH	RIVER FLOW
9 SEP 98	8:20 am	2	herring	72	
3 SEP 98	7:30 am	2	"	274	
30 OCT 97	2:30 am	2	"	147	
4 OCT 97	1:40 am	2	"	63	
30 SEP 97	4:30 am	2	"	103	
26 SEP 97	5:45 pm	2	"	100-150	

#(7)

Scott Decker - NHFGD 603-271-2501

John Warner → Coulter Lab
Cornell.

└ river specific resource assessment

EPA lab →

From 94-95 Study

plankton study - spottail & common shiner more abundant in ambient
smelt " " " thermally affected zone
compared to other areas. But
* mixing zone & thermally affected zone strongly dominated by bluegill.
* spottail & common shiner dominated ambient

* - Review HQ draft guidance document on 316(a) 1977
Phil has a copy.

11-5-02 Scott Decker - NHFGD 603-271-2501
I called @ 10:50 - left message.

Steve Wheeler NHFGD 603-271-2501

- state wide inventory? no "

yellow perch —

(6) Developing winter temps to protect perch.

* Find out stocking effort - salmon, shad, herring for Suncook, Soucook, and, rivers north of Garvins falls Dam.

* Studies from 60's & 70's - Bob Estabrook? — Bring back - make copies
Ask Peter Nolan.

* Has there ever been plume studies conducted in cooler periods
< 39°F (3.8°C)

12/99 N10 3.5°C] ——→ FIRST RECORDED TEMP @ N10 IN SPRING IS MARCH 27. TEMP RANGED FROM 3.99–3 BETWEEN MARCH 27-29

(*) POSSIBLY ___ PLUME SINKS
SO? MAY HAVE A GREATER INFLUENCE ON PERCH
ATTRACTION — ALSO, IN
MAY BE MISSING PLUME AT

* NHFGD Letter to EPA &/OR DES - STATUS OF RESTORATION
* USFWS - " " EPA W/ SIMILAR.
EFFORTS (SHAD, HERRING, SALMON, ETC). CONCERNS RE: ENT. & IMP,
& RECOM. FOR T LIMITS

* ANNUAL DREDGING IN CANAL?

* Gonadal development YP & walleye - <11°C for ≥ 185 days

* lethal temp white sucker 30.5 (Hokanson.
* — for habitat exclusion - use avoidance temps.
+ UILT yellow p. 29.2 - 33°C - Hok

Basis for establishing temp. limits.

- consistent w/ goals of CWA- temp. is considered a pollutant
- resident & anadromous species that are present that are sensitive to the elevated temps. generated by the plant
- algal community & benthic community can be affected by chronic exposure to elevated temps.
- plume can influence almost 50% of surface area of Hooksett pool during summer conditions
- thermal plume causes or contributes to stratification in lower section of pool, which has been shown to depress DO levels to levels that violate state wq standards.
- reduced DO at depth may further stress fish that are already avoiding stressful surface temperatures.
- existing data does not ~~support~~ demonstrate that the pre-existing fish community has been maintained.

[• plume likely extends, and comes in contact w/ shoreline, especially during summer months. — in [violation] of permit narrative requirement to minimize

Reduce the spatial extent of elevated temps.
Ensure adequate passage for out-migrating anadromous
American eel-
Downstream adult herring — Nov.

(*) DRAFT FINAL REPORT WAS DUE March 1, 1994-
EVER COMPLETED?

May 8, 2002 letter.
Temp data loggers installed @ S4 @ 2 greater depths.

* INTAKE- in violation of A.1.C of permit — all live fish, etc. returned to their natural habitat.

Review of Reports Submitted by PSNH in draft form. 2006

Thermal Discharge Effects on Downstream Salmon Smolt Migration
May 2006 (draft) - Normandeau

Question ① - which unit was online? Capacities of each?
(get from
② - where were smolts obtained from? Unit 1 120 mgw
all fish @ 8:09 pm - why. 2 350
③ - released @ 8:09 p.m. - why? 2 combustion turbines
50 mw each

④ 2 units vs. 1 running during study

	(2003)	(2005)
1 online - release #'s	1, 2	1, 2, 3, 4, 5
2 online - release #'s	3, 4, 5	

only 3 of 10 studies conducted w/ 2 units on. why?

pg 35 discusses 1 vs. 2

(29 - 1 regurg)
28 fish released (total) w/ 2 units operating
78 fish " w/ 1 unit "

106
-28
78

⑤ Interesting to know whether thermal plume extends down to Hooksett Dam — or.... are smolts exposed to elevated T's

Interesting to see to what lengths you've gone to discredit your own previous sampling efforts.
This raises questions on the validity of all your data. Your new information is un convincing.
~~we will~~ EPA will use temp limits based on peer-reviewed studies to ensure temperatures w/in the Hooksett pool are protective of the species present '72? (when the plant went on line, ~~when~~ prior to start-up of second unit)

Smolt passage study

confirm 2 units : Unit 1 120 MW
Unit 2 350 MW
plus 2 combustion turbines 50 MW each

Q: The report indicates only that one unit or two units were on line, but not which unit was on line. That is important to know.

Q - Were the combustion (one or both) ever operating?

Q - why were all releases conducted at ~ 8:00 pm.?

Q - In the 10 releases ~~conducted~~ over the 2 years (03,05) why were only 3 conducted with 2 Units running?

~~Q: wh~~

Q: While the study seems to indicate impeded passage. It's unclear if the fish are actively avoiding the plume, or are exposed to it.

Q: Does the plume extend down to the Hooksett dam? If so, are smolts being exposed to to elevated temps before passing over the dam?

* print from Det. Doc: Table 5.6-1

Most sensitive species for each life stage.

yellow perch egg 19.1°C

* look at Original permit & fact sheet - compliance pt.
S-12, S-8, S-4

Det Doc → March 20 - May 20 19.1°C (66.4°F) - yell perch egg survival.

April 1 - July 15 28.3°C (83°F) p.62 p.58 → larvae (YP)

28.3 (83F) - juvenile perch
28.3 (83F) - adults

Need to determine when yellow perch larvae are likely to be present in river.

* Check ambient T data to see how close ambient gets to limits throughout year.

(+) low flow, high temp. - 2 unit operation at all.
(+) temp. data for x sections? → of river.
(+)

Species reviewed

ambient fluctuations
↳ that is also affected by changes in flow from ~~upper~~ dams -

* - yellow perch
- white sucker
- Atlantic salmon
-

other "cool water" species

Most sensitive resident species

* egg - 18°C (64.4°F) Yell. perch - demersal. - shallows
time [March 20 - May 10]. (Charles R)

* larvae - perch 27°C (80.6) Charles.
& 28.3°C (83°F) protective for Charles.
time April 1 - July 15

* juveniles yellow perch - 27°C (80.6)
28.3 (83) - considering ambient fluctuations.

(look @ recent perch data to see if they are inhabiting waters w/temps above these limits)

* adult -

* adult spawning

Get From John — location of cited sources
RTC & final permit.

05 data 8/22/05 Report (pg 54) indicates yellow perch abundance is 4.5 / Aug Sep' the in =
4 15 W 4 transects at 15 2@ 15 E
in Aug - Sep 05 2@ 15 W

caught 4 fish per 4,000 transect feet
~~of~~ or 1 fish / 1,000

If mixing zone transects are included.

12 transects total (13 E, W; 14 E, W; 15, E, W)

8 fish per 12,000 transect feet or. 0.67 fish / 1,

04 data Report claims 5.0 fish per 1,000 feet (CPUE)

just sites 15 E & W 4 transects which resulted in
2 perch caught = 0.5 fish

including all "thermally influenced sites (excluding canal):

12 transects resulting in 2 fish caught.
= 0.16 fish.

pose the Q: to others re: amount of habitat to be restored.

location - from Normandeau 1967-68. (pg 4)
distance ~~7.9~~ miles.
5.75

86.80
73.14
13.66

power plant is located near the center of the Hookset 'Pond' at mile 84.00

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larval perch collected.

95 - collected May & ~~June~~. no eggs collected.

collected [10 May & 16 May], w/ higher concentrations on 10 May. Report (pg 9 - Fisheries study) suggests larvae could have been present before sampling started.

Table 3-2 provides spatial distribution of perch larvae. (temps ranged 12.9 - 14.7°C) pg 12

Studies 1975-77 - appear to have sampled in June, July, Aug.
no larvae collected in ~~the~~ entrainment samples

* Spawning period April 15 - April 30 Lake Oneida - same lat.
April 43°

1967-68 - Report does not identify ichthyoplankton in its discussion of zooplankton. Only generally states fish eggs and larvae were present.

Larvae time April 15 - June 15 (Krieger 83)

* 92 Report pg 2-16 - larvae - upon hatching, positively phototactic & pelagic

May

MOST SENSITIVE EGG T — 18° (bottom – shallows) 10-day incubat
TIME PERIOD — April 15 → April 30? May 30?
(1) (look at ambient temps.

MOST SENSITIVE LARVAE T – max 28°C (Krieger) max SI 23° – min 29°
(15–22)
TIME PERIOD suggest 28 @ Surface
~~April 30~~ May 1 — June 30. 28 °C @ Surface

MOST SENSITIVE JUVENILE T ~~28°C~~ @ Surface (29)
TIME PERIOD throughout year.
not protective.

MOST SENSITIVE ADULT T ~~28°C~~ @ Surface – all times except
TIME PERIOD winter chill period.
not protective

MOST SENSITIVE ADULT REPRODUCTIVE T
TIME PERIOD Nov 1 — April 1 152
Nov 1 — April 30 181 days @ 10°
@4°C Dec 1 (99) → April (1) – 121 days @ 4
@8°C Nov 10 (99) → April 30 (00) 171 days @ ~~10~~ 8°

MOST SENSITIVE ADULT SPAWNING STAGE ~~T~~ 12.2 → 15.0 → (17.2°)
TIME PERIOD
Mar 20 – Apr. 1 | April 2 – 14 | April 15 – 30

Krieger, et al, 83 (pg 14) –
Ag 1 April → June
when ambient reaches 7–13°C
April 1 →

RATIO OF S-4 (AREA) TO ENTIRE POOL.

(S-4) / (POOL) $\frac{1}{14} = \frac{x}{100}$ = 7% (7.14)

3-12 / (POOL) $\frac{2}{11} = \frac{x}{100}$ ~~2~~ 11x = 200 x = 9.09 (~~9%~~) 18% (18.18)

BIP — Community in 68-69 → dominance

American shad. pg 3-1 (1992 report) — only one expected to spawn in the river mainstem

Ambient temps

	winter chill period (Nov 1 – April 1)		
Avg. T @ N10	NOV - DEC 00	- $\frac{46.814}{9}$	= 5.20 °C
	NOV, DEC 01, MAR 02		
	NOV 02		
	NOV, DEC 03		
	NOV 04		

Avg T @ N10	April, may 2000 - 05	101.979 / 10	= 10.1979

- 8:43 - Phil → Call 96(
978-473-97

Yellow Perch

SPAWNING 4-19°C (HOK 77, p 1530)
7-13° (Krieger, p 1)

successful reproduction ~~spawning~~ of perch depends on rising T's during spawning & early life stages (HOK 7

EGG 6.8 - 19.9 (HOK, 77, p 1530)
18.0 (KOONCE 1977, Table 2) 16% mortality vs. 70% @ 21°
19.9 Krieger p. 14 upper TL 50

LARVAE 3.7 - 21°C early embryonic stage
7.0 - 22.9 later " "
27 (Kendall gave them 28.3)

Jan 97 Report
samples collected 5/10
6/27/95. perch collect
only during first 2
sampling dates 5/10,

JUVENILE 24 optimum, 28°, may represent chronic stress cond. Tidwe
max growth Temp 26.8 . Eaton 94
optimum growth 26-30, died at 34° Piavis (Ches Bay)

ADULT max growth Temp 26.8 Eaton 94
ULT 26.5, 29.2, Black '52, 30.9, 29.7, 32.5 (by ref)

REPRODUCTIVE 160 days @ 8°C 151 days between 10/31 - 4/1

Merrimack Studies - Highlights

① EFFECTS OF THERMAL RELEASES ....

- Studies conducted 6/67 — 10/68
- project director Donald Normandeau.
- Unit I (120 MW) was already online, Unit II (350 MW) came online ~~shortly after Unit II~~ or just prior to start of second year of data collection. * Unit II brought online [May 1968]
- Philip Wightman, NHFGD designed & directed fish studi
- Thermal studies indicate heated effluent does not mix w/ river water, but became stratified. lens of warm water extended southward towards Hooksett Dam.
- warm water is mostly restricted to upper 3 feet. (3-4')
- Δ DO in 68 between surface & bottom samples were significant & consistent. Not the same north of station (p 96)
- DO consistently lower at S0 (west bank) than N-10 pg 100
- Impacts to plankton (particularly zooplankton) were clearly demonstrated (pg 202). pg 208 → Flagellates, ciliates, rotifers, & cladocera were most susceptable.
- Conclusion. rise in temp. of c.w. has a sig. effect on plankton suspended in it.
- Periphyton studies indicated little to no growth in canal, but similar abundances at S-17 compared to N-10. (p 212)

FISH DATA. relative abundance

	1967	# caught	1968	# caught	AVE
yellow perch	21.7	3447	25.3	2127	
brown bullhead	18.9	3008	8.8	743	
smallmouth	1.0	162	1.5	123	
white sucker	10.8	1716	~~1312~~ 15.6	1312	
largemouth	0.1	8	0.1	8	
Chain pickeral	1.0	162	1.5	123	

* Study suggests area south of discharge to be more productive than north.

Out of 16 species listed, 8 ....

Of the ~~8~~ 9 most dominant species in 67 (representing 1.0% of total composition, or more), 8 showed dramatic declines in absolute abundance. Changes in relative abundance varied. Only golden shiner increased. 47% fewer fish caught in 1968. (p 223)

Hockset

	67	68		total	avg	
y. perch	21.68	25.26	1	46.94	23.47	(2)
sm bass	2.11	2.24	2	4.35	2.18	(7)
e. chain pick.	1.02	1.46	3	2.48	1.24	(9)
br. bullhead	18.92	8.81	4	27.73	13.87	(3)
common sunfish (pump)	33.89	27.46	5	61.35	30.68	(1)
rosebreasted sunfish	4.18	5.58	6	9.76	4.88	(6)
com. wh. skr.	10.79	15.58	7	26.37	13.19	(4)
golden shiner	5.33	11.18	8	16.51	8.26	(5)
yellow bullhead	1.44	1.72	9	3.16	1.58	(8)

3:21:30

(2) Summary Report covering (67-78)
march 79

* Unit I began operating in 12/60 Intake velocity 45.7 cm/s
Unit II " " 5/68 1.5 ft/sec

* 6/1972 - spray pools installed

* Hooksett Pool shallow - most less than 3 m deep.
* below Suncook predom sand -> cobble substrate - several SAV beds noticeable late in season. (p.5)

* pg 140 - Fisheries methods reported in Wightman (1971)
pg 127 citations. Wightman, ? 1971. Merrimack River thermal study. N.H. Fish and Game Dep., Division of Inland and Marine Fisheries. 111 pp.

* pg 82 Entrainment impacts probably occurred within first few years of station operation

Impingement Total # of fish impinged in 1976 was 1449
12 species, bull head, yellow perch, minnows
pg 83 & sunfish 1977 est. to be 2504

84 RIS - including white sucker, brown bull head, pumpkinseed, y. perch, golden shiner.

92 tox test discussion for yellow perch "apparent spill"

pg 94 - White sucker. "least heat - tolerant species -

pg 95 brown bullhead

97 conclusion - continued ~~dominance~~ abundance of the dominant species eg. white sucker, brown bullhead, does not include yellow perch. Get more info on brown bullhead life history

(4)
(2) Merrimack Station
Fisheries Study Jan 97

* pg 23 CPUE yellow perch / decreased significantly fyke nets 67-78

e-fishing 72-76 (Table 4-1] pg 24

Second major change in fish community is increase in bluegill abundance

pg 25. - re: competition between bluegill & y perch.

pg 27 1995 except for a single high catch of perch in canal in March, y perch were not abundant in any segment of HP at any time of year.

(pg 12) adult fish
CPUE of YP 94-95 lowest observed in 11 years of sampling. - (all year) & lowest for June - Sept period. to most previous years.

Table 4-1 (p. 24) -

Fyke.	1973	N & S	combined/averaged	1.40
				1.84
	1978	"	" "	3.24/2 = 1.62
	1995	N & S	" / avg.	0.04
				0.04
				0.08/2 = 0.04
E-fishing	1972	N & S	combined/avg.	12.33
				6.50
				18.83/2 = 9.415
	1995	N & S	combined/avg	0.75
				1.00
				1.75/2 = 0.88

~~1972~~ 1976 - N 2.50 + S 1.50 = 4.00/2 = 2.00

1992 Phase I Prelim Report

Target species now only largemouth, smallmouth pumpkinseed & yellow perch.

* pg 2-17 lifestage T req's for y. perch.

p4-6 plume effects on resident species – heated water remains at the surface downstream – exceeding T for most species during summer high T, low flows.

Table 4-1 (p4-7) lifestage & T info for perch, etc

pg 5-4 decline in yellow perch

pg 6-1 – little if any movement of res. species within pool.

pg 6-1 Winter sampling indicated yellow p., bullheads, white sucker, & pickerel moved into canal or thermal plume area.

p 4-2 – plume extends as a lense of warm water 1-2 meters deep. Southward

refers to Report 2 pg 11-12

(5) 2004-2005 ~~2006~~
(4)

Table 3-4, 3-5 (39)

2004 trapnet results - (pg 5) & 36

total of 642 individuals — Rel. abund.

1	smallmouth - most abund.	34.9%
2	spottail shiner -	(20.6%)
3	rock bass	11.2%
4	blue gill	10.7%
		77.5%

CPUE

original dominants (from 60's)

br. bullhead	1	0.8%
chain pick	2	0.2%
white sucker	3	4.8%
yellow perch	4	2.0%
		7.8%
pumpkinseed	5	1.2
		9.0%

e fishing 2004

yellow perch	2.8%	0.87
w sucker	3.2%	1.2
pumpk.	1.5%	0.56
c. pickerel.	0.3	0.11
br. bullhead	0.0	0.01
	7.1% %	

spottail shiner	56.9%
LM bass	11.2%
S m bass	5.1%
blue gill	6.0%
	79.2%

Combined CPUE for 9-most abundant species in 1960's & 70's.

		1970	2000's
1.	~~[illegible]~~ brn bull	(21.4)	0.0
2.	e pick	0.3	
3.	G shiner	0.5	
4.	pump.	(11.6)	0.0
5.	red breast sun	2.2.	
6.	small mouth	3.1	
7.	walleye	0.0	
8.	white sucker	(10.8)	0.1
9.	yellow perch	(6.0)	0.1
		(49.8)	(0.2)

$$\frac{42.8 \text{ (sm bass)}}{57.1 \text{ (total 9)}} = \frac{x}{100}$$

$$4280 = 57.1x$$

$$x = 75\% \quad (74.95)$$

Table 7-2 (pg 59) of trends report (2006)

total CPUE 70's 59.6
2000's 6.5

$$\frac{6.5}{59.6} = \frac{x}{100}$$

$$650 = 59.6x$$

$$x = 10.9$$

~~E-fishing 2005~~ Table 3-7
Trapnet 2005

	CPUE	Total Abundance
yellow perch	0.03	2 fish caught
W sucker	0.06	4 " "
pumpksd.	0.03	2 " "
chain P, br. bull	not listed – none caught	

205 fish caught – total

E fishing 2005 Table 3-~~8~~8

i.39

	CPUE	RA	Total Abund
yellow perch	1.12	9.4%	115 *
white sucker	1.23	10.4%	127 *
pump.	0.33	2.8%	34
chain P.	0.07	0.6%	7
no br. bullhd. listed		0	0

Table 6-2 52 perch caught Aug – Sept (e fishing)

caught 21 fish Sept 11 at ambient site 11E – (no size data – maybe school of yoy.

Table 6-3 CPUE for 2005 efishing. They state 5.2. I calculate 2.08

Table 7-1 fish ~~biomass~~ total abundance normalized for effort?

* While there is an obvious shift in dominance to ~~warmwater~~ species ~~whi~~ that better tolerate warmer water, there appears to be an overall loss of production for most ~~spec~~ species including large & sm m bass. Ex. blues

look at CPUE for
Table 7-2 Trepnut data

70's CPUE for all fish combined is 59.6
2000 " " " " " " 6.5

70's mixing zone CPUE was 62% ~~45.8~~ more productive 45.8
than ambient zone

2000's mixing zone and ambient the same (6.6 vs 6.4)

70's 14 species found in mixing zone (*includes category Carp & minnow family)?
2000 10 species " " mixing zone.

> of the 14 species found in mix zone in 70's, only 6
were found there in 2000's

Table 6-3
electrofishing - yellow perch Aug - Sept 2005 Ambient zone.
they claim CPUE 10.50

CPUE of (5.2) 8 Sampling events
8) 42 ——— 42 fish (yellow perch) caught
40
2.0

includes a single catch of
21 fish on 9/26
(size?)

Pg 7 2005 E fishing
perch "abundant" 9.4% -
~~115~~ fish caught during 103 sampling events
157

#5 -

Assuming station 11 is in thermal zone

Aug/Sept 2005 E-fishing

# Samples	# fish	CPUE
4	25	6.25

pg 14 During 2005 CPUE for yp were at highest levels since 1973. Increased in within all 3 zones, highest since 72 w/in ambient zone, 1974 w/in mixing zone, 76 w/in thermally-influence)

However ---

Total of 1218 fish caught
NO SIZE data

74 Study 1444 fish impinged
not extrapolated for flow/operation

Check # of spottails caught in 95

Table 6-6 Claims yellow perch was 2nd most abundant species (Aug-Sept) in ambient zone

		# fish	# Sampling events	CPUE
2005	total perch caught -	157 (includes 35 caught 12/18 x 2 = 70)		
Aug-Sept	Ambient -	42	8	5.25 (21 fish caught on one date) 10.5
	mixing -	6	8	0.75 1.5
	Thr. inf -	4	4	1.00 0.5
	canal -	0	6	0.0
		52	26	2.0

see pg 14 in Fig 6-6

70 fish in canal. [157] perch fish total caught anywhere in 2005

$\frac{70}{157} = \frac{x}{100}$ x = 44.6% all fish caught were found in canal in Dec.

$\frac{76}{157} = \frac{x}{100}$ x = 48.4

		# caught	# Sampling events	CPUE	Table 3-9 Report
2005 (all months)	Ambient zone -	57	32	1.78	1.78
	mixing -	9	32	0.28	0.28
	therm inf. -	5	15	0.33	0.33
	canal. -	84	24	3.5	1.83
		157	103		1.12

In E-mail to Dave, Mal, etc

⊙ new info reviewed:

- VT Yankee
- Normandeau Study 69
- files on basis for limits

⊙ inaccurate/insufficient data from Norm.

⊙ Need to discuss previous rationale for permit decisions, and reason for change of opinion.

⊙ more thorough discussion of 316(a) since we will need to respond to PSNH's request.

⊙ Assistance from other agencies.
- analysis from NHFGD.

⊙ Looking ahead:

⊙ graphing data.

ak

MK RTC item C-3 (47)

(*) Shift in community to Shad

AT - yellow perch-

largemouth 2005 e-fishing

in Ambient zone # sampling events

$\frac{77}{32} = 2.40$ 32

(Aug/Sept 122) (69) fish 8 events

69/8 = 8.625

CPUE

Alewife

E fishing	04	05
August (30, 31)	19	0
Sept (27)	6	0
Oct	1	0
	26	

Report claims 80 were caught in 2004

optimal

[149 cal. days] → 50/10 e

Data comparability -> discuss w/ John M. & others.

focus - primarily on Relative Abundance.

* request 94/95 data in order to graph rel. abundance

70 -

Relative Abundance

either e fishing or trapnet

1960's

From NHFGD report (Wightman, 1971)

MK I (Unit 1)	120 MW	uses	60,000	gallons / minute	1960
MK II (Unit 2)	350 MW	"	140,000	" "	5/68

MK-1 $\frac{60{,}000\ g}{min} \times \frac{60\ min}{hr} \times \frac{24\ hr}{day} = 86.4$ mgd

MK-2 $\frac{140{,}000\ g}{min} \times \frac{60\ min}{hr} \times \frac{24\ hr}{day} = 201.6$ mgd

MK-1 & MK-2 combined 86.4 + 201.6 = 288 mgd

Report states combined is 200,000 gpmin. (444 cfs)
or 286,560,000 gall/day
286.6 mgd

(50)

Table 4-3 - Entire Pool.

$$60.2 - 6.5 = 53.7$$

$$\frac{53.7}{60.2} = \frac{x}{100}$$

$$5370 = 60.2x$$

$$x = 89.2\%$$

[Turnout]

From Table 3-17 FAR ~~species~~ resident indigenous fish community (~~[illegible]~~ as determined by sampling conducted by NHFGD in 1967-1968.

Brn bullhead
chain pickerel
Common shiner
fall fish
golden shiner
largemouth bass
margined madtom
pumpkinseed
redbreast sunfish
smallmouth bass
white perch *
white sucker
yellow bullhead
yellow perch.

1970's ~~UCHPL~~

		LCL	CPUE	UCL
Total	UHP	21.6	46.6	71.6
	HP	35.9	60.1	84.1
	LHP	34.0	73.6	113.2

[Upper pool] [Lower Pool]

2000's

	LCL	CPUE	UCL
UHP	1.1	2.8	4.6
HP	2.0	3.6	4.7
LHP	1.9	4.8	7.6

[ENTIRE POOL]

Percent change -

$$46.6 - 2.8 = 43.8$$

SEE PG 27 CALC. NOTEBOOK #3

←

Figure ~~4-1~~ Table 5-3

CPUE Hooksett Pool	1972	73	74	76	95	04	05
Smallmouth	0.80	4.15	3.10	4.90	1.40	5.35	1.90
Largemouth	5.65	0.85	6.55	2.65	6.05	9.55	6.10
pumpkinseed	37.65	20.20	25.40	19.45	0.95	0.70	0.90
yellow perch	8.30	5.50	3.95	1.05	0.20	0.65	2.60
white sucker	1.40	0.20	4.65	2.00	0.20	0.75	0.40
brown bullhead	2.15	0.55	0.60	0.20	0.0	0.0	0.0
golden shiner	0.30	0.25	0.45	0.00	0.2	1.35	0.40
fallfish	1.70	0.50	0.05	0.00	0.45	1.45	1.30
TOTAL	57.95	32.2	44.75	30.25	9,45	19.80	13.6

lumping years in 70's hides changes that occurred during the 1970's

Table 4-2

Ambient Zone — 1972: 59.50, 2005: 19.89

$59.50 - 19.89 = 39.61$

$\frac{39.61}{59.50} = \frac{x}{100}$

$3961 = 59.5x$

$x = 66.6\%$

←

Thermally-Influenced Zone CPUE — 1972: 56.4, 2005: 9.41

$56.40 - 9.41 = 46.99$

For Table 5-6

Changes between 1970's & 2000's trapnet CPUE - combined BIC.

$\frac{46.99}{56.40} = \frac{x}{100}$

$4699 = 56.4x$

$x = 83.3\%$

upper pool

$41.7 - 2.4 = 39.3$

$\frac{39.3}{41.7} = \frac{x}{100}$

$3930 = 41.7x$

$x = 94.2$

~~lower pool~~

~~$67.5 - 3.8 = 63.7$~~

~~$\frac{63.7}{67.5} = \frac{x}{100}$~~

~~$6370 = 67.5x$~~

~~$x = 94.4$~~

entire pool

$54.5 - 3.0 = 51.5$

$\frac{51.5}{54.5} = \frac{x}{100}$

$5150 = 54.5x$

$x = 94.5$

See pg

AR-206

Vol 2 of 4 ①

Bow. fact sheet.

Q: does any one have. "Predictive Model and Users Guide for Spring and Fall Optimization of Power Spray Modules ?

Suncook R. (N-13)

13
x 500
1500
500
6500

Suncook R S-6

6 x 500 = 3000

Bow Bog Brook. N-10 x 500 (5000)

Description of Merrimack mainstem ✓
" " Hooksett Pool. ✓

* Get dates of when dams were installed
* common sunfish = pumpkinseed?
* Retention time of water in Pool. ?
* Ask NHFGD for ~~any~~ earlier surveys of Hooksett Pool.
* 67/68 - study design.

Report #2 ~~1977~~ 76 impingement est " " 1449 2504

Total # fish caught in 2005 efish 1218
trap 205
2004 efish 3677
trap 642

2005 2004
1423 + 4319 = 5742/2 = (2871) ...

Merrimack River Thermal Study - NHFGD. 1971
Philip Wightman

Abstract. - 3 year study - evidence of increase in largemouth population
* indication of planktonic population

PG 2-3 describes water requirements of units.
Combined - stated to be ~~444~~ 444 cfs, or 286,560,000 gpd
286.5 mgd

444 cfs is more than the 7Q10 of the river.

* PG 3 - heat differential sometimes higher due to build up of sand/silt in front of intake, resulting in decrease of intake volume (plus increase in intake velocity - not stated). Check on this.
Do they dredge periodically?

PG 4 - Thought spray modules would ~~be~~ negate any advert impacts to river ecology, and further study would simply be "academic". So while ~~in~~ the originally plan was for a long-term study, it was terminated after 3 years.

PG. 5 - results from 67-69 study - ~~no adverse~~ resident adult fish pops not adversely affected by increased thermal flows from plant based on:
- similarity of composition between north & south sections of river.

p. 5 - electro-fishing evidence. increase in largemouth in southern section.

PG 6 - thermal stratification - heat conduction below stratified layer is evident in the forebay of the Hooksett Falls dam.
* "likely a detrimental effect would occur to future anadromous fish migrations in this sector."

p. 7 DO comparable N & South, however more DO is needed for metabolic processes. — Recommends flows be increased to combat periods of low D.O. concentrations in southern section.

p7 - comparison of zoo & phytoplankton - shows reduction south of plant. - Though situation "not critical" it may be of some consequence during periods of low flows and high seasonal temps., as well as to future fisheries.

p8 12 - fishery described. "warm water" smallmouth, largemouth white and yellow perch, brown & yellow bullhead, walleye white sucker, golden shiner, chain pickerel, & sunfish.

p 13 - fish studies - fyke. gill, & electro fishing gear.

- studies in 1969 (netting) was less extensive than in 67 & 6 it (69) was primarily for age-growth data.

p 16. electro-fishing - Area 1 (north) - shocked both sides of pool as far north as N-10. Area 2 (South) shocked in its entirety all years of study.

Plus 2 tribs electrofished in north section in 67-68 Gill netting conducted in 67 & 68. — Results inconclusive & discontinued in 69.

* ⟨ Fyke netting conducted on a limited scale - in winter of 68, 69 & in the canal area, canal/river confluence, as well as downstream. to determine fish movement into canal during winter months.

p17. - Species list.

p17 - Fyke netting. 67-69. Areas 1 & 2, netting conducted concurrently during June & July to prevent seasonal bias.

p 18-19 variations in netting effort resulted. As such, focussed on relative abundance rather than total numbers

p20 - golden shiner. 69 showed decline south, but increase in north. Other species (abundant) (e.g., pump, y perch, white sucker, b. bull.) showed similar trends north & south.

p 20. Northern section - species dominating changed from year to year (67-69) while south pumpkinseed remained dominant. At that time, the study results suggested that the northern section doesn't favor the domination of a particular species as much as the southern section (and Amoskeag pool). It is possible that the predominance of ~~yellow~~ pumpkinseed could be a result of heated effects. Further study is needed.

p 30 An increase in catch percentage was noted in '69 over '68 returns in the southern sections for perch, walleyes, sm bass ~~white~~ white suckers. Does not appear to be causing undue stress to adult fish populations. Acclimation to increased temperatures has occurred in sections affected by warmer water.

- not clear what effects to physiological make-up behavioral aspects & biological rythms of these fish are.
- thermal effects did not create a rapid change in the fishery composition as was feared.
- Does not imply that over a long period of time that some effect to fish population will not occur.

* Duration of study covers only one year of ~~operation~~ increased thermal conditions (68-69) overall effect to the fishery will not be evident for several

☆ Need to describe more thoroughly varying habitats in HP and what lifestages use them.

p 31. There was thermal strat. in canal in summer before MK-II came on line. 38.5°C top – 24.8°C bottom. Afterwards, there was no stratification 38.9°C top 38.5°C bottom.

p 34 – Winter fyke sampling in canal. 1968 – 3458 fish captured in six days of fishing. brown bullheads 90.4% pumpkinseeds 7.8% – ~~the~~ yellow perch, w sucker, LMB

p ~~35~~ 35 – confluence sampling. – white suckers appeared to prefer this area. to ~~that~~ that in canal. Brook trout caught. pumpkinseed appear to be most temp. tolerant

p. 36 – small number of small mouth juveniles caught in extreme high heat in 68 summer netting in canal. Evidence that some fish will swim into & exist in hot water although it is of a lethal temp.

– loss of heat tolerance & gain in resistance to low temps are inherently slower processes, requiring up to 20 days. in some species to approach completion

* Suggests future cases of emerging power plant shutdowns should be investigated to determine effects to fishery

p 40. Sunfish and especially 1m bass show increase in Southern Section compared to north

p 42. 69 – white suckers not as abundant in shallow waters of the south section as they were in the north possible temp effects.

p 44. young suckers may be displaced from shallows in southern section due to heating effects.

p. 46 discussion re difference between e fishing & fyke net. e fishing tend to target shallow areas w/ young fish populations while fyke nets target deeper water habitat & larger fish.

46-47 increase in large mouth bass – more desireable habitat?

Smallmouth 10% increase in north vs 10?

☆

e fishing cont.

p 48 Yellow perch - showed fluctuation in northern sections vs. steady 3-yr decline in southern section.
thermal "death point" of 73-77°F (Erickson Jones)

p. 48 Suggests perch were displaced to deeper water. May also apply to white sucker.

points ~~of~~ out survival at high temps (35.3–36.6°C) may indicate acclimation to high temps is possible providing it is a gradual process.

p. 49 The fact ~~that~~ the normal river populations are changing through natural processes tends to obscure the true impact of thermal effects in this area, and only further study will resolve such questions

p 50 Fish migration w/in popl.

p 52 Based on recapture results, it appears vertical & horizontal movement w/in an area is most likely the way fish are avoiding heated flows rather than movement upstream or downstream. If stratification hadn't occurred more movement would have taken place.

p 52 Gill netting - Because decreases occurred in all sections sampled, "it becomes more apparent that a natural change
☆ took place in the river itself" ? Why would he think that? (ask the others)

p 55. Walleyes maintain their #'s during 67-68 gill netting study.

p 77 1968 was considered a "wet year" - cycle of dry years, like early to mid 60's could have a significant effect on thermal conditions in

End review p 79.

p 75 Flows — data indicates during periods of low flows & high air temps there is more heat conduction in the entire cross section of the river south of the plant

* present facilities are approaching max demand for cooling water the river can support in late summer when flows are at their minimum.

* Potential impacts of "considerable magnitude" could result if additional facilities are constructed.

Temperature

p 80 – Some temp readings ~~are~~ on lower thermistors are inaccurate.

☆ These data were recorded before discharge canal was modified and PSM installed

p. 119. July 14-18. – peaks at SO ranging from 40.5°C (104.9°F) on July 16 to 39°C (102.2°F). max surface T @ S-17 was 33.4°C (91.1F) ~~at~~ on July 18.

☆ p. 124 "because temperatures tend to be higher in the shallow areas of the littoral zones, which are the most biologically productive part of a river system, it is felt that the inhabitants of this area such as young fish could suffer from this heating effect."

☆ 125 yellow perch – UL acclimated at 77°F was 85.5 (Lezzi, Filson & Myers, 1952) white sucker UL 86° (Black, 1955)

Temps of 90°F or better in these (shallow, littoral) areas is going to cause such species to seek refuge in the cooler depths where temps are not as extreme.

p. 125. predation by larger fish inhabiting the deeper waters.

p. 125. Discusses differing T requirements for different life stages.

p. 126 buildup of heated water in forebay of the Hooksett Dam. may have serious effects to anadromous fish

p. 126. temps which exist in the river are going to have a significant effect to the resident and future fish of the area.

☆ p. 126. It is hope[d] cooling facilities (psnh's) under construction will provide these temperatures.

p. 127 Benthos
two indicator species identified Elliptio complanatus a ~~[illegible]~~ freshwater mussel and Campeloma decisum a snail.

p. 132. Station S-8 was area of highest Elliptio abundance in 1967, but was nearly devoid of Elliptio during 68 sampling. Sig. reductions in numbers also occurred at N-9 & N-7 in 68.

p. 146 - plankton studies.

p. 150 - declines in certain planktons in South, including green algae, diatoms, rotifers, cladocera, & copepoda.

☆ pg. 152 Appears to be a reduction in frequency of occurrence of plankton in the surface waters south of plant

p. 152 zooplankton & phytoplankton appear to be adversely affected.

p. ~~152~~ 154 Welch states (?) (limnology text) temp. acts directly and indirectly in influencing the vertical distribution of plankton which are sensitive to difference in temp. change.
- "indirect effects" include changes in density &

p.154 ~~floatation~~ flotation levels of certain planktons which are delicately adjusted to ~~flotation~~ flotation.

p. 155 importance of plankton to survival of certain life stages must not be overlooked.

whether organism reduction will have any effect on the fish life of the area as it exists at present is doubtful.

some reduction did occur.

p.171 Fish use considerably more O_2 as temp. increases. more O_2 is needed in the southern section to maintain life. Fish must be active to forage, escape predation & maintain position against current.

p.172 A combination of high temps & low DO could cause a decrease in such activity. O_2 demand in juveniles is greater than adults. Could result in loss of year class

p.175 Overall conclusions – read again.

p.177. data dealt mainly w/ adult fish; effects to juveniles & reproduction is not known.

White suckers showed displacement (e.g. shift) to north. Largemouth increasing in South.

p.178. There are times when cooling water demands exceed flow of river (low flows, late summer)

p.179 benthic studies – Sampling techniques left much to be desired.

p. 180. this study was way too short a duration to provide any conclusive evidence of biological changes due to thermal effects. Does appear certain changes could be in the process, but...

p. 180 recommend long-term study of plankton abundance downstream from plant.

p. 180 recommend ~~e~~ fishing be continued annually (fall) for 10 years.

p. 180. contact NHFGD during emergency shut downs.

p. 180 additional flows be released to safeguard biota during low flow periods when facility is using more than the total flow.

★ these species are depressed everywhere.

★ productivity is down due to lower nutrient levels.

* Fully describe plume influence in HP.

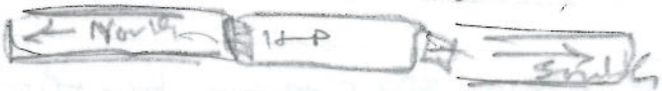
*

→ as nutrients go down, competition for habitat & forage becomes more critical.

Conclusions – current discharge ~~permit~~ does not meet goals of existing permit.

~~its not no longer~~

- Habitat has changed



comparison of fish assemblages in other impounded rivers in New England?

Does VT Yankee has a far-field area where they sample? YES

Q: Is productivity measured anywhere else in NH?

health of species w/in NH. (MA & ME, VT?)

- yellow perch
- brown bullhead.
- pumpkinseed
- white sucker

- acclimation to higher temps. – survival vs. prosper

nutrient levels

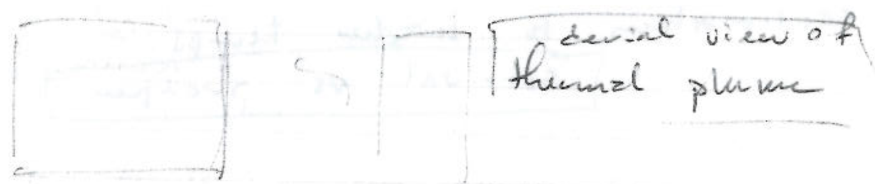
Given that heat is a regulated pollutant, the domination of ~~pollutant~~ heat tolerant species

would equate w/ domination of pollution-tolerant species.

- diversity (we would argue "baseline" diversity
- Communities capacity to sustain itself.
  - evidence that the community is not able to sustain it self.
- necessary food chain species. but these species
  - early evidence of impacts (white sucker, bullhead. to plankton community
- Lack of domination by pollution-tolerant species.

define Balanced Indigenous Community
brown bullhead.

Graphics.



- No reason to believe Merrimack Station introduced any species.

GET VT YANKEE DATA!

LOOK at ambient temps year-round in Vernon Pool

REL AB

REL AB

AMB. MIX THERM.

1967 1968 1969

REL AB

1970 — selected years

RELATIVE AB

1994

REL AB

2004-05

Questions concerning VT YANKEE

- Fish data - locations, frequency
- Species - change in Rel Ab.
- Ambient T's
- Ambient flows - fraction of flow w/drawn by plant. Closed-cycle open.
- water depths

Tisc
~~Muelyler~~.
Brian Douglass.

Review of Vt Yankee 316(a) Demo Doc.

Appendix 2 (p. 272?) lists various temps & citations

e.g.		UILT	growth op.	avoidance	pref	spawn	earl
	spottail -	95-100 (95)	86	95-102(95)	86	59-68	56-
	smallmouth -	98.6 (98)	89.6-91.4	95-100 (95)	73-82	59-70	59-
	yellow perch	84-95	50-76	79-88 (83)	64-81(77)	45-59(50)	4[illegible] (...
	largemouth	95-98 (95)	75-86 (83)	87-99 (90)	81-89(86)	68-70(70)	5[illegible] 7[illegible]
	white sucker	88	75 (81)	81-90 (86)	73-84(81)	50-68(60,65)	

Q: for JPK find out exactly where T is measured
@ S-4 surface etc

Mark S. 316(b) - Mark thinks it requires use of technology - strict tech standard.
[what is best technology? - Towers
is it practicable? -
wholly disproportionate - did they?]

(*)(*) talk w/ FWS about 316(a) & (b). w/ Mark Stein
states have to be as stringent as fed law.

go to Supreme Court. -> (could be overturned.)

316(a) - is an exception to [anti-backsliding]

Mixing Zone.

Intention of MZ was to provide minimal area of non-attainment in order for thermal plume to thoroughly mix with receiving waters.

- Based on ~~demonstr~~ 20 x years of historical data, PSNH has not been able to ~~...~~ reach target temps at the edge of the mixing zone. Further, in river ~~itz~~ temperature monitoring has demonstrated that complete mixing does not occur within the mixing zone ~~at...~~ ~~...~~ particularly during low flow periods in summer months.

It's unclear if meeting T limits at the edge of the existing MZ. Since the plant has been unable to ~~a~~ demonstrate continuously compliance during summer months.

+ EPA ~~+~~ does not believe that expanding the mixing zone boundaries will protect the biological communities or populations of indigenous species, as required under the minimum criteria for mixing zones found at Part Env-Ws 1702-02 of NH SWQS.

EPA - has decided to ~~enforce~~ establish numeric T limits ~~the T~~ limits that were in the existing permit in a first effort to ~~prote~~ restore and protect the balanced-indigenous population in the Hooksett Pool.

Table 7-1

	1970s AMBIENT	1970s MIX	2000s AMBIENT	2000s MIX
% Deck	15%	7%	3%	1.2%

$\frac{15}{7} = \frac{3}{1.2}$

$21 = 18.24$

$\frac{7}{15} = \frac{x}{100}$

$15x = 700$

$x = 46.67$

$\frac{1.2}{3} = \frac{x}{100}$

$120 = 3x$

$x = 40$

N-10 MAX. August

n	$\bar{x}$	S_x	σ_x
31	81.8	1.96	1.93

MAX AVG. AUG 84-04 DAILY AVG

81.8 REPRESENTATIVE?

$\Delta T \leq 1°F$ 81.8 - 82.8 = 28.2°C

N-10 August MEAN

n	$\bar{x}$	S_x	σ_x
31	75.04	~~1.32~~ 1.34	1.31

MEAN AVG AUG 84-04

75.04 REPRESENTATIVE?

75.4 median

S-4 MAX AVG. AUG

N	$\bar{x}$	S_x	σ_x	TOTAL
31	91.2	2.78	2.73	2828.3

MAX AVG S4- AUG

91.2

S-4 MEAN AVG AUG

N	$\bar{x}$	S_x	σ_x	TOTAL
31	81.86	1.61	1.58	2337.8

MONTHLY

MEAN AVG S-4 AVG.

81.86

ΔT's from S-O → South.
above "avoidance" temp for perch
% of available acreage lost

loss of habitat — forage, refuge

competition w/ ww species

thermal attraction + possible problems.

based on prevalence of
y perch. w. sucker in discharge
canal in Nov. Dec sampling

conform ambient temps sometimes approach avoidance
temp. for yellow perch, white sucker, etc.
Increased Temp cause additional stress.

from Table 3-7 of FAR

BIC	~~Smallmouth~~ 1972	73	74	76	95	04	05
	SMB ~~Amb~~ ~~EI~~	Amb	TI	Amb TI	Amb TI	Am TI	

from Table 3-7 of FAR ~~for~~ Efishing CPUE (Aug-Sep)

BIC SPECIES	72		73		74		76		95		04		05	
	Amb	TI	Amb	TI	Amb	TI	Amb	TI	Amb	TI	Amb	TI	Amb	TI
Smallmouth	0.60	1.00	1.75	5.75	1.10	5.10	4.93	4.83	0.75	1.83	7.67	3.45	1.25	2.33
Largemouth	6.50	4.80	0.88	0.83	5.20	7.90	2.64	2.67	3.13	8.00	10.56	8.73	8.63	4.42
pumpkinseed	31.90	43.40	16.88	22.42	11.40	39.40	15.43	28.83	0.00	1.58	0.33	1.00	0.50	1.17
yellow perch	12.80	3.80	7.00	4.50	2.90	5.00	1.07	1.00	0.25	0.17	1.22	0.18	5.25	0.83
white sucker	2.40	0.40	0.50	0.00	9.00	0.30	2.71	0.33	0.50	0.00	1.67	0.00	0.88	0.08
brn. bullhead	1.80	2.50	0.75	0.42	0.60	0.60	0.07	0.50	0.00	0.0	0.0	0.0	0.0	0.0
gold. shiner	0.10	0.50	0.13	0.33	0.80	0.10	0.0	0.00	0.0	0.33	3.00	0.00	0.5	0.33
fall fish	3.40	0.00	1.13	0.08	0.10	0.00	0.0	0.00	1.13	0.00	2.89	0.27	2.88	0.25
TOTAL	59.5	56.4	29.02	34.33	31.10	58.40	26.85	38.16	5.76	11.91	27.34	13.63	19.89	9.41

FOR DET DOC Table 5-5

Trapnet CPUE all species combined. (from Table 3-17 in FAR)
COMPARISON OF DECADES

	Upper HP	Lower HP	Entire HP
1970's	46.7	74.0	60.2
2000's	6.6	6.4	6.5
% change	85.9%	91.4%	89.2%

$\frac{6.6}{46.7} = \frac{x}{100}$ 660 = 46.7x 100.00 − 14.13

$\frac{6.4}{74.0} = \frac{x}{100}$ 640 = 74.0x x = 8.65 100.00 − 8.65 = 91.35

$\frac{6.5}{60.2} = \frac{x}{100}$ 650 = 60.2x x = 10.8 100.00 − 10.80 = 89.20

From Merrimack Station Thermal Study, NHFGD (1971)
Conducted each year in June & July
in Areas 1 (N) & 2 (South)

Fig's 7 & 8 Rel Abundance ~ Fyke Netting (TRAP NET) (to nearest whole %)

Species	Year	N	S	Combined/AVG	3-YR AVG
① P. Seed	1967	33	32	65 /2 = 32.5	
	68	25	31	54 /2 = 27	
	69	14	24	38 /2 = 19	
				TOTAL AVG. 78.5/3 =	26.2
② Yellow perch	67	26	24 18	44 /2 = 22	
	68	30	23	53 /2 = 26.5	
	69	23	18	41 /2 = 20.5	
				69.0/3 =	23.0
③ SMB	67	2	2	4 /2 = 2	
	68	2	1	3 /2 = 1.5	
	69	5	3	8 /2 = 4	
				7.5/3 =	2.5
④ RBS	67	4	4	8/2 = 4	
	68	6	5	11/2 = 5.5	
	69	2	3	5/2 = 2.5	
				12.0/3 =	4.0
⑤ ECP	67	1	1	2/2 = 1	
	68	2	1	3/2 = 1.5	
	69	2	2	4/2 = 2	
				4.5/3 =	1.5
⑥ CWS	67	11	10	21/2 = 10.5	
	68	18	12	30/2 = 15	
	69	29	17	46/2 = 23	
		19.33	13	48.5/3 =	16.2
⑦ EGS golden shiner	67	2	7	9/2 = 4.5	
	68	6	14	20/2 = 10	
	69	10	10	20/2 = 10	
				24.5/3 =	8.2

Species	Year	N	S	COMB/AVG.
⑧ BBH	67	14	22	36/2 = 18
	68	7	10	17/2 = 8.5
	69	10	16	26/2 = 13
				39.5/3 = [illegible]
⑨ YBH	67	1	1	2/2 = 1
	68	2	1	3/2 = 1.5
	69	2	2	4/2 = 2
				4.5/3 [illegible]
LMB	67	0	0.	= 0
	68	0	0.2 (app)	= 0.1
	69	0	0.4 (app)	: 0.2
				0.1

9 species comprise 26.3 96.3 % of all fish caught

all other species = 3.7 %

96.3

30 Lancaster St.
4 B

Revised to include all BIC species – See pg 27 notebook #3 and p. 50, #1

Trapnet CPUE BIC Species (from Table 3-17 FAR p. 74)

	1970 upper HP	1970 lower HP	1970 ENTIRE HP	2000 upper HP	2000 lower HP	2000 ENTIRE HP
Brown bullhead	17.6	25.8	21.7	0.0	0.0	0.0
fallfish	0.2	0.1	0.1	0.1	0.0	0.0
golden shiner	0.2	0.9	0.6	0.0	0.0	0.0
largemouth	0.3	0.1	0.2	0.0	0.0	0.0
smallmouth	2.1	4.1	3.1	1.8	3.6	2.8
white sucker	9.8	12.2	11.0	0.2	0.1	0.1
yellow perch	7.0	5.2	6.1	0.2	0.1	0.1
pumpkinseed	4.5	19.1	11.7	0.0	0.0	0.0
TOTAL	41.7	67.5	54.5	2.4	3.8	3.0

upper HP difference

41.7 (70's) − 2.4 (00's) = 39.3

$\frac{39.3}{41.7} = \frac{x}{100}$ 3930 = 41.7x x = 94.24 % decline

lower Hooksett Pool

67.7 (70's) − 3.8 (00's) = 63.9

$\frac{63.9}{67.5} = \frac{x}{100}$ = 6390 = 67.5x, x = 97.67 % decline

Entire Hooksett Pool

54.5 (70's) − 3.0 (00's) = 51.5

$\frac{51.5}{54.5} = \frac{x}{100}$ = 5150 = 54.5x, x = 94.49 % decline

From Merrimack Station Thermal Study, NHFGD (1971)
E-fishing - RA,
data taken from graphs (figs 10 & 11) to nearest 1%

		N	S	Combined/Avg	3 yr Avg
P Seed	67	46	47	93/2 = 46.5	
	68	50	28	78/2 = 39	
	69	22	34	56/2 = 28	
				TOTAL AVG = 113.5/3 =	37.8
Y.P.	67	32	16	48/2 = 24	
	68	13	10	23/2 = 11.5	
	69	38	10	48/2 = 24	
				TOTAL AVG = 59.5/3 =	19.8
SMB	67	9	6	15/2 = 7.5	
	68	4	1	5/2 = 2.5	
	69	3	1	4/2 = 2.0	
				TOTAL AVG = 12/3 =	4
RBSF	67	8	~~6~~ 6	14/2 = 7.0	
	68	3	~~7~~ 7	10/2 = 5.0	
	69	1	~~4~~ 17	18/2 = 9.0	
				TOTAL AVG = 21/3 =	7
LMB	67	8	14	22/2 = 11	
	68	10	41	51/2 = 25.2	
	69	21	31	52/2 = 26	
				TOTAL AVG = 62.2/3 =	20.7
ECP	67	2	1	3/2 = 1.5	
	68	3	3	6/2 = 3	
	69	3	3	6/2 = 3	
				TOTAL AVG = 7.5/3 =	2.5
CWS	67	1	1	2/2 = 1	
	68	1	0	1/2 = 0.5	
	69	7	0	7/2 = 3.5	
				TOTAL AVG = 5/3 =	1.7
EGS	67	0	0	0/2 = 0	
	68	0	3	3/2 = 1.5	
	69	0	1	1/2 = 0.5	
				TOTAL AVG = 2/3 =	0.7
Eel	67	0	0	0/2 = 0	
	68	0	1	1/2 = 0.5	
	69	0	1	1/2 = 0.5	

see last pg.

		N	S	Comb/Avg	3 yr
BBH	67	1	1	2/2 = 1	
	68	0	1	1/2 = 0.5	
	69	0	2	2/2 = 1.0	2.5/
				TOTAL AVG =	0.
YBH	67	0	0	0/2 = 0	
	68	0	1	1/2 = 0.5	
	69	1	1	2/2 = 1.0	1.5/
				TOTAL AVG =	0.

From Table 6-2 - draft study (5/06)
p. 48

avg. efishing rel. abundance for 2004, 05

	04	+ 05			
p.s.	1.5	4.0	= 5.5/2	= 2.8	✓
y p	1.4	11.7	= 13.1/2	= 6.6	✓
bbh	0.0	0.0	= 0.0/2	= 0.0	✓
cws	1.6	1.8	= 3.4/2	= 1.7	✓
gold. sh.	2.8	1.8	= 4.6/2	= 2.3	✓
rbs	5.5	8.3	= 13.8/2	= 6.9	✓
smb	11.2	8.5	= 19.7/2	= 9.9	✓
ybh	0.0	0.0	= 0.0/2	= 0.0	✓
ecp	0.3	0.7	= 1.0/2	= 0.5	✓
lmb.	20.0	27.4	= 47.4/2	= 23.7	✓

from Table 7 - Norm (1970)

Summary of E-fishing Results (67-69)

Between now and COB tomorrow.

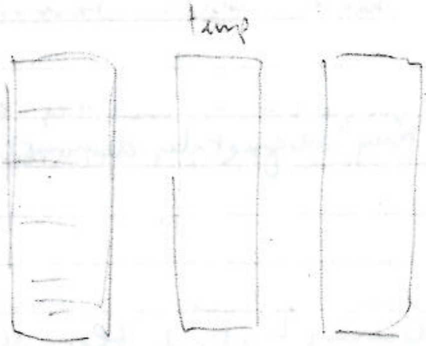
* review Dave's remarks again - modify as appropriate
* finalize format - include place holders yet to be completed.
* add bar graphs
* expand on section regarding effects of plume.
* add section on mixing zone.

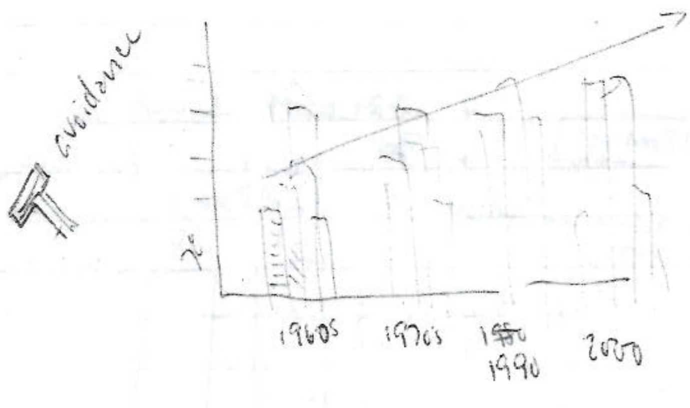
- missing info -
- Se
- call John M. -
  - any stocking of sunbass, others WW species
  - what is he doing?
  - cold water fishery
  - NH F&G - policy on protecting ecosystem.

* discuss consistency w/ 316(a) guidance BP & Kendall

- look up mix zone policy EPA Tech Support Doc.

baseline species





5 ~~temp~~

CPUE
perch
white sucker
pumpkinseed

Temperature

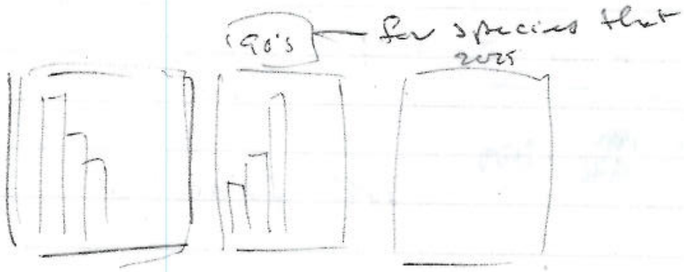
Analysis

① Q: Has there been (or have they adequately demonstrated?) appreciable harm to the BIP?

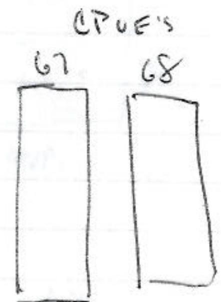
ANS: No, they haven't demonstrated the absence of AH.
or yes, there has been AH.

Community level

BIP | 1967 | 68, 69 | vs | 2004-05

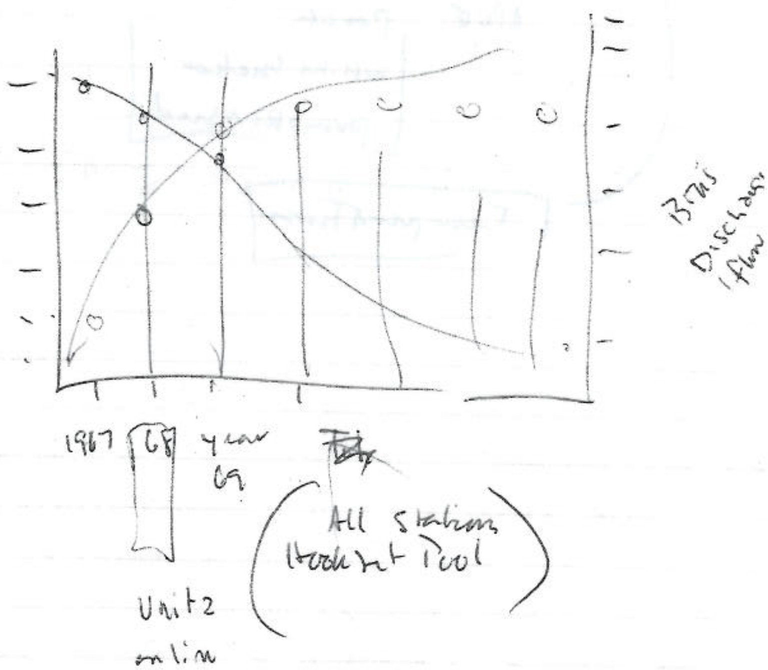


Species level.



* Combine CPUE's for all stations 1967, 68, 69

Fyke, CPUE



• Compare trophic guild designation w/ VT yankee

TOTAL Table 7-2 CPUES for Fyke netting 70, 2000's

70's		2000's				dupp
Ambient -	45.8	A	6.6	6.6/45.8 = x/100 =	14.4%	85.6
mixing	74.0	M	6.4	6.4/74.0 = x/100 =	8.6%	91.4
Total	59.6	T	6.5	6.5/59.6 = x/100 =	10.9	89.1

☆ pg 48 Thermal Study NHFGD - discusses how increase in fyke net catches may reflect avoidance of heated shallows where e-fishing is conducted (e.g. white sucker)

good to look at length freq info see if this is true.

e fishing CPUE

67		68		69		# N	yellow perch	S	N
N	S	N	S	N	S			216	

67
68
69

1967 - E fishing CPUE from Normandeau Study.

216/12,500 $\frac{216}{12500} = \frac{x}{1000}$

efishing yellow perch

216,000 = 12,500 x
x = 17.28 CPUE South 67
23.6 North 67

177/7,500 $\frac{177}{7,500} = \frac{x}{1000}$ 7500x = 177,000
x = 23.6

Just kept — Keep

both combined $393/\frac{20,000}{} = \frac{x}{1,000}$ $\frac{393}{20}$ = ~~1965~~ CPUE 1967 weighted.

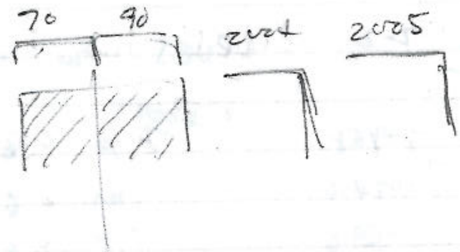
393,000 = 20,000x

continued. next page

Total Hooksett Pool 17.28 (S)
23.6 (N)

CPUE Efishing Sept

yellow perch 67, 68, 69,



check 70's & 90's data - for efishing

Sept	67 - 69
Aug - Sept	70 - 90, 2000's

90's yellow perch CPUE - efishing
per 1000 ft - transect

(95)

	North	South (mixing & thermally affected)
Aug	0.25	0.0 + 0.5
Sept	0.25	0.0 + 0.5
avg.	0.25	0.50

pg 49 Draft report (06)

YP fyke = 13.97
fyke → 67 — total (Normandeau Rpt) —

78 Normandeau Report —
Pg. 139. Perch found primarily in temps between 21–25°C (77), but occasionally as high as 34°C (93.2)

* Pg 65 NORM. 69 REPORT ~~Draft Report~~ Electrofishing — yellow perch

CPUE

Keep

		total		north	south	
Added. just Sept.	1967	~~19.65~~	(20.44)	23.6	17.28	
	68	~~4.65~~	(4.63)	4.53	4.72	
	69	~~7.85~~	(9.43)	15.73	3.12	
Aug & Sept	72	8.72		13.38	5.5	(Therm + mixin)
	73	5.89		7.00	5.0	
	74	4.22		3.38	4.92	9.83/2
	76	1.17		1.63	0.94	1.88/2
	95	0.22		0.25	0.25	0.5/2
Sept	04	0.52		1.38	0.325	0.65/2
	05	2.08		5.25	0.88	1.75/2

CPUE / 1,000 ft ~~to~~ transect

from 1969 Fisheries Investigation

(O-N-10) North = 7,500 ft
(O-S-24) South = 12,500 ft

1968

North 34 $34/7500 = x/1000$ $34{,}000 = 7500x$ $x = 4.53$
South 59 $59/12{,}500 = x/1000$ $59{,}000 = 12{,}500x$ $x = 4.72$
Combined $9.25/2 = $ 4.63
93 $93/20{,}000 = x/1{,}000$ — $93/20 =$ 4.65

1969

North 118 $118/7500 = x/1{,}000$ $118{,}000 = 7500x$, $x = 15.73$
South 39 $39/12{,}500 = x/1{,}000$ $39{,}000 = 12500x$, $x = 3.12$
Combined 157 $157/20{,}000 = x/1{,}000$ $157/20 =$ $x = 7.85$

Yellow perch fyke results (Table 3, Normandeau 68)

	N	S		
67	16.28	11.65	= 27.93/2 =	13.96

from NHFGD study

67 1810/161 1668/193 = 3478/354 = 9.82

FROM MERRIMACK Fisheries Study (Jan 97)

Relative Abundance (94-95) FYKE NET

	Pump	Rock Bass	Bluegill	SMB	White Sucker	YP	LMB
Aug 95	(N) 0 (S) 3	(N) 5 (S) 0	(N) 1 (S) 0	(N) 5 (S) 0	(N) 12 (S) 0	(N) 1 (S) 1	(N) 0 (S) 3
Sep 95	(N) 1 (S) 4	(N) 0 (S) 13	(N) 1 (S) 3	(N) 0 (S) 7	(N) 14 (S) 3	(N) 1 (S) 0	(N) 0 (S) 35
	1 + 7 = 8	7 + 13 = 20	2 + 3 = 5	5 + 7 = 12	26 + 3 = 29	2 + 1 = 3	0 + 8 = 8
	8/120 = 6.7%	16.7%	4.2%	10.0%	24.2%	2.5%	6.7%

fish totals
Aug 95 = 55
Sept 95 = 65
120

	BBH	Golden Shiner
Aug 95	(N) 0 (S) 0	(N) 0 (S) 0
Sept 95	(N) 1 (S) 0	(N) 0 (S) 0
	1 + 0 = 1	0 + 0 = 0
	0.8%	0.0%

Efishing R.A 95

	BG	Pump	LMB	SMB	Redbreast	Fallfish	Spottail	Rock	[illegible]S	YP
Aug 95	N 62 S 557	N 0 S 5	N 18 S 44	N 1 S 13	N 5 S 60	N 9 S 0	N 1148 S 0	N 1 S 0	N 2 S 0	N 1 S 1
Sept 95	N 67 S 425	N 0 S 14	N 7 S 52	N 5 S 9	N 2 S 51	N 0 S 0	N 13 S 0	N 1 S 8	N 2 S 0	N 1 S 1
	129 + 982 = 1111	0 + 19 = 19	25 + 96 = 121	6 + 22 = 28	7 + 111 = 118	9 + 0 = 9	1161 + 0 = 1161	2 + 8 = 10	4 + 0 = 4	2 + 2 = 4
	41.7	0.7	4.5	1.1	4.4	0.3	43.6	0.4	0.2	0.2
			8.1	1.9						

fish totals
Aug 95 2002
Sept 95 661
2663

74%

w/out Spottail 2663
−1161
1502

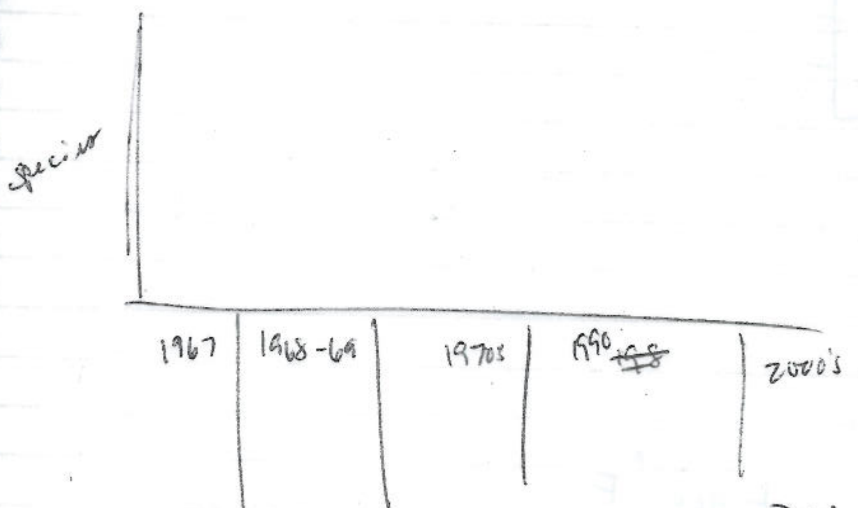
Spottail 43.6%
Bluegill 41.7
85.3%

	Golden	Com. Shin
AUG	N 0 S 4	N 68 S 1
SEPT	N 0 S 0	N 1 S 0
	0 + 4 = 4	69 + 1 = 70
	0.2	2.6

3/29 DRAFT

Add 316(a) demo - det doc.
Fact Sheet - summary

Review new report (not yet received)
+ Address each demonstration individually
Conclusion
+ new temp limits.



Community
REL AB.

E fish
Trapnet

Dominant species in 1960's
1960 70 90 2000

Community in ~~B~~ 2000s
5% or more

Efishing
Trap net.

TRAP
2000

PISC	1	SMB	42.8%
	2	RBS	7.9%
	3	R.k Bss.	11.1%
INSECT	4	Spottail	18.4%
	5	Bluegill	7.3%
			87.5%

~~1960's~~ 1960's

INSECT	1	pumpkinseed	26.2
	2	yellow perch	23.0
OMNIVORES	3	brown bullhead	13.2
	4	white sucker	16.2
	5	golden shiner	8.2
			86.8%

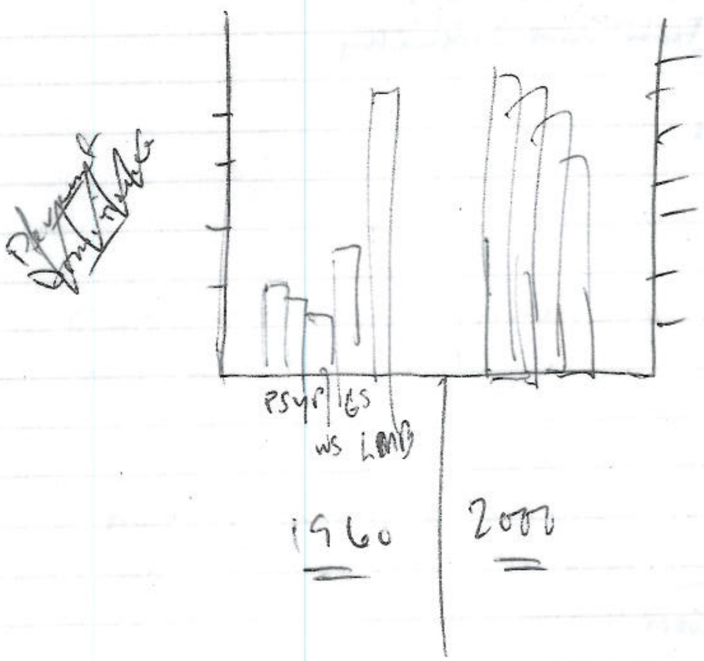
Efishing 2000

PISC / INSECT	1	SmB	10.3
	2	RBS	6.4
	3	Spottail	20.5
	4	BG	12.6
	5	LMB	22.3

Efish 60's

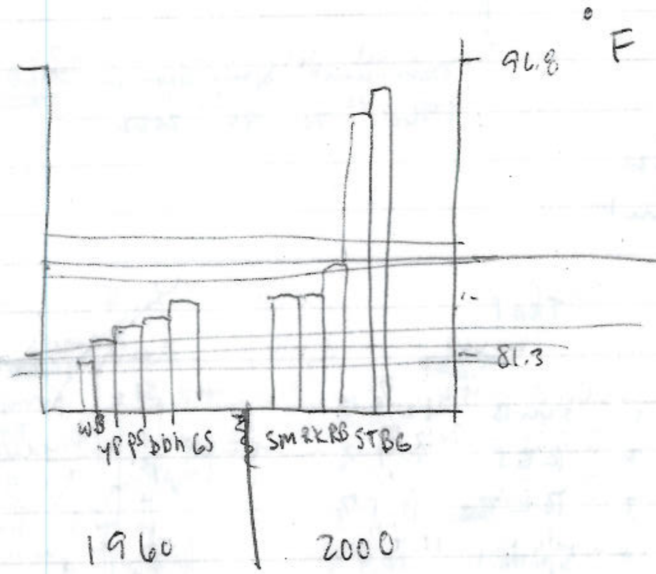
INSECT	1	pump	37.8
	2	perch	19.8
	3	rock bass	7.0
PISC	4	lmb	20.7

E fishy



(max tolerance Temp or preferred T.)

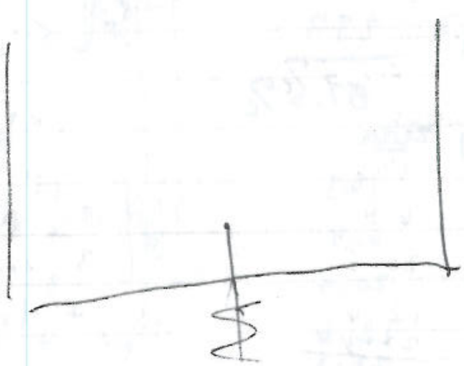
Temp



AVG TEMP @ S-4 ~~AUG/SEPT~~ July, Aug, Sept

AVG TEMP @ N-10 July, Aug, Sept

E



efishing table 6-2 FAR

	04		05	
Spottail	N ~~28.3~~ 271	% 28.3	N 16	% 3.6

28.3 + 3.6 = 31.9 / 2 = 15.95

N 271 + 16 = 287

287 / 1402 = x / 100

20.47

	04		05	
Bluegill	N 64	% 6.7	N 112	% 25.1

6.7 + 25.1 = 31.8 / 2 = 15.9

64 + 112 = 176

176 / 1402 = x / 100 = 17600 = 1402 x = 12.55

CPUE's from 1969 Norm Report - E fishing
Table 7 (p 65)

pumpkinseed (common sunfish) (0 - N - 10) North = 7,500 ft. (0 - S - 2+) South = 12,500 ft.

1967	NORTH	173	173/7500 = x/1,000	173,000 = 7500x	x = 23.1
	South	772	772/12,500 = x/1,000	772,000 = 12,500 x	x = 61.8
	COMBINED			23.1 + 61.8 = 84.9/2 =	42.5
1968	NORTH	163	163/7500 = x/1,000	163,000 = 7500 x	x = 21.7
	SOUTH	163	163/12500 = x/1,000	163,000 = 12500 x	x = 13.04
	COMBINED			21.7 + 13.04 = 34.7 / 2 =	17.4
1969	NORTH	68	68/7500 = x/1,000	68,000 = 7500 x	x = 9.1
	SOUTH	145	145/12500 = x/1,000	145,000 = 12500 x	x = 11.6
				9.1 + 11.6 = 20.7/2 =	10.4

from Report 2006 Table 6-3 pg 49

	TOTAL COMBINED	NORTH	SOUTH (MIX + THERMAL ZONES)		
1972	~~36.6~~ 39.17	36.63	29.25 + 49.17	78.4 / 2 =	39.2
1973	21.28	16.9	33.67 + 11.5	45.2 / 2 =	22.6
1974	23.72	12.9	40.17 + 20.75	60.9 / 2 =	30.45
1976	18.94	16.6	30.17 + 6.75	36.9 / 2 =	18.45
1995	0.56	0.0	1.00 + 1.00	2.00 / 2 =	1.00
2004	0.70	0.37	1.38 + 0	1.38 / 2 =	0.69
2005	0.90	0.5	[illegible]	[illegible]	[illegible]

Pumpkinseed CPUE:

	North	South	Total
1967 – 69 avg.	53.9/3 = 17.97	92.24/3 = 30.75	70.3/3 = 23.43
1972, 73, 74, 76	~~83~~ 83.03/4 = 20.76	110.7/4 = 27.68	103.11/4 = 25.78
1995 same			
2004-05 avg.	0.87/2 = 0.44	1.755/2 = 0.88	1.6/2 = 0.8

See p. 39

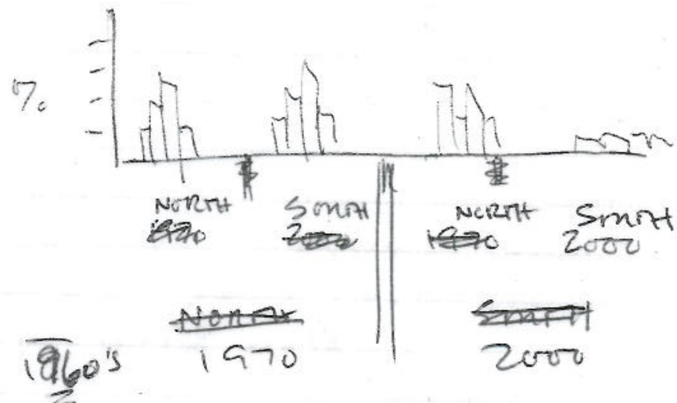
Yellow perch CPUE

	No. Fish South	# North	Total
~~1967~~ 1967	216	177	393
	$\frac{216 \text{ fish}}{12{,}500 \text{ ft}} = \frac{x \text{ fish}}{1{,}000 \text{ ft}}$	$\frac{177 \text{ fish}}{7{,}500 \text{ ft}} = \frac{x \text{ fish}}{1{,}000 \text{ ft.}}$ (~~12,500~~)	$\frac{393 \text{ fish}}{20{,}000 \text{ ft.}} = \frac{x \text{ fish}}{1{,}000 \text{ ft.}}$
	x = 17.28	x = 23.6	x = 19.65
1968	59	34	93
	$\frac{59 \text{ fish}}{12{,}500 \text{ ft}} = \frac{x \text{ fish}}{1{,}000 \text{ ft}}$	$\frac{34 \text{ fish}}{7{,}500 \text{ ft}} = \frac{x \text{ fish}}{1{,}000 \text{ ft}}$	$\frac{93 \text{ fish}}{20{,}000 \text{ ft}} = \frac{x \text{ fish}}{1{,}000}$
	x = 4.72	x = 4.53	x = 4.65
1969	39 fish	118	157
	$\frac{39 \text{ fish}}{12{,}500 \text{ ft}} = \frac{x}{1{,}000 \text{ ft}}$	$\frac{118 \text{ fish}}{7{,}500} = \frac{x}{1{,}000 \text{ ft}}$	$\frac{157 \text{ fish}}{20{,}000} = \frac{x}{1{,}000 \text{ ft}}$
	x = 3.12	x = 15.73	x = 7.85

A Graph - Res Ind. Comm. (BIC)

1. R.A. change over time (total pool)
   60 70 90 2000
   a. e fishing
   b. trap net.

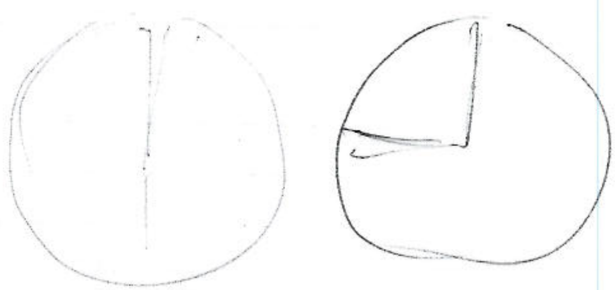
2. R.A



3. Catch PUE over time by area

[yellow perch
pumpkinseed
white sucker
blue gill
small mouth bass.

* Pie graph 1960 (70) 2000
Rel abundance
   warm water
   cool water
   cold water



Two most sensitive

11:40 Ex

* Check avoidance temps for sm bass.

Avg daily max

* How is T calculated for compliance @ VY?
Check NRC EIS

* consider combining Trapnet & E fishing catch #

(see pg 115 VY 316(a) table 5-14.

1975 Study - discusses Fyke net results as being most quantifiable sampling method - suggests perch & brn bullhead are more abundant north of discharge. - Does not agree w/ 67/68 data

4/07 316(a) Report Review

Q: Trapnet stations Draft report has a station 2E & 3W. Final report has 2W & 3E.

- Need to compare data w/ draft report, including tables, graphs, omissions & explanations.
- look at statistical analysis - how it changed since draft.
- basis for "no prior appreciable harm" determination.

— Compare report w/ presence-absence data from 70's report (seining data)

Q: Efishing results

		draft report	final station - # fish
August 05	perch	15W - 4	15E - 4
		14W - 2	14E - 2
		12W - 10	12E - 10
		11E - 4	11W - 4
Sept 05	yellowperch	11E - 21	11W - 21
		12E - 1	12W - 1
		12W - 6	12E - 6
		13W - 2	14E - 1
		14E - 1	14W - 1
		14W - 1	13E - 2

Q: Fig 3-8 in Final report does not include 1972 CPUE for yellow perch in ambient zone (13.38) in Draft

Q: Table 6-3 CPUE's for perch 1972 don't match #'s graphed in Final Fig 3-8.

Comparison between yellow perch data from Draft (Table 6-3) Report and Final Report (table 3-7) - EC-sein CPUE

Q Table 3-7 - calculates "ambient" and thermally-influenced zones of Hackett Pool by thermal regime at time of sampling.

How many T samples taken in 1,000 ft sample?
How is a Temp calculated for purposes of establishing a "zone"?
One location may be ~~temp~~ "ambient" one day (hour) and not the next.

Draft Table 6-3	Final Table 3-7
Ambient	Ambient
Mix & Th. In.	Therm In.
Total	Total

7 temperature sampling events

1. 11 May 1995
2. 24 May "
3. 9 June "
4. 21 June "
5. 14 Sept "
6. 24 Sept "
7. 11 Oct "
8. 11 July 1978
9. 8 Aug 1978

= Table 2-3 (p 15)

Final Report Perch Electrofish data

August Ambient Thermally Affected length / age

Trapnet date

		TOTAL FISH		Length. (mm)
04	April	3	Station 1, 2	231, 262, 276
	May	7	Station 1	178, 258, 213, 197, 253, 192, 264
	June	0		-
	July	1	3	223
	Aug	0		-
	Sept	1	1	55
	Oct	0		-
	Dec	1	2	168
05	APRIL	0	-	
	MAY	0	-	
	JUNE	2	3	189, 188
	JULY	0		
	AUG	0		
	SEPT	0		
	OCT			
	DEC			

Evidence of Appreciable Harm

Electrofishing CPUE for 95, 04, 05 (see p. 64 in Final Report)

95 = 89.8% of fish caught are represented by the 3 most heat tolerant species

04 = 55.0%

05 = 56.0%

→ Check red breast sunfish

where are they found most? - north? - less predatory

spottail UILT & avoidance 95°C, op for growth 86°F
92.8 - 100.0 | 80.06 - 87.8

bluegill UILT 33.8 - 37.8°C, growth op. 26.7 - 31.0
avoidance

largemouth avoidance 90 - 94.5, op growth 83

(*) provide explanation for using e fishing data from 1960's.

(*) more presence "pumpkinseed" example

(*) 1972 sucker data? - suitability of using e-fishing sampling for white sucker.

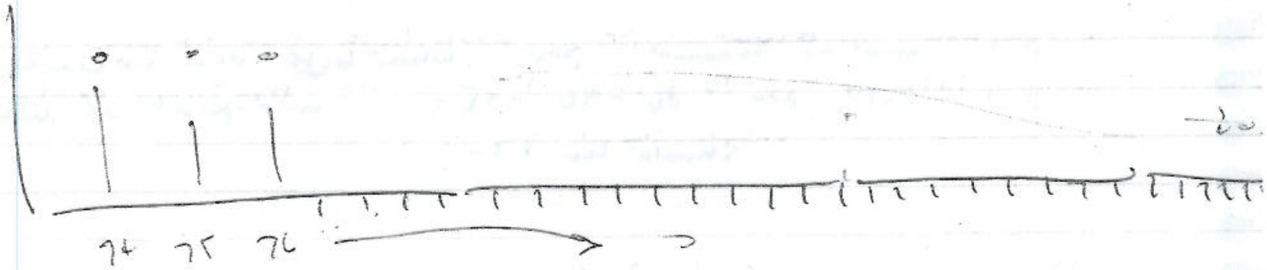
(*) no mention of attractive influence of plume during winter periods of gonadal development.

(*) e-fishing catches many juveniles - (refer to prior Norm. Hebbon report) whereas fyknet catches more adults

2007 - Thermal model.

p 1. end of second par. when both are exceeded.
p 1 last par. 86 - 90 - 95 - mid-point of UILT - not appropri.
Should be 83 -

pg 12 Station 3 S-4, A-0 expected to exceed 86% for
par 3 4 53 and 20 days, respectively. 86 F / 30 C
in July and August
p 13. S-4 - Surface not experienced by B.P.



72 → 76, 78, 95 04 05 9 year
1

5 years

= Efishing CPUE - final report

	1972	2005	% decrease
Amb	62.80	22.12	64.8
FI.	65.30	11.5	

62.80 − 22.12 = 40.68

$\frac{40.68}{62.8} = \frac{x}{100} = 64.78$

~~$\frac{22.12}{62.80} = \frac{x}{100}$ = 35.22%~~ ~~35.22~~

~~$\frac{62.80}{22.12} = \frac{x}{100}$, 6280 = 22.12x, x =~~

$$\begin{array}{r} 65.30 \\ -11.50 \\ \hline 53.80 \end{array}$$

$\frac{53.80}{65.30} = \frac{x}{100}$: 5380 = 65.30x

x = 82.39

TO DO:

ask John M. about trends analysis.
Sharon " Mustard Report.
Matt about Stats support from Narragansett

demonstrates the weakness ~~is~~ of this analysis ~~as suitable~~ for measuring biological significance.

run analysis w/out 22 fish from Sept catch

do separate stats - need to get data to conduct

* check CPUE for NY
* check 1975 e fishing data
* pg 65 (Final Report) P-value of perch 0.051

* no reason given for not using 1975 e fishing data in the trends analysis.

(*99) " 46221

species - electrofishing

	South	North	Combined
1967	13	10	13
68	13	10	14
69	11	12	13

species richness.

70's · 2000's

Efish

electrofishing effort in 60's versus 2000's.

60's Sept only north of station 0 (0-N-10): 7,500
south " " (0-S-24) = 12,500

20,000 feet

2000's Sept & Aug - north of station 0 - 4 stations × 1,000 = 4,000
south of station 0 - 6 " " " = 6,000

10,000

10,000 ft/month × 2 months = 20,000'

According to Norm. Report (Black cover 1968?) p. 8.

N-1 → N-6 marked @ 500' intervals, 5 × 500' = 2500' N-0 → N-10
N-6 → N-10 " " 1000' " 4 × 1,000 = 4,000 = 6,500
S-1 → S-24 " " 500' intervals 23 × 500 = 11,500' S-0 - N-10 78
S-0 → S-1 = ~500' = 12,000'

* Table 3-6 (p.61) - 80 alewife captured in 2004 (Efish)
Table 3.5 (p60) - alewife in 2004 captured in Thermally-influenced zone

Appendix D-52, 53 - 2004 Efish

alewife	- 14	caught @ (11, 12)	ambient	] August
"	5	" " 15	Therm. inf ?	] August
"	6	" @ (11,12)	ambient	- Sept
	25 total.			

Q: where are the other 55?

* Q: Table 3-17 (p.74) why is "Carp & Minnow Family" listed as a species?

Yellow Perch

1967 growth rates (from NHFGD, Thermal Study, 1971)

p. 62

	1967	68	69	
Age 1	3.6" (North)	3.7(N)	3.7(N)	
	3.7" (South)	3.5(S)	3.7(S)	
	3.65 avg	3.6 avg	3.7 avg	3.65" = 1 × 2.54 = 9.27 cm
Age 2	5.3" (N)	5.6(N)	5.6(N)	
	4.9" (S)	5.3(S)	5.5(S)	
	10.2/2 = 5.1" Avg	5.45 avg	5.55 avg	5.1" = 12.95 cm
Age 3	7.6" (N)	7.1(N)	7.1(N)	
	7.0" (S)	6.9(S)	6.8(S)	
	14.6/2 = 7.3" Avg	7.0 avg	6.95 avg	7.3" = 18.54 cm
Age 4	8.9" (N)	8.6(N)	8.3(N)	
	9.0" (S)	8.4(S)	8.2(S)	
	17.9/2 = 8.95" Avg	8.5" avg	8.25 avg	8.95" = 22.73 cm
Age 5	10.0" (N)	9.8(N)	NO DATA	
	10.0" (S)	9.1(S)		
	20.0/2 = 10.0" Avg	9.45 avg		10.0" = 25.40 cm

	67	68	69		3 YR AVG			
Age 1	3.65"	3.60"	3.70"	=	3.65"	× 2.54	=	9.27 cm
Age 2	5.10"	5.45"	5.55"	=	5.37"	× "	=	13.64 cm
Age 3	7.3"	7.0"	6.95"	=	7.08"	× "	=	17.98 cm
Age 4	8.95"	8.5"	8.25"	=	8.57"	× "	=	21.77 cm
Age 5	10.0	9.45	NO DATA	=	9.73"	× "	=	24.71 cm

Efish yellow perch data 2005

52 yellow perch caught Aug - Sept.

# fish		# fish
0-9.27 cm	(1)	11
9.27-13.64 cm	(2)	34
13.65-17.98	(3)	~~4~~5
17.99-21.77	(4)	1
21.78-24.71	(5)	1

Review Bray-Curtis Index- papers.

pumpkinseed caught in 1967 electrofishing -

$$\frac{772 \text{ pump.}}{1445 \text{ fish total}} = \frac{x}{100} \qquad 77200 = 1445x \qquad x = 53.43\%$$

Temp. tolerances (from Norm. fish analysis report, 2007, unless otherwise noted)

	UILT	opt-growth	Avoid	Preferred
Smallmouth bass	98.6	89.6 - 91.4	95-100	73-82 (juv) 80.6 (adult) 86-87.8 (juv)
Largemouth bass	95-98	75-86	90-99 96	86-89 (juv) 81
Pumpkinseed	94	86	88	83-90 adult 89 juvenile
Yellow perch	84-95 (juv) 90 (adult) 84 (adult-juv) 85 larvae	72 73-76	79-84 84	64-77 (adult, j. 77-81 yoy

bluegill - get info

Redbreast sunfish

Print this
- look up Mathur et al (1981) - concluded that redbreast sunfish and four other centrarchids (including largemouth & bluegill) have similar acute preferenda. observed as high as 33-35°C.

max T for growth, survival & production 25-30°C

& look up references used in this report.

★ Mathur, D., R.M. Schutsky, E.J. Purdy, Jr., and C.A. Silver. 1981. Similarities in acute temperature preferences of freshwater fishes. T... A... F... S...

Total Trapnet CPUE (p. 74 FAR)

	upper pool	lower	total pool
1970	46.7	74.0	60.2
2000	6.6	6.4	6.5

$\frac{46.7}{74.0} = \frac{x}{100}$ $\frac{74.0}{46.7} = \frac{x}{100}$

46.7
23
69.7

74x = 4670 740.0 = 46.7x
x ≈ 63.1% x = 15.85

$\frac{6.4}{74.0} = \frac{x}{100}$ $\frac{74.0}{6.4} = \frac{x}{100}$

18.65
91.35

115.625

74.0
− 6.4
67.0

BIC only upper

$\frac{2.9}{46.7} = \frac{x}{100}$

290.0 = 46.7x

x = 6.21

(*) decrease by 100 − 6.2 = 93.8%

lower

$\frac{4.8}{74.0} = \frac{x}{100}$

480.0 = 74.0x
x = 6.49

100 − 6.5 = 93.5%

total

$\frac{3.9}{60.2} = \frac{x}{100}$

390 = 60.2x

x = 6.47

100 − 6.5 = 93.5

the

95
1968
127

2005
1968
37

Temperature Data.

* Normandeau (St. A's) 67-1968 x-sections

* Norm July 1977 – Profiles for July 22, Aug 26, 1976
Oct 13,

* Norm Report Sept 1976 – profiles for June 26, July 1, July 3,
July 7, 1975

Note pg 19. (Both Units I & II & 208 Spray modules were operational during the July 1 survey.)

* Norm Report. 1979 – – Aug 4, 77, Sep 2, 1977, Sept 19 74,
Aug 26, 1976, June 26, 1975, July 7, 1972

* Norm Report 1978 – July 11, Aug 8, Sept 19, 1978.

	June	~~Aug~~ July	Aug	Sept.
72		7		
73				
74				19
75	26	1, 3, 7		
76		22	26	
77			4	2
78		11	8	19

used. (boxed: 78 – July 11, Aug 8)

5.4 – 7.2

III D) Conclusion bullet.

1. Imprint EPUE for BIC

$$\frac{56.3}{60.2} = \frac{x}{100} \qquad 5630 = 60.2x$$

$$x = 93.5\% \text{ reduction}$$

$$60.2 - 3.9 = 56.3$$

Imprint RA - [67-68] → 2000. — ? [69]

2. $86.8 - 3.4 = 83.4$

$$\frac{83.4}{86.8} = \frac{x}{100} \qquad 8340 = 86.8x$$

$$x = 96.1\%$$

3.

Perch / Temp data 2004-05 - report.

77°F (25°C) - preference temp for perch.

# samples in exceeded		ambient (11,12)	13,14,15 surface	bottom
	July 04	(11-0/2)(12-0/2)	13-2/2, 14-2/2, 15-2/2	13-1/2, 14-0/2, 15-2
	Aug 04	(11-0/2)(12-0/2)	13-2/2, 14-2/2, 15-2/2	13-2/2, 14-0/2, 15-
	July 05	(11-0/2)(12-1/2)	13-2/2, 14-2/2, 15-2/2	13-2/2, 14-1/2, 15
	Aug 05	(11-0/2)(12-0/2)	13-2/2, 14-2/2, 15-2/2	13-0/2, 14-1/2, 15

2004 - July & Aug - Ambient stations never exceeded 77 (25) on surface or bottom 0/8

2004 July & Aug - Thermally influenced surface temps at 13, 14 & 15 all exceed 77 (25) 12/12
bottom temps at 13, 14, 15 exceeded 77 (25) 6 out of 12 samples (50%)

2005 July & Aug Ambient stations exceeded 77 (25) 1 out of 8 samples (surface), never exceeded on bottom (0/8) 15/16 samples ≤ 77 (25)

2004, 05 Combined - Ambient 15/16 samples ≤ 77 (25)

2005 July & Aug Thermally influenced stations
surface - all exceeded (12/12)
bottom - (6/12) 50% exceeded.

2004, 05 Combined - Thermally-influenced - 12/24 samples > 77 (25) 50 at depth
100% 24/24 samples > 77 (25) SURF.

perch caught (e fish)

	TOTAL #	# AMBIENT ZONES	# ≤ 77 (25) at depth	# >
July 2004	23	20	2	1
Aug 2004	11	9	2	0
July 2005	10	8	1	
Aug 2005	20	14	6	
	64	51 (79.7%)	11 (17.2%)	(3.1%)

62 (96.9%) ≤ 77 (25)
2 (3.1%) > 77 (25)

$\frac{51}{64} = \frac{x}{100} =$ $\frac{2}{64} = \frac{x}{100} =$

$\frac{11}{64} = \frac{x}{100} =$

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Temp Limits for Perch (Juvenile)
from Hokanson (1977) p. 1537

3 Studies (Summer) UILT 30.9
Acc. T's. ← 23-25 29.2
22-24 32.3
92.4/3 = 30.8

Acc T.	Life stage	Season	UILT
~~23-25~~ 22-24	J.A	summer	29.2

declines in Trapnet CPUE

		Upper HP	Lower HP	Entire Pool
1	1970	46.7	74.0	60.2
2	2000	6.6	6.4	6.5
3	2009 (BIC only)	2.9	4.8	3.9

% red. (1→3)

46.7 − 2.9 = 43.8; 43.8/46.7 = x/100; 4380 = 46.7x; x = 93.8% ✓

74.0 − 4.8 = 69.2; 69.2/74.0 = x/100; 6920 = 74.0x; x = 93.5% ✓

60.2 − 3.9 = 56.3; 56.3/~~74.0~~ 60.2 = x/100; 5630 = ~~74.0~~ 60.2x; x = 93.5% ✓

Fall fish E fishing

		Station 11	12	13	14	15
2004	Aug	(4)	(17)	(2)		
	Sep	(3)	(1)	(1)		
2005	Aug	(5)	(2)	(1)	(1)	
	Sep	(2)	(14)		(1)	
		14	34	54	2	

54 TOTAL

$\frac{6}{54}$ = TI

49/54 = AMBIENT

$\frac{49}{54} = \frac{x}{100}$ 4900 = 54x

x = 90.7

White sucker larvae. [TEMP]

May 28

				mean 28
N-10	Temp.	(mean)	61.3°F	(16.27°C)
		(max)	71.2°F	(21.8°C)
S-0	T	(mean)	77.9°F	(25.5°C)
		(max)	91.4°F	(33)
S-d	T	(mean)	63.6°F	(17.56°C)
		(max)	81.1°F	(27.3°C)

White sucker presence in T1 zone during electrofishing (July, Aug, Sept) 2005 & 2004

	Station	# fish	Temp (S)	(B)	Notes
July (05)	12W	8	24.6	24.6	all between 400-500 m
	11W	1	24.89	~~23.86~~ 24.7	
	11E	1	24.9	~~23.7~~ 24.8	
	12E	1	~~24.5~~ 25.1	24.9	
Aug (05)	*15W	1	27.4	24.4	all between 290-503
	12E	1	23.9	23.9	386
	12W	4	24.4	24.0	477
	11W	1	24.5	23.9	423
	11E	1	24.6	24.1	
Sept (05)	NONE CAUGHT 0				

3 suckers < 150 mm = juv (Twomey 8...)

TOTAL		
04	25	21 am
05	19	18 am
	44	39

1 @ 85
7 between 139-193
3 > 212

05 TOTAL (J,A,S) [19] - 18 in ambient zone

3 between 467-525 — (1 171)

			S T	B
July (04)	11E	2	24.0	23.7
	11W	1	24.1	23.7
	12W	4	24.1	24.0
	* 14E	2	27.5	24.0
	* 15W	1	26.0	25.3

all between 335-444

	Stn	# fish	S T	B
Aug (04)	12W	3	24.6	24.4
	12E	1	24.5	24.4
Sept (04)	11W	1	24.3	24.3
	11E	4	24.3	24.3
	12E	5	24.5	24.4

04 T...

Summary of E-fishing Results (67-69) Table 7. Nov. 70

SPECIES	YEAR	S	N	NS COMBINED	# ALL FISH COMTS	RA	3-YR AVG RA
Red Breast Sun	67	87	9	96	1984	4.83	
	68	43	7	50	576+359=935	5.35	19.72/3=
	69	69	1	70	420+314=734	9.54	6.6
Pumpkinseed (Common Sun)	67	772	173	945	1445+539 = 1984	47.63	111.52/3=
	68	163	163	326	935	34.87	
	69	145	68	213	734	29.02	37.2
White Sucker	67	11	2	13	1984	0.66	4.22/3=
	68	1	3	4	935	0.43	
	69	0	23	23	734	3.13	1.4
Largemouth	67	193	64	257	1984	12.95	
	68	234	26	260	935	27.81	67.05/3=
	69	128	65	193	734	26.29	22.4 *
Smallmouth	67	103	84	187	1984	9.43	13.59/3=
	68	9	12	21	935	2.25	
	69	6	8	14	734	1.91	4.5
Chain Pickerel	67	23	18	41	1984	2.07	7.44/3=
	68	17	9	26	935	2.78	
	69	11	8	19	734	2.59	2.5
Yellow perch	67	216	177	393	1984	19.81	51.15/3=
	68	59	34	93	935	9.95	
	69	39	118	157	734	21.39	17.1
Brn Bullhead	67	9	6	15	1984	0.76	2.17/3=
	68	3	0	3	935	0.32	
	69	7	1	8	734	1.09	0.7
Yellow Bullhead	67	3	0	3	1984	0.15	1.26/3=
	68	4	0	4	935	0.43	
	69	3	2	5	734	0.68	0.4

Summary - Continued

Species	Year	S	N	NS Combined	# All Fish Comb	RA	3-YR AVG. RA
Fallfish	67	13	5	18	1984	0.91	3.59/3 =
	68	0	11	11	935	1.18	
	69	0	11	11	734	1.50	1.2
Eel	67	1	0	1	1984	0.05	1.45/3 =
	68	7	1	8	935	0.86	
	69	4	0	4	734	0.54	0.5
Golden Shiner	67	9	1	10	1984	0.50	2.92/3 =
	68	15	0	15	935	1.60	
	69	5	1	6	734	0.82	1.0
Shiner spp.	67	0	0	0	1984	0	13.59/3 =
	68	20	93	113	935	12.09	
	69	3	8	11	734	1.50	4.5
Mad tom	67	0	0	0	1984	0	0.11/3 =
	68	1	0	1	935	0.11	
	69	0	0	0	734	0	0.04 0.0
Walleye	67	5	0	5	1984	0.25	0.25/3 =
	68	0	0	0	935	0	
	69	0	0	0	734	0	0.1

WHITE SUCKER RA 4 DECADES - TRAPNET

	% RA AVG. NORTH	% RA AVG. SOUTH	% RA AVG. TOTAL
1960 (67-69)	19.33	13.00	16.17
1970	20.90	16.40	18.20
1990 (AUG, SEPT 95)	21.7	2.5	12.1
2000's	2.7	1.6	2.1

AR-206

Vol 3 of 4

from Vt Yankee final report (2004) model

Vernon Pool 26 mi long and 770 m (.48 mi) max width
total volume 49.3 x 10^6 (1.7 x 10^9 ft^3)

Vt Yankee 0.5 mile north (above) Vernon Dam

3.2.3.1 - temps (Surface) in Vernon Pool up to 27.5C (81.5F) in July. - influenced by outfall

p.26. Station F (ambient) high of 25.0°C (77.0F July.

p39 - depths as ~~high~~ much as 40' approaching dam.
avg depth in axis of river 16' (5m)

p. 59. Avg temps. (F1) 26.3 surface

Vt Yankee 316(a) demo

p. 153. 324 acres of bottom habitat and (0.194 bill ft^3 v

vs. 2,481 acres and 1.3814 bill

bottom habitat	volume
$\frac{324 \text{ acres}}{2481 \text{ acres}} = \frac{x}{100}$	$\frac{0.194 \text{ bcf } H_2O}{1.3814 \text{ bcf } H_2O} = \frac{x}{100}$
32400 x = 2481	19.4 bcf H_2O = 1.3814
x = 13.1%	x = 14%

App. B
from p. B-4→B-1
in FAR 07

Ambient (Station's 11, 12) Surface temps in Hooksett Pool

		surface	bottom	ΔT
2005 ~~2004~~	July 25 max	24.9	24.7 - 24.8	0.1-0.2
	26	25.1	24.9	0.2
2005	Aug	24.6	24.1	0.5
2004	July	24.5	24.1	0.4
"	Aug	24.6	24.4	0.2

. Max Temps @ 13 W Surface and bottom during e-fishing

	max	surface	bottom	ΔT
2004	July	26.8	23.8	3.0°C
	Aug	30.1	25.9	4.2°C
2005	July	33.7	30.3	3.4°C
	Aug	30.5	24.5	6.0°C

calculation for max T. Sect. 8.3.1.4b

yellow perch larvae mortality

→ 30 minutes @ 31.3°C (88.3F)* @ (15.0C (59.0F))
10 " @ 33.7 C (92.7F) "

juveniles
~~60~~ 15 minutes @ 34.0°C (93.2 F) @ 22-23 (71.6-73.4)
~~30~~ ~~75~~ 60 " @ 32.0 C (89.6) " "

(larvae) (young?) (juvenile)

31.3 (88.3F) ≥ T$_x$ ≥ 32.0 (89.6F)

$$\frac{31.3 + 32.0}{2} = \frac{63.3}{2} = 31.7^\circ \ (89^\circ F)$$

* 31.3 (88.3) use as limit.

5636
5634

Eggs

Larvae

April 10 — May 30

May 1 — June 30

43/2= 21.5
21.5

21.5 + (10.8/3)

21.5 + 3.6 =
25.1

Gonadal development

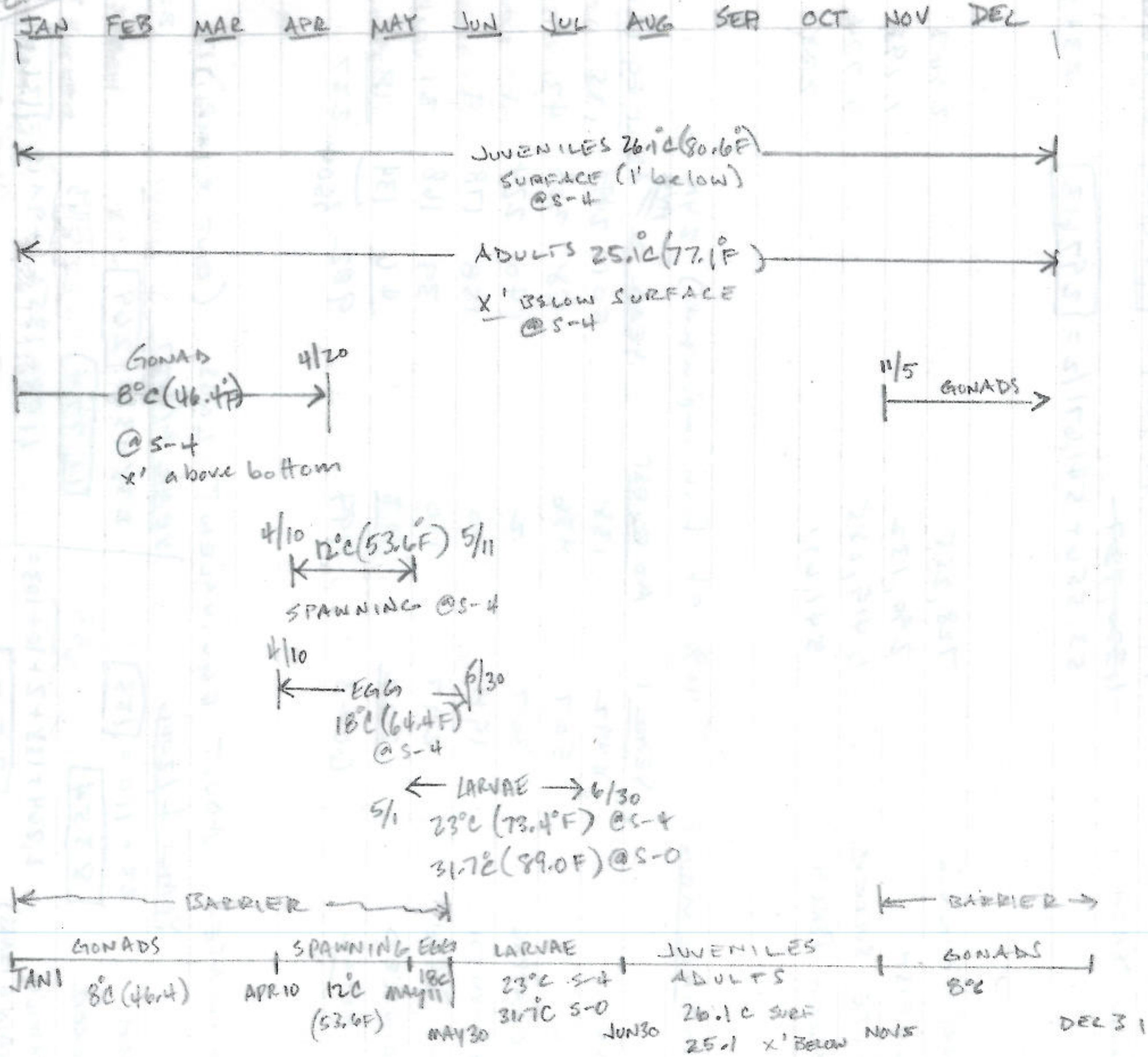
< 5.0°C @ N-10 (20-year data set) avg daily mean.

starts Oct 26
ends April 30.

O N D J F M A
4 + 30 + 31 + 31 + 28 + 31 + 30 = 185

30 31 31 28 31 20 = 171

RESIDENT SPECIES



Entrainment Estimates from Table 5-7 p. 124
Norm 2007 C - (rep 90% of fish entrained)

TAXON	ANNUAL ENT. EST. BOTH UNITS COMBINED ALL LIFESTAGES COMBINED — 2-YR AVG	ADULT EQUIVALENT EST. — 2-YR AVG
2006 ∘ CARP & MINNOW FAMILY	1,125,153 + 728,255/2 = 926,704	4,850 + 2967/2 = 3909
∘ SUNFISH FAMILY	474,752 + 290,132/2 = 382442	2,264 + 1198/2 = 1731
∘ WHITE SUCKER	1,320,727 + 1,419,085/2 = 1369906	8,354 + 11774/2 = 10,064
∘ YELLOW PERCH	~~1,320,727~~ 53,556 + 541,671/2 = 297,613	23 + 238/2 = 131

2007 ∘ CARP & MINNOW	728,255	2,967
∘ SUNFISH	290,132	1,198
∘ WHITE SUCKER	1,419,085	11,774
∘ YELLOW PERCH	541,671	238

IMPINGEMENT (90% of fish impinged)

	YEAR 1	AD. EQ EST.	YEAR 2	2 YR AVG	ADULT EQ. EST	AE 2 YR AVG
BLUEGILL	4492	138	501	2497	135	137
SPOTTAIL	507	436	98	303	43	240
BLACK CRAPPIE	307	2	140	224	1	2
LARGEMOUTH	198	10	158	178	9	10
YELLOW PERCH	297	110	39	168	31	71
PUMPKINSEED	222	103	46	134	18	61
TOTAL	6023	799	982	3504	237	521

ESTIMATED ADULT EQUIVALENT LOSS (ENT & IMP)

	YEAR 1/2006	YEAR 2/2007	2-YR AVG
YELLOW PERCH	23 + 110 = 133	238 + 31 = 269	201
WHITE SUCKER	8354	11,774	10,064
SUNFISH FAMILY (INCLUDING BASS)	2,264 + 138 + 2 + 10 + 103 = (253) 2,517	1,198 + 135 + 1 + 9 + 18 = (163) 1361	1939
CARP & MINNOW FAMILY	4,850 + 436 = 5286	2,967 + 43 = 3010	4148
[illegible]	[illegible]	TOTAL = [illegible]	11,352

RA trapnet June - July 2004-05 FAR Table A-1 A-3

June 04 — Ambient (Stations 1E, W) — Therm-Inf. (Stations 2W, 3E)

(3.07, 4.83, 1.02, 1.93 = 10.85)

	Ambient			Therm-Inf.		
Rock bass	3, 5, 1, 2	(11)		3, 1, 1	(5)	3.09, .95,
smallmouth	3, 1, 3, 2 (3.07, 0.97, 3.07, 1.93) =	(9)	9.04	3, 23, 5	(31)	(3.08, 21.97, 5.16 = ?)
Bluegill	1	(1)	.97	5, 4,	(9)	5.16, 3.81 = 8.97
fallfish	1,	(1)	.97	0	(0)	
brown bullhead	1	(1)	.96	0	(0)	
redbreast	1	(1)	0.96	1,	(1)	
black crappie	0	(0)		3,	(3).	(3.08)
white sucker	0	(0)		1,	(1)	.96
yellow bullhead	0	(0)		1,	(1)	1.03
TOTAL			~~23.85~~ 23.75			~~50.18~~ 48.29

June 05 — Ambient + June 04/2 = — Therm-Inf + June 05/2 =

	Ambient		Therm-Inf
Rock bass	1.89, ~~3.10, 0.95~~	(2)	(0)
Smallmouth	3.10, 0.95, ~~7.38~~		7.38
Bluegill	(0)		(0)
fallfish	(0)		(0)
brown bullhead	(0)		(0)
red breast	1.89 ~~1.89, 1.05~~		1.05, 14.75
black crappie	(0)		(0)
white sucker	1.89		(0)
yellow bullhead	(0)		(0)
spottail	0.95		(0)
tes. darter	0.95		(0)
mag. madtom	~~2.11~~		2.11
yellow perch	(0)		2.11

11.62 + 27.4 = 39.02

entire Hooksett Pool - # fish collected

	June 04	July 04	June 05	July 05	Relative Abundance %
1. pumpkinseed	0	0	0	0	0
2. yellow perch	0	1.04	2.11	0	
3 brown bullhead	0.96	0	0	0	
4. white sucker	0.96	0.99	1.89	0	
5. golden shiner	0	0	0	0	
TOTAL FISH CAUGHT	72.04 +	47.64 +	39.02 +	22.07	

RA trapnet June - July 2004-05 FAR Table A-1, A-3

July 04	Ambient (1E, W)		Therm Inf (2W, 3E)	
Rockbass	0		1.04, 1.00	(2.04)
Smallmouth	1.03, 4.99	(6.02)	8.3, 6.98, 2.08, 5.99	(23.35)
Bluegill	1.00		1.00, 1.04, 1.00	(3.04)
fallfish	0		0	
brown bullhead	0		0	
redbreast	1.03, 1.00	(2.03)	0	
black crappie	0		1.00	
white sucker	0.99		0	
yellow bullhead	0		0	
spottail	1.03		0	
margined madtom	1.00		0	
yellow perch	0		1.04	
TOTAL	(12.07)	←	30.47	= 42.54

July 05				
Rockbass	1.00, 2.04,	(3.04)	1.99, 1.00	(2.99)
Smallmouth	2.00, 2.04,	(4.04)	11.96, 3.98	(15.94)
Bluegill	2.00,		1.00, 1.05	(2.05)
fallfish	0		0	
brown bullhead	0		0	
redbreast	1.02		1.99	
black crappie	0		0	
white sucker	0		0	
yellow bullhead	0		0	
spottail	0		0	
marginal madtom	0		0	
yellow perch	0		0	
TOTAL	10.1	+	22.97	= 33.07

Trapnet RA. for June & July in 2004, 05 based on FAR data.

Species	2004	2005	Total Fish Caught 2004	Total Fish Caught 2005	Rel. Abund 2004	Rel. Abund 2005	Rel Abundance Avg (2 yr)
pumpkinseed	0	0	114.58	72.09	0	0	0
yellow perch	1.04	2.11	114.58	72.09	0.9	2.9	1.9
brown bullhead	0.96	0	114.58	72.09	0.8	0	0.4
white sucker	1.95	1.89	114.58	72.09	1.7	2.6	<2.2
golden shiner	0	0	114.58	72.09	0	0	0

Relative Abundance 04 05 2-YR AVG

yellow perch $\frac{1.04}{114.58} = \frac{x}{100}$ $\frac{2.11}{72.09} = \frac{x}{100}$

$104 = 114.58x$ $211 = 72.09x$

$x = 0.9\%$ + $x = 2.9\%$ $= 3.8/2 = 1.9$

brown bullhead $\frac{0.96}{114.58} = \frac{x}{100}$ 0

$96 = 114.58x$

$x = 0.8\%$ + $x = 0$ $= 0.8/2 = 0.4$

white sucker $\frac{1.95}{114.58} = \frac{x}{100}$ $\frac{1.89}{72.09} = \frac{x}{100}$

$195 = 114.58x$ $189 = 72.09x$

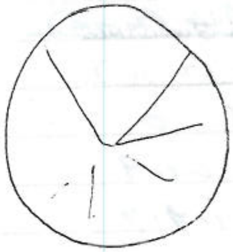
$x = 1.7$ + $x = 2.6$ $= 4.3/2 = 2.2$

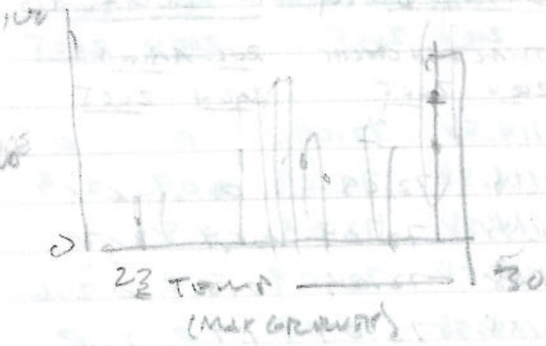
pumpkinseed 0 0 = 0.0

golden shiner 0 0 = 0.0

TOTAL 4.5

1960's 70's 2000's





RA

1960's 1970's 2000's

1960's (1967-69)

Rank RA max growth

1

MAX GROWTH
23 - 23.9
24 - 24.9
25 - 25.9
26 - 26.8
27 - 27.9
28 - 28.9
29 - 29.9
30 → 30.5

★ Define cool water as including long durations of cool temps in summer growing season

E Fish

MAX GROWTH	SPECIES	REL ABUNDANCE 1960's	1970's	2000's
WARMEST				
	Bluegill			
	LMB			
COOLEST				

Trap netting

Electrofishing CPUE 1972 – 2005 from FAR Table 3-7 p. 64
for species reg. BIC FOR ENTIRE HOOKSETT Pool

	1972	73	74	76	95	2004	2005
Brn Bullhd	2.15	0.55	0.60	0.20	0.0	0.00	0.00
Fallfish	1.70	0.50	0.05	0.00	0.45	1.45	1.30
Gold Shiner	0.30	0.25	0.45	0.00	0.20	1.35	0.40
Largemouth	5.65	0.85	6.55	2.65	6.05	9.55	6.10
Pumpkinseed	37.65	20.20	25.40	19.45	0.95	0.70	0.90
Smallmouth	0.80	4.15	3.10	4.90	1.40	5.35	1.90
Yellow perch	8.30	5.50	3.95	1.05	0.20	0.65	2.60
sub TOTAL	56.55	32.00	40.1	28.25	9.25	19.05	13.2
white sucker	1.40	0.20	4.65	2.00	0.20	0.75	0.40
	57.95	32.20	44.75	30.25	9.45	19.80	13.60

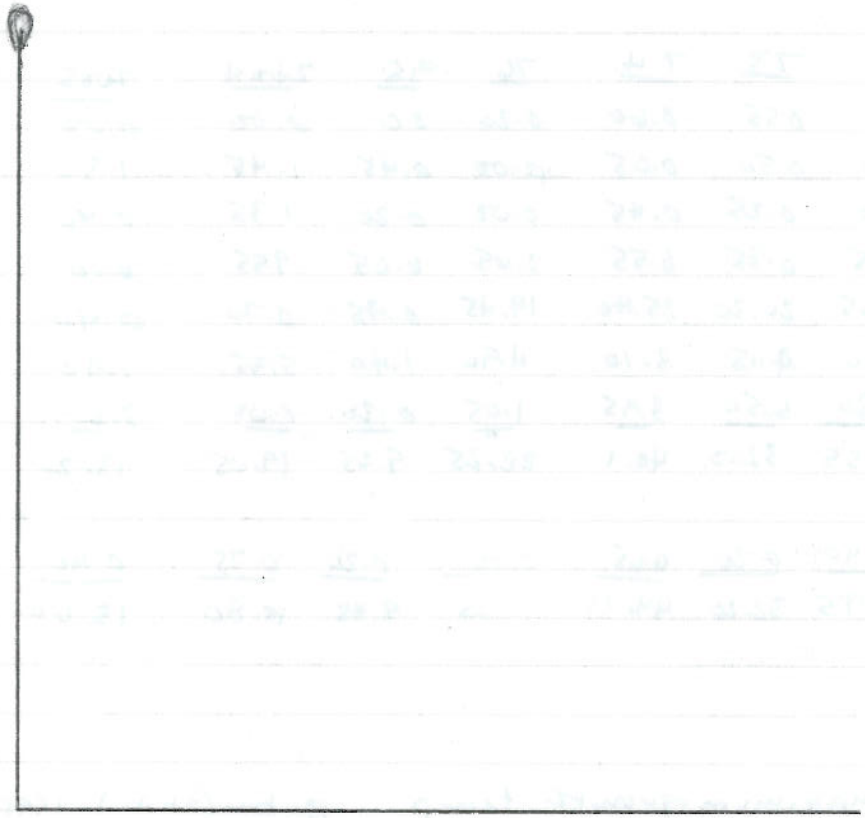
TEMP
Calculated maximum growth temp Eaton (et al) 1995

species	Max growth temp		FTDMS	
white sucker	26.0	7	27.3	8
yellow perch	26.8	6	29.1	7
bluegill	30.0	1	31.7	1
brown bullhead	27.8	4	29.5	5
golden shiner	23.8	8	30.8	3
largemouth bass	29.0	2	31.7	2
rock bass	27.4	~~4~~ 5	29.3	6
Smallmouth	28.2 ~~29.5~~	3	29.5	4
redbreast	25-30 (27.5) average			

FWS Habitat Suitability Index Nov. 19

bluegill	30.0 ~~bluegill~~	31.7
largemouth	29.0	31.7
smallmouth	28.2	29.5
brown bullhead	27.8	29.5
rock bass	27.4	29.3
yellow perch	26.8	29.1
white sucker	26.0	27.3
golden shiner	23.8	30.8
spottail shiner		
PUMPKINSEED (FAR)	30.	

from VT Yankee 86°/30°C
from FAR 86°F / 30°C



FAR C-5

optimum for growth		preference
89.6-91.4 -	Smallmouth	73-87.8
75- 86	largemouth	86-89
86	pumpkinseed	83-90
72-76	yellow perch	64-81
75	white sucker	73-81
(82°) [illegible]	brown bullhead	

yellow p 64 → 81
W sucker 73 → 81
pump 83-90
SmB 73 ← → 88
LmB 86 → 89

CPUE trends analyses -

① yellow perch

using Normandeau's data set only (electrofishing)

	# samples	Kendall's Tau b value	p value	trend
Ambient zone:				
Normandeau		-0.429	0.177	"stable"
EPA		-0.524	0.099 (2 tailed)	
★ Norm w/out 72 data (EPA)		0.333 – 0.348 (2 tail)	0.068 (1 tailed)	
Thermally-influenced		~~-0.429~~	~~0.177~~	~~stable~~
Normandeau		-0.429	0.177	stable
EPA		-0.781	0.014 (2 tailed)	reject
			0.015 (1 tailed)	reject
Entire Hooksett Pool		~~-0.429~~	~~0.334~~	~~stable~~
			(0.050886)	
Normandeau	7	-0.619	0.051	stable
EPA	7	-0.619	< 0.035 (1-tailed)	

② yellow perch

using data from 1967-69 and Normandeau's data set

n ≥ 10

	Kendall's Tau b value	p value	trend
Ambient zone	-0.6		
Thermally-influenced			
Hooksett Pool			

Species representing BIC (br bullhead, fallfish, golden shiner, largemouth, smallmouth, pumpkinseed, white sucker, yellow perch)

			Kendall's Tau b	P value	trend
BIC	72-05	Ambient only			
"	67-05	" "			
	72-05	Thermal-Inf only			
	67-05	" "			
	72-05	Entire Pool			
	67-05	" "			

Non-parametric. Kendall Tau

Largemouth Bass. efishing CPUE from Table 3-7 FAR A63-64

	72	73	74	76	95	04	05
Amb	6.50	0.88	5.20	2.44	3.13	10.56	8.63
TI	4.80	0.83	7.90	2.67	8.02	8.73	4.42
H.P.	5.65	0.85	6.55	2.65	6.05	9.55	6.10

★ Norm. results for smallmouth (Amb) & largemouth (Amb + TI) are all identical

★ Norm: results for yellow perch (Amb + TI) are identical

★ Largemouth (Fig 3-6) missing data pt for 2004.

Small mouth bass

	72	73	74	76	95	04	05
Amb	0.60	1.75	1.10	1.93	0.75	7.67	1.25
TI	1.00	5.75	5.10	4.83	1.83	3.45	2.33
HP	0.80	4.15	3.10	4.90	1.40	5.35	1.90

Norm. Conducted a parametric

From FAR Table 3-8 p 65

Largemouth

	Kendall's Tau b	p value	trend
Ambient Zone			
Normandeau	0.333	0.293	stable
EPA	0.333	0.293	
Thermally-Influenced			
Normandea	0.333	0.293	stable
EPA			
Hooksett Pool			
Normandeau	~~0.4~~ 0.429	0.177	stable
EPA			

Smallmouth

	Kendall's Tau b	p value	trend
Ambient			
Normandeau	0.333	0.293	stable
EPA			
Therm-Inf Normandeau	-0.238	0.453	stable
EPA			
Hooksett Pool			
Normandeau	0.238	0.453	stable
EPA			

TRAPNET TOTAL CPUE

CPUE changes from 1970 - 2000 based on Table 3-17 (FAR) - Also, see pg 50 book #1 (calcs)

Upper pool

	CPUE	UCL	LCL
(70)	46.6	71.6	21.6
(2000's)	− 2.8	− 4.6	− 1.1
	43.8	67.0	20.5

$\frac{43.8}{46.6} = \frac{x}{100}$ $\qquad$ $\frac{67.0}{71.6} = \frac{x}{100}$ $\qquad$ $\frac{20.5}{21.6} = \frac{x}{100}$

$4380 = 46.6x$ $\qquad$ $6700 = 71.6x$ $\qquad$ $2050 = 21.6x$

$x = 94.0\%$ $\qquad$ $x = 93.6\%$ $\qquad$ $x = 94.9$

Lower Pool

	CPUE	UCL	LCL
(70's)	73.6	113.2	34.0
(2000's)	− 4.8	− 7.6	− 1.9
	68.8	105.6	32.1

$\frac{68.8}{73.6} = \frac{x}{100}$ $\qquad$ $\frac{105.6}{113.2} = \frac{x}{100}$ $\qquad$ $\frac{32.1}{34.0} = \frac{x}{100}$

$6880 = 73.6x$ $\qquad$ $10560 = 113.2x$ $\qquad$ $34.0x = 321000$

$x = 93.5\%$ $\qquad$ $x = 93.3\%$ $\qquad$ $x = 94.4\%$

Entire Pool

	CPUE	UCL	LCL
(70's)	60.1	84.1	35.9
(2000's)	− 3.6	− 4.7	− 2.0
	56.5	79.4	33.9

$\frac{56.5}{60.1} = \frac{x}{100} = 60.1x = 5650$ $\qquad$ $\frac{79.4}{84.1} = \frac{x}{100} = 84.1x = 7940$ $\qquad$ $\frac{33.9}{35.9} = \frac{x}{100} = 35.9x = 339$

$x = 94\%$ $\qquad$ $x = 94.4$ $\qquad$ $x = 94.4$

(2f)

(Table 5-7)

Total CPUE trapnet data. - from Table 3-17 FAR.
All species.

	upper pool		lower pool		entire pool	
1970	46.7	46.7	74.0	74.1	60.2	60.3
2000's	− 6.6	− 6.5	− 6.4	− 6.5	− 6.3	6.3
	40.1	40.2	+ 67.6	+ 67.6	53.9	54.0

$\frac{40.1}{46.7} = \frac{x}{100}$ $\frac{67.6}{74.0} = \frac{x}{100}$ (~~74.0 / 67.6~~) $\frac{53.9}{60.2} = \frac{x}{100}$

4010 = 46.7 x 6760 = 74.0 x (~~7400 = 67.6 x~~) 5390 = 60.2 x

x = −85.9 % x = −91.4 % x = 89.5 %

x = 86.1 % x = 91.4 % 5400 / 60.3 x

(x = 89.6)

For Table 5-10.

Trapnet CPUE change 1970's - 2000 for Yellow Perch

	upper pool	lower pool	entire pool
1970's	7.0	5.2	6.1
2000's	− 0.2	0.1	0.1
	6.8	5.1	6.0

$\frac{6.8}{7.0} = \frac{x}{100}$ $\frac{5.1}{5.2} = \frac{x}{100}$ $\frac{6.0}{6.1} = \frac{x}{100}$

680 = 7.0 X 510 = 5.2 X 600 = 6.1 X

X = − 97.1 % X = −98.1 % X = −98.3 %

for 5.6.2.1.1.9

CPUE - electrofishing - all resident species caught in 1972 (does not include eel)
Hooksett Pool wide - data taken from Table 3-7.

Combined CPUE 1972 63.2 fish
" " 2005 15.6 " > comparing same species.

CPUE	1972	2005		
Ambient	62.2	21.9	62.2 − 21.9 = 30.3	$\frac{30.3}{62.2} = \frac{x}{100}$; 3030 = 62.2x; 48.7%
T-I Zone	64.2	11.41	64.20 − 11.41 = 52.79	$\frac{52.79}{64.20} = \frac{x}{100}$; 5279 = 64.2x; x = 82.2%

(30)

For Table 22. calculated flows at Hooksett & Garvins Falls Dams. 1993-2007

Flow data from USGS Surface-Water Website.

Adjustment factor from PSNH 2003.

MEAN

July ~~Avg~~ Averaged Mean = 2,990 @ Goffs Falls
2,990 x 0.785 = 2347 @ Garvins Falls 0.785
2,990 x 0.907 = 2712. @ Hooksett 0.907

August Averaged Mean = 1940 @ Goffs Falls
1940 x 0.785 = 1523 @ Garvins
1940 x 0.907 = 1760 @ Hooksett

Sept. Averaged Mean = 2,040 @ Goffs
2040 x 0.785 = 1601 @ Garvins
2040 x 0.907 = 1850 @ Hooksett

AVG'D. MINIMUM

July minimum = 982 @ GOFFS
982 x 0.785 = 771 @ GARVINS
982 x 0.907 = 891 @ Hooksett

AUGUST MIN (AVERAGED) = 781 @ GOFFS
781 x 0.785 = 613 @ GARVINS
781 x 0.907 = 708 @ HOOKSETT

SEPT. MIN = 758 @ GOFFS
758 x 0.785 = 595 @ GARVINS
758 x 0.907 = 688 @ HOOKSETT

6.00

AVERAGED MAX

JULY
MAX = 7542 @ GOFFS
7542 x 0.785 = 5920 @ GARVINS
7542 x 0.907 = 6841 @ HOOKSETT

AUG
MAX = 4839 @ GOFFS
4839 x 0.785 = 3799 @ GARVANS
4839 x 0.907 = 4389 @ HOOKSETT

SEPT
MAX = 6774 @ GOFFS
6774 x 0.785 = 5318 @ GARVINS
6774 x 0.907 = 6144 @ HOOKSETT

July

316(b)		Monthly Avg	monthly max	1993 - 2006
7/31	1993	253.9	259.6	
	94	257.5	260.6	
	95	256.9	260.1	
	96	242.7	260.9	
	97	253.1	(262.5)	
	98	254.2	258.1	
	99	246.6	257.5	
←	00	244.2	257.9	2077.2
2009.1	01	237.	258	
	02	234.1	258.8	
	03	220.1	259.6	
	04	244.2	256.4	
	05	256.2	256.7	
	06	257.1	258.1	

3457.8 ÷ 14 =   3624.8 ÷ 14 = 258.91

14 year mean 246.98

247 mgd x 1.55 cfs/mgd = 382.9 cfs

259 mgd x 1.55 cfs/mgd = 401.5 cfs

July
flow at Garvins cfs
min mean
771 2347

$\frac{382.9}{771} = \frac{x}{100}$

$\frac{383}{2347} = \frac{x}{100}$ x 16.37.

$\frac{401.5}{771} = \frac{x}{100}$ $\frac{401.5}{2347} =$

(32)

conversion - flow requirements for plant (Norm. 1979) p.3

12.6 cms $ft^3 \rightarrow m^3 \times (35.3144)$

$12.6 \times 35.3144 = 444.96$ cfs

1 mgd = 1.55 cfs

$\frac{444.96 \text{ cfs}}{1} \times \frac{1 \text{ mgd}}{1.55 \text{ cfs}} = 287.1$ mgd

(33)

R.A. Vernon Pool

from p. 115 of 316(?) Demo.

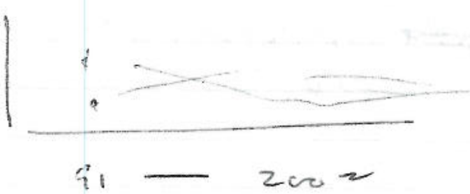
VY (upstream)	1968–1980	1991–2002
pumpkinseed	10.7	11.9
bluegill	2.3	~~11.9~~ 14.3
yellow perch	16.1	39.0

R.A. Hinsdale(?) Pool

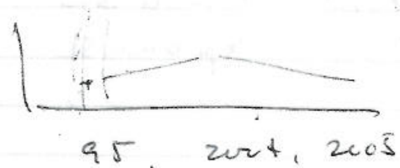
	1992–
pumpkinseed	
bluegill	
yellow perch	

Vernon pool

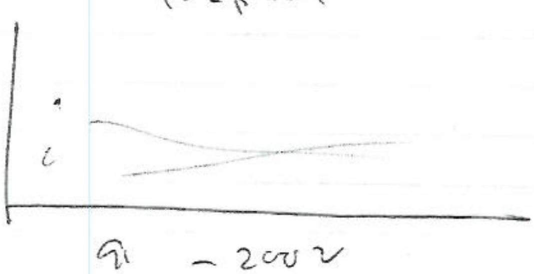
E fish



Hinsdale(?) Pool



Trap net



(34)

Table 5-17 Trapnut
Change in RA 1960, 70's, 2000's, and max growth Temp.

1960's	1970's	2000's
86 (30)	86 (30)	86 (30)
82 (27.8)	82.8 (28.2)	86 (30)
80.2 (26.8)	82.0 (27.8)	82.8 (28.2)
78.8 (26.0)	80.2 (26.8)	81.5 (27.5)
74.8 (23.8)	78.8 (18.2)	81.3 (27.4)
401.8/5 = 80.36	409.8/5 = 81.96	417.6/5 = 83.52
80.4 (26.9 C) $\bar{x}$	82.0 (27.8 C) $\bar{x}$	83.5 (28.6 C) $\bar{x}$

Standard Deviation SD

~~AI's~~ 4.12	sample SD	2.74	sample (S_x)	2.34	sample
3.68	population SD	2.45	~~Pop~~ population σ_x	2.10	pop.

316(b)

Impingement sampling schedules - report (Norm. 2007c)
Table 2-5 (p. 36)

Report identifies 21 voided sampling efforts including all of Sept 06 (unit 1) and April-May 07 (unit 2).

Impingement sampling occurred from June 2005 - mid Dec 2005 25 weeks

and. March 2006 - Nov 2006 (34 weeks)

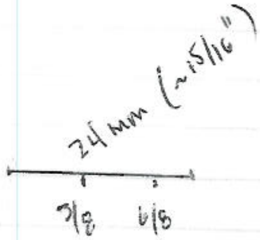
mid-March 2007 - June 2007 (15 wee

74 weeks to

52 x 2 = 104
- 74
30 missed weeks

Entrainment survival - no larvae collected on 25 May 07
18 June 07

Week of		
14 May 07	204,453	larvae collected (both units
21 May 07	105,034	" " "
28 May 07	112,409	" " "
18 June 07	118,214	" " "
25 June 07	~~249,274~~ 328,430	" " "



Approach velocities p.28 §308 resp. (Norm 2007d)

1.5 (Unit I) fps compared to 0.5 fps (industry standard)
x = 3

1.82 (Unit II) fps. $\frac{1.82}{0.5} = \frac{x}{100} = 3.64$

Unit I 3 x's average.
II 3.64 x's

Extraordinary Impingement Events - reported

time	Date	Unit	#	Species	size
~~1745~~	Sept 26, 97	2	100 - 150	juvenile river herring	6.5 - 9.5 cm
0430	Sept 30, 97	2	103	" " "	6.5 - 9.5
0140	Oct 4, 97	2	63	" " "	" "
0230	Oct 30, 97	2	147	" + adult " "	6.5 - 25.5
0730	Sept 3, 98	2	274	" " "	6.0 - 9.0
0820	Sept 9, 98	2	72	" " "	7.0 - 10.0

Percent composition of larval entrainment

	2006 both units		2007 both units		two-year avg
B. Bullhead	2.4 %	67,772 / 2,756,283 = x / 100	0	2.4/2 =	1.2
Carp & minnow	36.1		23.9	60/2 =	30.0
herring family	0		0.1	0.1/2 =	0.0
Marg. Madtom	1.2		0	1.2/2 =	0.6
Rock bass	2.1		0	2.1/2 =	1.1
Spottail shiner	0		0.2	0.2/2 =	0.1
Sunfish family	13.9		7.7	21.6/2 =	10.8
Tess. darter	0.8		3.3	4.1/2 =	2.1
Unidentified	0		0	-	0
White sucker	41.6		45.8	87.4/2 =	43.7
Yellow perch	1.8		18.1	19.9/2 =	10.0
Total	99.9		99.1 %		99.7 %

~~Bullhead~~

Q: ask Daniella & John about identification to species level for sunfish, minnows, etc.

(38) entrainment vs. flow.

	monthly avg	monthly max
May 2006	123 mgd	260.8 mgd
May 2007	141.2 mgd	260.3 mgd.

Winter Impingement Rates

from Norm 2007C (p. 74).

(39) Calculations for Table 11.~~6~~7 (impingement) Det Doc.

	2005		2006		2007	
Species	Imp	AEL	Imp	AEL	Imp	AEL
Bluegill	171	86	~~4432~~ 4665	~~167~~ 173	158	33
Spottail	354	318	161	122	90	40
B. Crappie	231	18	197	11	46	4
Lm Bass	167	10	151	10	~~5~~ 37	5
Y. Perch	145	54	161	57	39	31
Pump.	103	74	~~74~~ 139	~~21~~ 44	24	4
All species combined	1171	560	5474	417	394	150
	June-Dec 7 mos		Jan- Dec 12 mos		Jan- June 6 mos	

Impingement by species from Table 4-3 Norm 2007c and relative abundance. * FROM FAR Table 3-6

		%	2004	2005		mean	
1 black crappie	(3)	5.3	0.1	0.4	(6)	0.5/2 =	0.2
2 blue gill	(1)	62.6	6.7	25.1	(3)	31.8/2 =	15.9
3 l.m. bass	(4)	4.6	20.0	27.4	1	47.4/2 =	23.
4 pumpkin seed	(6)	4.0	1.5	4.0	(5)	5.5/2 =	2.1
5 spottail shiner	(2)	7.4	28.3	3.6	(2)	31.9/2 =	16.
6 yellow perch	(5)	4.1	1.4	11.7	(4)	13.1/2 =	6.6
		88%					

* RA of other dom. species

(40) From Norm 2007c. p 63 Fig 4-3

Est. Tot monthly impingement - both Units adjusted for flow & collection efficiency
July 2005 - June 2007

Month	Year ~~of~~ 2005		2006	2007	2 YR MEAN	SD	Rank
(1) Jan		(5)	214	67	141		8
(9) Feb		(6)	163	48	106		9
(7) Mar		(3)	(256)	66	161		7
(10) Apr		(9)	115	57	86		10
(3) May		(2)	(307)	174	241		3
(1) Jun		(1)	(4300)	220	2260		1
(6) Jul	143	(4)	215		179		6
(12) Aug	29	(11)	17		23		12
(11) Sep.	88	(12)	11		50		11
(4) Oct	(286)	(8)	134		210		4
(5) Nov	244	(7)	161		203		5
(2) Dec	(581)	(10)	102		342		2

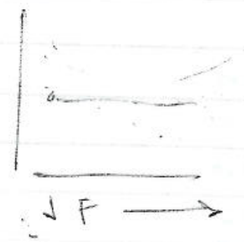
1 June
2 Dec
3 May
4 Oct
5 Nov
6 Jul.
7 Mar
8 Jan
9 Feb
10 Apr
11 Sept
12 Aug.

March had 3rd highest impingement rate in ~~2007~~ 2006 and 5th highest in over 24 months of sampling.

Impingement Data (from 2007C)
Table 4-4

3.25 (83 mm) golden shiner

Species	Mean Length (mm)	Month/yr
B. Crappie	71	Oct 05
	70	Nov 05
Bluegill	52	May 06
	53	June 06
	58	July 06
Largemouth	69	Oct 05
	70	Nov 05
Pumpkinseed	101	Oct 05
	78	May 06
	52	June 06
Spottail shiner	106	Dec 05
	63	June 07
yellow perch	131	Dec 05
	118	Mar 06



(72)

Critical Swimming Velocity from EPRI 2000

species	avg length	avg crit velocity	temp
yellow perch	15.6 cm (6.1")	18.9 cm/s (0.62 f/s)	2-4C (35.6-39.2 F)
	10.5 cm (4.1")	20.0 " (0.66 f/s)	10 C (50F)
	10.5 cm (4.1")	34 " (1.12 f/s)	20 C (68 F)

yellow perch impingement Table 4-4 (p. 78) Norm 2007c

Jan - Mar

$\frac{9}{28} = \frac{x}{100}$

900 = 28x

x = 32%

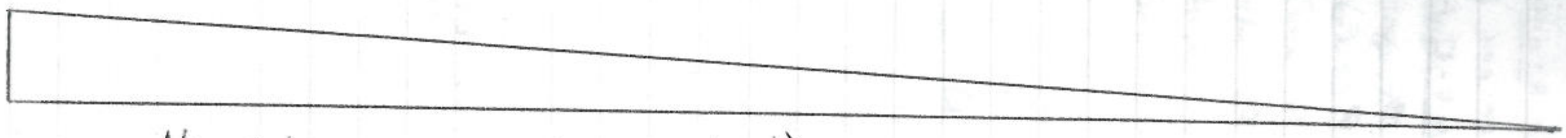
Dec - Mar

$\frac{22}{28} = \frac{x}{100}$

2200 = 28x

x 79%

Slope of proposed fish trough.



1/16 : 1 (optimal for survival)

1/4 : 1

what Merrimack
Station is proposing for
"Slide" section of trough.

(4d) Fish impingement for Dec → March Table 4-5 Unit 1 vs. 2.

YEAR 1	Unit 1 Raw	Unit 1 Adj. I	Unit 2 Raw	Unit 2 Adjusted I		# days on one pump for Unit 2
Dec 05	42	371	24	209		0
Jan 06	7	112	5	102		0
Feb 06	0	23	2	141		0
Mar 06	20	200	2	55		0
TOTAL	69	706	33	507		

YEAR 2	Unit 1 Raw	Unit 1 Adj. I	Unit 2 Raw	Unit 2 Adjusted I		# days on one pump for Unit 2
Dec 06	2	33	5	68		0
Jan 07	2	35	2	32	1/17 - 1/29	13
Feb 07	1	16	2	32		?
Mar 07	2	28	2	37		?
TOTAL	7	112	11	169		

	Unit 1	Unit 2
YEAR 1	706	507
2	112	169
TOTAL	818/2 = 409	676/2 = 338

CRITICAL ~~SWIMMING~~ VELOCITIES FOR SOME SPECIES FOUND IN HOOKSETT POOL (FROM EPRI 2000)

SPECIES	AVG CRIT VEL		TEMP	~~SIZE~~ LENGTH	
ALEWIFE	35.7 cm/s	(1.17 f/s)	29 (84F)	13.7 cm	YOY ?
ALEWIFE	39.5	(1.3 f/s)	24-25 (75-77F)	9.8 cm	
ALEWIFE	63.6	(2.1 f/s)	20 (68F)	13.6 cm	
BLUEBACK	22.7	(0.7 f/s)	10 (50F)	8.5 cm	
BLUEBACK	34.7	(1.1 f/s)	15 (59F)	8.9 cm	
BROWN BULLHEAD	32.0		17	5.2 cm	
WHITE SUCKER	48.0		12-19	17.0 cm	} NOT YOY
	73.0		12-19	37.0 cm	

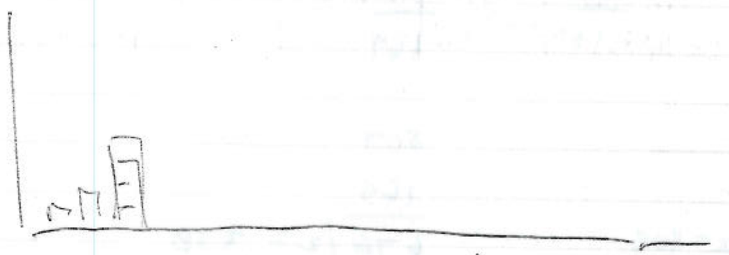
(45)

Larva
Entrainment from Table 5-1 2007C

Month	YR	Unit 1	Unit 2	Both Units
April	07	0	59,724	59,724
May	07	556,360	65,726	622,086
June	06	351,603	1,234,410	1,586,013
June	07	1,002,996	764,462	1,767,458
July	06	306,781	123,754	430,485
August	06	27,304	0	27,304
Sept	06	NS	0*	0

June mean: Unit 1 677,300. Unit 2 999,436 Both 1676735

* only one sample taken.



PS 64. Monthly Flows Unit 2

$ft^3 \rightleftharpoons m^3$
0.0283 35.3144

May 07 Total Unit Flow 8.40 (Mm^3)

May 06 " " " 7.85 (Mm^3)

(R6)

Fig 13.1 – Larva data from Norm. 2007c Table 3-7, p. 52

month/year	2006 Ap	2007 Ap	2006 May	2007 May	2006 Jun	2007 Jun	2006 Aug	07 Au
Unit 1	NS	0	0		351,603			
Unit 2	NS							
Both units								

Mo/year	Ap 06*	Ap 07	May 06**	May 07***	June 06	June 07	July 06	July 07*	Aug 06	Aug 07*
Unit 1	NS	0	0	556,360	351,603	1,002,996	306,731	NS	27,304	NS
Unit 2	NS	59,724	742,481	65,726	1,234,410	764,462	123,754	NS	0	NS
Both units	NS	59,724	742,481	622,086	1,586,013	1,767,458	430,485	NS	27,304	NS

* No Samples
** 1 Sample Unit 1
*** 2 Samples Unit 2

= 13.5.4d

total est. # fish impinged in Unit 2 in June 2007
B-25 (Norm 2007c)

3941 Adjusted × 20.2% survival = 796.08

  3941
− 796
  3145

R I Bos

6/23/09 New report from Normandeau received.
"Biocharacteristics of yellow perch and white sucker populations in Hooksett Pool of the Merrimack River." "June 2009"

		(3 samples?)	(6 samples?)
Sampling effort	weekly	14 April - 2 May 2008	1 Sept - 10 Oct 2008
		SPRING	FALL

Garvins
Hooksett Pool Am
" " TI
Amoskeag

CAVE?

* Purpose of report (p. 2). Evaluate 4 of 9 response metrics identified by EPA in 1977 guidance for assessment of appreciable harm
  (1) reproduction (spawning habits & fecundity)
  (2) condition factors
  (3) disease and parasitism
  (4) age and growth

* sampling avoided summer period of low flow and higher T's

ELECTRO - YELLOW PERCH

fish/samples

	GARVINS	CPUE	THERMAL	CPUE	AMBIENT	CPUE	AMOSKEAG	CPUE
4/18	96 ~~116~~/10 =	9.6 ~~11.6~~	4/16 5/11	2.45	4/14-18 0/12 =	0	4/14-18 1/7 =	0.14
4/28-5/2	2/10 =	0.2	4/21-25 9/14 =	.64	4/21-4/25 0/29 =	0	4/21-25 5/27 =	0.19
9/1-9/5	54 ~~64~~/9 =	7.1	9/1-9/5 22/7 =	3.14	4/28-5/2 2/13 =	0.15	4/28-5/2 3/11 =	0.27
			~~10/6-10/10~~		9/1-5 7/16 =	0.44	9/8-9/12 = 0/11 =	0
	~~180~~ 152 ~~182~~/29 =	~~6.28~~ 5.58	9/29-10/3 3/5 =	0.6	9/29-10/3 5/3 =	1.67		
			10/6-10/10 7/7 =	1.0	10/6-10/10 - 3/5 =	0.6	9/56 =	0.16

152/29 = 5.24

46/44 = 1.05   17/78 = 0.22

63/122 = 0.52
Hooksett Pool

EFFORT = 1000 FT TRANSECT

TRAPNET - yellow perch   EFFORT 24-HOUR SET

GARVINS

DATES	FISH CAUGHT/SAMPLES	CPUE
14-18 APRIL	—	
21-25 APRIL	62/10	6.20
28 AP-2 MAY	—	
1-5 SEPT	2/6	0.33
8-12 SEPT	—	
29 SEPT-3 OCT	—	
6 OCT-10 OCT	—	
TOTAL	64/16 =	4.0

THERMAL HP

DATE	FISH/SAMPLE	CPUE
	—	
→	0/10 =	0
	—	
→	0/8 =	0
	—	
	—	
	—	
TOTAL	0/18 =	0

AMBIENT HP

DATES	FISH/SAMPLE	CPUE
	—	
	0/8 =	0
	—	
	0/8 =	0
	—	
	—	
	—	
TOTAL:	0/16 =	0

AMOSKEAG

DATES	FISH/SAMPLES	CPUE
14-18 APR	—	
21-25 APR	0/12 =	0
28 APR-2 MAY	—	
1-5 SEPT	—	
8-12 SEPT	—	
29 SEPT-3 OCT	—	
6-10 OCT	✓	
TOTAL	0/12 =	0

Calculating UILT for adult yellow perch.

	UILT	SEASON	SOURCE
1	32.3	S	FERGUSON 1958 - DISCUSSED IN KRIEGER et al
2	30.9	S	Brett 44 - in Hokanson 77
3	29.2	S	Black 53 " " "
4	32.3	S	Hart 52 " " 77

124.7 / 4 = 31.2 = 88.1

5	~~28.7~~ 30.9	Cherry et al. 77 in W. & Christie
6	~~30.9~~ 28.7	Brown 74 - in Wismar & Christie

TOTAL (1-6) 184.3/6 = 30.7°C (87.~~8~~3°F) UILT (30.7°C) 87.3°F

19-24°C (RANGE) 21.5°C - mid pt OPT (21.5°C) 70.7°F from Krieger et al 8

OPT T (C°) + 1/3 (UILT - OPT) =

21.5 + 1/3 (30.7 - 21.5) =
21.5 + 1/3 (9.2)
21.5 + 3.1 = 24.6°C (76.3°F)

21.5 + 1/3 (31.2 - 21.5) =
21.5 + 1/3 (9.7)
21.5 + 3.23 = 24.7

Calculating flow velocity between Stations S-0 and S-4.

Avg flow at Garvins Falls in June, from FERC application document Vol I, Dec. 2003 Fig B-7, pg. B-12

Garvins 50% greater or equal to ~2,600 cfs
therefore, also 50% less than or equal to.

River width and depth info from report "Merrimack R. Monitoring Program, 1976. (NAI) dated July 1977. pp 20-21

at ~~S-0~~	avg. (est.) width	avg. (est.) depth	depths every 100'	mean
S-0	500'	7.8 ~~8-6 12 (avg 9)~~	6, 8, 10, 12, 3 = 39	7.8
S-1	550'	7.8	5, 9, 9, 10, 6 = 39	7.8
S-2	600'	8.5	6, 7, 8, 8.5, 13 = 45.5	8.5
S-3	475'	11.3	7, 9, 16, 13, = 45	11.3
S-4	450'	10.6	8.5, 11.5, 13.5, 9 = 42.5	10.6
	2575/5 = 515'	46/5 = 9.2		46

MEAN X-SECTIONAL AREA S-0 - S-4 = 515' · 9.2 = ~~478~~ 4738 sf

MEAN = 46/5 = 9.2

STREAM VELOCITY × STREAM X-SECTIONAL AREA = VOLUMETRIC VELOCITY

X (ft/sec) × 515' · 9.2 = 4738 ft² = 2,600 cfs

X = 0.548 ft/sec = 0.55 ft/sec

Approx. distance S-0 → S-4 = 2,000 feet

Distance = Time × Speed
2,000 ft = T × 0.55 ft/sec
3636.4 sec = T
☆ 60.6 min = T   Approx. time it takes a drifting larvae to travel from S-0 to S-4.

Flow velocity based on data provided in NAIWC. (NORM 1976
from Table 2, p. 15. for 8/15/75. — No data for June, July. provided.

Transects D = Downstream Discharge.

	SURFACE AVG
D - I	0.16
D - N	0.10
D - O	0.19
D - S	0.15
	.60 / 4 = 0.15 Kts

in KNOTS (K
1 Kt = 51.47 c

.15 Kt × 54.47 cm/sec = 8.1705 cm/SEC

8.1705 cm/SEC = 3.217 in/SEC = 0.2681 ft/SEC = 0.27 ft/SE

For Table 4 - -

(52)

Calculating the highest weekly averaged mean temp at N-10, based on 21-yr data set (1984-2004)

(8) August 1-7

	Mean - (N-10)
1	76.1
2	76.3
3	76.3
4	77.1
5	77.1
6	76.9
7	76.6
	536.4/7 = 76.62 °F (24.8 °C)

Days that exceed 74.7 (23.7)

June @N-10	- 0
July	- 25
Aug	- 19
Sept	- 0
	44

(8) Aug 2-8 (slightly warmer) (0.2)

	(MEAN) N-10	MEAN (S-4)
2	76.3	83.0
3	76.3	84.3
4	77.1	84.8
5	77.1	85.2
6	76.9	84.2
7	76.6	82.7
8	76.3	82.7
	536.6/7 = 76.66 °F (24.8 °C)	586.9/7 = 83.84 °F 28.8 °C

(1) April 14-20

	mean (N-10)	mean (S-4)
14	43.7	48
15	44.4	48.3
16	44.9	48.7
17	45.2	48.9
18	45.9	49.4
19	46.1	49.6
20	46.4	50.0
	316.6/7 = 45.23 °F 7.4 °C	342.9/7 = 49.0 °F 9.4 °C

April 21 – May 8

(2) May 2-8

MEAN @ N-10

5/2	51.7
5/3	52.1
5/4	52.3
5/5	52.7
5/6	52.6
5/7	53.2
5/8	53.5

368.1/7 = 52.59°F
11.4°C

MEAN @ S-4

	~~53.9~~
5/2	54.4
5/3	54.8
5/4	55.1
5/5	55.3
5/6	55.4
5/7	55.8
5/8	56.0

386.8/7 = 55.26°F
12.9

(3) May 9 – 27

MEAN @ N-10

5/21	60.1
5/22	60.4
5/23	60.6
5/24	60.8
5/25	60.6
5/26	60.7
5/27	60.7

423.9/7 = 60.56°F
15.9°C

MEAN @ S-4

5/21	62.2
5/22	62.5
5/23	62.7
5/24	63.1
5/25	63.1
5/26	62.9
5/27	63.1

439.6/7 = 62.8°F
17.1°C

(4) May 28 – June 15

N-10

6/9	65.9
6/10	66.5
6/11	66.7
6/12	66.8
6/13	66.9
6/14	67.3
6/15	67.8

467.9/7 = 66.8°F
19.3°C

S-4

6/9	68.4
6/10	69.1
6/11	70.1
6/12	70.4
6/13	70.5
6/14	71.1
6/15	71.6

491.2/7 = 70.2°F
21.2°C

TIME PERIOD MAY 1 – JUNE 15 PERCH ACUTE (LARVA)

(5) N-10 - MAX S-0 MAX

JUNE 14 - 75.6°F 24.2°C
JUNE 12 - 94.3°F 34.6°C

(6) AMERICAN SHAD LARVA - ACUTE JUNE 16 – JULY 31

N-10 MAX		S-0 MAX	
July 31	85.1°F 29.5°C	JULY 9	102.6°F 39.2°C

(7) SHAD LARVA WEEKLY AVG JUNE 16 – JULY 31

	(N-10) MEAN		(S-4) MEAN
July 21	75.8	July 23	82.9
22	76.0	24	82.6
23	76.6	25	82.9
24	76.6	26	83.3
25	76.5	27	82.9
26	76.5	28	82.5
27	76.0	29	83.0
	534/7 = 76.3°F 24.6°C		580.1/7 = 82.9 28.3

(#8 prec. page)

(9) yellow perch juvenile (acute) Aug 1 – Nov 4

	N-10 (MEAN)	S-4 (MEAN)
AUG 5	77.1°F 25.1°C	85.2°F 29.6°C

(10) & (11) yellow perch juvenile and adult Oct 1 – Nov 4

N-10 (MEAN)		S-4 (MEAN)	
OCT 1	60.2°F 15.7°C	OCT 1	67.4°F 19.7°C

(10) & (11) yellow perch adult & juvenile Oct 1 – Nov 14

	N-10 (MEAN)		S-4 (MEAN)
OCT 1	60.2	OCT 1	67.4
2	59.5	2	67.1
3	59.1	3	66.5
4	58.4	4	65.7
5	57.6	5	65.4
6	56.7	6	65.0
7	56.0	7	63.4
	407.5/7 = 58.2°F		460.5/7 = 65.8°F
	14.6°C		18.8°C

(56)

velocity 0.3 m/s (1.0 ft/s)
0.15 m/s (0.5 ft/s)
0.08 m/s (0.25 ft/s) ~

Review of Supplemental Alternative Technology Evaluation
Oct 2009

* Exec Summary (p. v) - (+ p. 1) Report suggest we requested info on seasonal deployment of WWS, etc.. we did not.

* "EPA identifies WWS w/ 1.75 mm mesh as BTA" - from Phase II regs.

* p. vi - PSNH evaluates slot sizes from 9 mm → 1.5 m

* p. vi - They now propose that "Seasonal" use of WWS w/ upgraded fish returns is BTA

* p. 3 → WWS would only be used from April → ~~Nov~~ July due to frazil ice

* p. 3 → due to low sweeping velocity (< 2 fps), WWS would only be used from April - July.

p. 7. need 13-24 (Unit 1) and 31-52 (Unit 2) screens depending on slot size. ~~[illegible]~~ only 1.5 mm - 9.0 mm was evaluated. Assume? high range corresponds w/ smallest slot size (1.5) therefore, 24 + 52 = 76 ~~[illegible]~~ WWS would be needed for 1.5
How much for 1.0, 0.5 ?

p. 9. site layout - distance protruding into river
Unit 1 60 - 90 ft.
2 65 - 95 ft.

* p10 get 1984-2004 - flow velocities referenced if we don't have already.

* look up white sucker eggs -

White suckers - dusk & dawn spawners. Plankton studies may have missed period when eggs are drifting downstream.

* ichthyoplankton studies 2005-2007 not adequate to fully characterize (larval fish community)

American shad egg 2.5 - 3.8 mm — Stier & Crance
2.5 - 3.5 mm diameter. Klauda et al
larva 6.0 - 10.0 mm after hatching " "
9.0 - 12.0 mm when yolk-sac is absorbed 4-7 days. " "
photo positive " "

larva 5.7 - 10.0 mm after hatching — Stier & Crance
12.2 mm. 4-7 days. (following absorption of yolk sac) "

Studies cited in WWS studies/literature

Weisberg et al. (1987)

(58)

* EPRI May 2003 - At higher slot velocities some larger fish, as well as eggs, may be extruded through screen slots.

Sizes of eggs and larvae from literature.

Species	life stage	length or diam. (mm)	Reference
American shad	egg	2.5 – 3.8 mm	Stier and Crance
	egg	2.5 – 3.5 mm	Klauda et. al
	larva (post hatch)	6.0 – 10.0 mm	" "
	" " "	5.7 – 10.0	Stier & Crance
	larva after yolk sac absorbed (4-7 days)	12.2	" "
		9.0 – 12.0 mm	Klauda et. al
Yellow perch	egg (fertilized)	2.26 (mean)	Mansueti 1964
	prolarvae (at hatching)	5.5 – 6.0 mm	"
	post larvae	6.0 – 13.0 mm	"
	young (juvenile) though not fully transformed	14.0 mm.	"
	larvae	4.9 – 7.8 mm u.5	EPRI 2007
White Sucker	egg	2.8 – 3.5 mm	EPRI 2007
bluegill	larvae	12.1 – 25.0 mm	EPRI 2007

(60)

Reduction in Flow from CCC

From p. 53 Resp 308 Nov. 2007

Total Reduction in flow (both units) 95.0%
(Summer) Total Intake Flow (CCC) 9,930 gpm
Total Intake Flow (1 THROUGH) 200,150 gpm

TOTAL (BOTH UNITS) $\frac{9,930}{200,150} = \frac{x}{100}$ (4.96%)

~~UNIT 1 (CCC) UNIT 2 (1 THRU) =~~ $\frac{9890}{200,150} = \frac{x}{100} = 4.94$

989000 = 200150 x

x = 4.94%

UNIT 1 (CCC - SUMMER or WINTER) p. 53 NOV 2007

make up water	1,230 gpm
screen wash	560
sluice water	1,810
	3,600 gpm

UNIT 2 (CCC - SUMMER + WINTER)

make up	2,920 gpm
screen wash	590
sluice water	2,780
	6,290 gpm
	+ 3,600
	9,890 gpm (both units CCC)

UNIT 1 (ONCE-THRU-SUMMER) UNIT 2 (1 THRU-SUMMER)

	UNIT 1		UNIT 2
CIRC WATER	59,000 gpm		140,000 gpm
SCREEN WASH	560 gpm		590 gpm
	59,560	+	140,590 = 200,150

UNIT 1 (1-THRU-WINTER) UNIT 2 (1 THRU-WINTER)

	UNIT 1		UNIT 2
CIRC WATER	59,000		140,000
SCREEN WASH	+560		+590
DE-ICING	-5,560		- 9030
	[illegible]	+	[illegible] = 185,560

FLOW

	CCC (Summer or Winter)	Once Thru (Summer) ~~CCC (Winter)~~	Once-Thru (Winter)	% Reduction (Winter) ~~(Summer)~~
UNIT 1	3,600 gpm	59,560	54,000 − 3,600 =	50,400
UNIT 2	6,290 gpm	140,590	131,560 − 6,290 =	125,270
COMBINED 1 & 2	9890	200,150	185,560	

Reduction	~~CCC~~ Once-Thru (Summer)		CCC			% Reduction
UNIT 1	59,560	−	3,600	=	55,960	94
2	140,590	−	6,290	=	134,300	96
COMBINED	200,150	−	9,890	=	190,260	95

UNIT 1

$$\frac{3,600}{59,560} = \frac{x}{100}$$

$$360000 = 59,560x$$

$$x = 6.04\%$$

$$\% = 94\%$$

UNIT 2

$$\frac{6,290}{140,590} = \frac{x}{100}$$

$$629000 = 140,590x$$

$$x = 4.47 = 4.5$$

$$x = ~~4~~\ 95.5$$

$$x = 96\%$$

UNIT 1 (CCC) / UNIT 2 (1 THRU) = 3,600 gpm + 140,590 = 144,190 gpm

UNIT 1 (1 THRU) / UNIT 2 (CCC) = 59,560 gpm + 6,290 = 65,850 gpm

UNIT 1 (CCC) / UNIT 2 (CCC) = 3,600 + 6,290 = 9,930 gpm

UNIT 1 (1 THRU) / UNIT 2 (1 THRU) = 59,560 + 140,590 = 200,150 gpm

(62)

Entrainment Estimates   Nov 2007   Table 2-1

	UNIT 1 (1 THRU) 2006	2007	AUG		UNIT 1 (CCC)		EST ENT.
APR	NS	NS		APR	–		
MAY	0 ?	556,360	556,360	MAY	556,360 x 6%	=	33,382
JUNE	351,603	1,002,996	677,300	JUNE	667,300 x 6%	=	40,038
JULY	306,731	NS	306,731	JULY	306,731 x 6%	=	18403[illegible]
AUG	27,304	NS	27,304	AUG	27,304 x 6%	=	1638
SEP	NS	NS					
TOTAL			1,567,695 x 6% = 94,062				93,462

UNIT 1 (CCC)	94,062
UNIT 1 (1 THRU)	1,567,695
UNIT 2 (CCC)	71,416
UNIT 2 (1 THRU)	1,587,018

UNIT 2 (1 THRU) AUG   UNIT 2 (CCC)

	2006	2007		
APR	NS	59,724	59,724	x 4.5%
MAY	742,481	65,726	404,104	
JUNE	1,234,410	764,462	999,436	
JULY	123,754	NS	123,754	
AUG	0	NS		
TOTAL			1,587,018 x 4.5% = 71,416	

UNIT 1 (1 THRU) + UNIT 2 (1 THRU) =
1,567,695 + 1,587,018 = 3,154,713

UNIT 1 (1 THRU) + UNIT 2 (CCC) =
1,567,695 + 71,416 = 1,639,111

UNIT 1 (CCC) + UNIT 2 (1 THRU) =
94,062 + 1,587,018 = 1,681,080

UNIT 1 (CCC) + UNIT 2 (CCC) =
94,062 + 71,416 = 165,478

Nov 200[illegible]

Combined Flow

	Unit 1	Unit 2	Combined	Sou[illegible]
• Existing (Both Units Once-Through)	59,000 + 560 = 59,560	140,000 + 590 = 140,590	200,150	p.s
• Unit 1 (CCC), Unit 2 (1 Thru)	3,600 +	140,590 =	144,190	s
• Unit 1 (1 Thru), Unit 2 (CCC)	59,500 +	6,290 =	65,790	s
• Unit 1 (CCC), Unit 2 (CCC)	3,600 +	6,290 =	9890	

Impingement (from Table 2-2 p.13) 2007

% red[illegible]

	Unit 1	Unit 2	Combined
• Unit 1 (CCC), Unit 2 (1 Thru)	0	3574	3574
• " " (1 Thru) " 2 (CCC)	1329	0	1329
• Unit 1 (CCC), Unit 2 (CCC)	0	0	0
• Both Units (CCC) Apr-July			

J	~~26~~ 170
F	127
M	19
A	26
S	~~26~~ 57
O	343
N	243
D	427
	1412

* Entrainment May Unit 1 larvae collected? No -
Use 2007 data only 683,907 for averaging purposes.
vs. 341,954. Unit 1 Average year = 2,019,756 vs. 1,677,802
Unit 2 " " = 1,787,008

3,806,764

(64)

current speed at intake (3 locations) for 8/15/76
Taken from Normandeau 1976 Anadromous fisheries investigations
Annual Report for 1976. (p. 15)

	Surface Avg.		Bottom Average.		
Intake - N	0.21 Kt	0.35 fps	0.17	0.28	
- O	0.17	0.28	0.15	0.25	ft/sec
- S	0.14		0.12		

1 Kt = 51.47 cm/sec. (from report)

60 m/h x 60 s/m = 3600

0.21 Kt x 6,000 ft/hr = 1260 ft/hr x 3600 x 10⁻¹ = 0.35 ft/s

0.17 x 6000 = 1020 ft/hr x 1/3600 = 0.28

0.15 x 6,000 = 900 ft/hr x 1/3600 = 0.25

0.12 x 6,000 = 720 ft/hr x 1/3600 = 0.20 ft/sec

0.6 K x 6,000 = 3600/hr x 1/3600 = 1.00

				Flow CFS		
July 1 ~~June~~ 1975 —	NS	depth	6'	3,000	Normandeau 1975	p 21
JUNE 26 75 —	NS		8'	3,500		15

10/30/75 - flow (avg daily) 3515 current speed 0.61 kt @ intake

FLOW (From p ~~17~~ 16! (308 Response))

Design flow.

See also p1 - book 4

UNIT 1	85 MGD	(131.5 cfs)
UNIT 2	201.6 MGD	(312.0 cfs)
	286 MGD	443.5 cfs

CONVERSIONS 1 cfs = 0.645 mgd , 1 mgd = 1.55 cfs

monthly mean flow in cfs - USGS Goffs Falls data ~~adjstg~~ adjusted for Garvins Falls (x0.785). Adjustment factor provided by PSNH (2003)

Flow data 1/93 → 9/30/2007

Goffs MEAN	Goffs MIN	Garvins		MEAN*	MIN (MEAN)**	Plant withdrawal	withdrawal % of river MEAN	MIN
14,400	4612	April	x ~~0~~.785	11,304	3620	443.5		
8,920	4130	May	x .785	7002	3242			
5440	1498	June	x .785	4270	1176			
2990	982	July	x .785	2347	771			
1940	781	Aug	x .785	1523	613			
2040	758	Sept	x .785	1601	595			

* of years evaluated

** minimum monthly mean from ~~1993~~ 1993 - 2007

	APRIL	MAY	JUNE	JULY	AUG	SEPT
MEAN	$\frac{443.5}{11,304} = \frac{x}{100}$	$\frac{443.5}{7,002} = \frac{x}{100}$	$\frac{443.5}{4270} = \frac{x}{100}$	$\frac{443.5}{2347} = \frac{x}{100}$	$\frac{443.5}{1523} = \frac{x}{100}$	~~1601~~ $\frac{443.5}{1601} = \frac{x}{100}$
	= 3.9%	6.3%	10.4%	18.9%	29.1%	27.7%
MIN(AVG)	$\frac{443.5}{4612} = \frac{x}{100}$	$\frac{443.5}{3242} = \frac{x}{100}$	$\frac{443.5}{1176} = \frac{x}{100}$	$\frac{443.5}{771} = \frac{x}{100}$	$\frac{443.5}{613} = \frac{x}{100}$	$\frac{443.5}{595} = \frac{x}{100}$
	= 9.6%	13.7%	37.8%	57.5%	72.3%	74.5%

(66)

Impingement from Fig 11-2 in Dat Doc.

Month	05	06	07	Avg	
1 Sept	88	11		99/2 = 50	
2 Oct	286	134		420/2 = 210	
3 Nov	244	161		405/2 = 203	
4 Dec	581	102		683/2 = 342	
5 Jan		214	67	281/2 = 141	> 408 AVG
6 Feb		163	48	211/2 = 106	
7 Mar		256	66	322/2 = 161	
				1213	

1 APR		115	57	172/2 = 86	
2 MAY		307	174	481/2 = 241	
3 JUNE		(4300)	220	4520/2 = (220)	2260
4 JULY	143	215		358/2 = 179	
5 AUG	29	17		46/2 = 23	
				749	(2789)

Impingement reduction & mortality reduction From 308 p.95 Table

	IR	IMR
Existing CWIS	0	0
CCC unit 1 only (9 mos)		84.6% - 47.5 (Fish Ret Sys) = 37.1%
CCC unit 2 only (9 mos)		74.9% - 47.5 = 27.4%
~~WWS~~ Ristroph (9 mos)		55.5 - 47.5 = 8%
MultiDisc (9 mos)		64.2 - 47.5 = 16.7%
WIP (9 mos)		65.9 - 47.5 = 18.4%
CCC both units (12 months)		95 - 47.5 = 47.5%

Est. Ann. Impingement From Table 2-2 308 Resp.		Reduction from Baseline	% Red mortality / # fish survive
Existing OTC-Both	4903	0	0
Option 1) Unit 1 CCC, 2 OTC w/FR	1329 x .05 = 66 3574 + 66 = 3640	3640/4903 = x/100 = 74 26%	3640 x 0.47 = 1,711 include fish returns only
2) Unit 1 OTC, 2 CCC w/FR	1329 3574 x 0.05 = 179 1329 + 179 = 1508	1508/4903 = x/100 = 31% 69%	1508 x 0.47 = 709
3) Units 1,2 CCC w/FR	1329 x 0.05 = 66 3574 x 0.05 = 179 245	95%	245 x 0.47 = 115
4) Both units CCC seasonal (Ap-Aug)	3345 x 0.05 = 167 OTC (Both) Sep-Mar = 1561 1,728	1728/4903 = x/100 35.24% 65%	1728 x 0.47 = 812 1728 x 0.55 = 950 Ristroph = 55.4% FishRet − 47.0% 8% WIP Screens 1728 x 0.66 = 1140

Adult Equivalent Ratio $\frac{16,880 \text{ (AE)}}{3,464,810 \text{ (larvae + eggs)}} = \frac{\_\_\_\_}{(\text{\# entrained})}$

Entrainment

$\frac{16,880}{3,464,810} = \frac{x}{}$

1,065,894 (1)
2,550,532 (2)
3,616,426 (3)

OPTION	million $
(1)	$2.7 ÷ 5193 = $520 / fish
(2)	8.1 ÷ 12,426 = $652
(3)	10.1 ÷ 17,619 = $573
(4,5)	7.9 ÷ 17,619 = $448

Impingement

$\frac{653 \text{ (AE)}}{4903 \text{ (Juveniles)}} = \frac{\_\_\_\_}{(\text{\# fish saved})}$

2,974 (1)
4104 (2)
4,773 (3)
3,987 (4)
4,315 (5)

(1)	$2.7 ÷ 396 = $6818 / fish (AE)
(2)	8.1 ÷ 547 = $14,808
(3)	10.1 ÷ 636 = $15,880
(4)	7.9 ÷ 531 = $14,876
(5)	7.9 ÷ 575 = $13,739

AR-206

VOl 4 of 4

Flow withdrawn as a percentage of available flow.

Sept 13, 2002 — River flow (USGS) ~~427~~ 538 cfs × 0.785 = 422.33 (correction)

plant max monthly for Sept 2002 — 257.5 mgd × 1.55 cfs/mgd = 399.13

399.13 (plant) / 422.33 (river) = x / 100

39913 = 422.33 x

x = 94.51% — not likely to be w/drawing max monthly on a day when river flow is @ lowest. Use "avg. monthly" if daily flow # not available.

Aug 2002 flow (monthly avg) USGS 780.6 cfs × 0.785 = 612.77 cfs Garvins

Plant (Aug monthly max) 258.7 mgd × 1.55 cfs/mgd = 400.99

400.99 cfs (plant) / 612.77 cfs (river) = x / 100

on day

40099 = 612.77 x — x = 65%

Aug 14, 2001

River flow 582 cfs × 0.785 = 456.87 cfs Garvins

Plant flow (monthly avg) 243.3 mgd × 1.55 cfs/mgd = 377.12 cfs

~~456.87 cfs~~ 377.12 cfs (plant) / 456.87 cfs (river) = x / 100

37712 = 456.87 x

on day

x = 82.54%

July 7, 1995

River flow 675 cfs × 0.785 = 529.88 cfs (Garvins)

Plant flow (mon. avg) 256.9 mgd × 1.55 cfs/mgd = 398.20 cfs

398.2 cfs (plant) / 529.88 cfs (river) = x / 100

39820 cfs = 529.88 x

x = 75.15%

CRITICAL VELOCITIES FOR SPECIES IN
HOOKSETT POOL (EPRI 2000) - Table 11.7 Dat Doc

SPECIES	TYPE	MEAN LENGTH (INCHES)	MEAN CRIT. VELOCITY (FT/S)	EXPERIMENTAL T RANGE (°F)
ALEWIFE	A	13.7 cm ( )	35.7 (1.17 f/s)	29 (~~84~~ 84F
"	"	13.6 cm ( )	63.6 (2.1 f/s)	20 (68 F)
"	"	9.8 cm ( )	39.5 (1.3 f/s)	24-25 (75-77
ATLANTIC SALMON	A	9.6 cm ( )	44.8 ( )	12.5 (
+ 5 more obs (# 347-351) SEE BELOW		11.1 cm ( )	44.2 ( )	12.5 (
		47.4 cm ( )	135 ( )	8 (
* ATLANTIC SALMON RANGE		9.6 - 47.4 cm ( )	44.2 - 135 ( )	8-12.5(
* ALEWIFE RANGE		9.8 - 13.7 cm (3.9-5.4)	35.7-63.6 (1.2-2.1 f/s)	20-25 (68-77
BLUEBACK		8.5 cm ( )	22.7 (0.7 f/s)	10 (50F)
" "		8.9 cm ( )	34.7 (1.1 f/s)	15 (59F)
* BLUEBACK RANGE		8.5-8.9 (3.4-3.5)	22.7-34.7 (0.7-1.1)	10-15 (50-5
* BROWN BULLHEAD		5.2 cm (2.0)	32 (1.1 f/s)	17 (62.6
* LARGE MOUTH BASS RANGE (SEE EPRI 2000 - 16 obs) Obs # 116 - 131		5.8-12.6 cm (2.3-5.0)	20 - 49.7 (0.7-1.6)	5-30 (41-86
* PUMPKINSEED SUNFISH		12.7 (5.0)	37.2 (1.2 ft/s)	20 (68)
* SMALLMOUTH BASS RANGE obs # 109-115 (7)		2.0 - ~~2.3~~ 2.3 (0.8-0.9) ~~2.3 ( )~~	4.79-31.17 (~~0.2-1.2~~) (0.2-1.0)	5-35 (41-95
YELLOW PERCH		15.6 ( )	18.9 (0.62 f/s)	2-4 (36-39F)
"		10.5 ( )	20.0 (0.66 f/s)	10 (50F)
"		10.5 ( )	34 (1.1 f/s)	20 (68F)
* YELLOW PERCH RANGE		10.5-15.6 (4.1-6.1)	18.9-34 (0.6-1.1)	2-20 (36-68 F)
~~WHITE SUCKER~~				
* ATLANTIC SALMON RANGE		9.6-57.5 (3.8-22.6)	44.2-216 (1.5-7.1)	8-18C (46.4-64.4)
WHITE SUCKER		~~ND~~ 17 ( )	48 cm ( )	12-19C (
		37.0 ( )	73 ( )	12-19
* WHITE SUCKER RANGE		17-37 (6.7-14.6)	48-73 (1.6-2.4)	12-19 (53.6-66.2

DECK ELEVATION OF SCREEN HOUSE 207'
" " RIVER BANK (TOP) 193'
14'
" " LOWER WATER LEVEL 187'

1/16 = 224'
6' @ 1/4 = 24
248'

MONTHLY AVG FLOWS (INTAKE) (MGD) AT MS (APRIL-SEPT) 1993-2007 RIVER

	APRIL	MAY	JUNE	JULY	AUG	SEPT
1993	207.8	114.3	250.1	~~248.4~~ 253.9	248.4	211.7
94	165.3	69.6	201.4	257.5	252.4	249.6
95	201.5	85.3	249.3	256.9	239.9	227.4
96	259.2	234.5	257	242.7	240.8	190.9
97	222.8	256	246.2	253.1	258.1	234.6
* MAX 98	[illegible] *	251.9	252.2	254.2	255	257.3
99	215.6	167.3	153.8	246.6	235.4	74
2000	222.2	185.6	254.8	244.2	242.7	243.3
01	203.5	76.8	203.8	237	243.3	247
02	162.4	118.8	246	234.1	253.9	188.1
03	68.2	142.9	248.4	220.1	251	237.4
04	128.2	182.3	255.8	244.2	255.9	251.3
05	252.4	86.6	250.9	256.2	236.7	256
06	175.7	123	245.6	257.1	256.8	173.8
07	175.5	141.2	247	ND	255.7	ND
TOTAL	2660.3	2236.1	3563.3	3457.8	3726	3042.4
÷ ~~AVE~~	14	15	15	14	15	14
~~AV~~ MEAN MGD	190	149.1	237.6	2467.0 / 247.0	248.4	217.3
× 1.55 cfs/mg	"	"	"	"	"	"
MEAN CFS	294.5 cfs	231.1	368.3	382.9	385.0	336.8 cfs

(÷ by # YRS)

ND = NO DATA.

MEAN RIVER FLOW CFS	14,400	8,920	5,440	2,990	1,940	2,040
	× 0.785	× .785	.785	.785	.785	.785
	11304	7,002.2	4270.4	2347.2	1522.9	1601.4

APRIL	MAY	JUNE	JULY	AUG	SEPT
$\frac{294.5}{11304} = \frac{x}{100}$	$\frac{231.1}{7,002.2} = \frac{x}{100}$	$\frac{368.3}{4270.4} = \frac{x}{100}$	$\frac{382.9}{2347.2} = \frac{x}{100}$	$\frac{385.0}{1522.9} = \frac{x}{100}$	$\frac{336.8}{1601.4} = \frac{x}{100}$
x = 2.6%	x = 3.3%	x = 8.6%	x = 16.3%	x = 25.3%	MEAN FLOW
3%	3.0	9.8	16	25	x = 21

(MIN FLOW — NEXT P. 6 →)

WORST CASE (LOW RIVER FLOW - MONTHLY MEAN) & HIGH MEAN PLANT FLOW

MONTH	YEAR				
APRIL	1995	RIVER	4612 × 0.785 = 3620.42	$\frac{312.33}{3620.42} = \frac{x}{100}$	= 8.6
~~APRIL~~	~~YEAR~~	PLANT	201.5 × 1.55 = 312.33		
MAY	1999	RIVER	4326 × 0.785 = 3395.91	$\frac{259.3}{3395.91} = \frac{x}{100}$	= 7.6% [8]
		PLANT	167.3 × 1.55 cfs/mgd = 259.3		
JUNE	1995	RIVER	2021 × 0.785 = 1586.5	$\frac{386.4}{1586.5} = \frac{x}{100}$	= 24.4% [2
		PLANT	249.3 × 1.55 = 386.4		
JULY	1995	RIVER	1216 × 0.785 = 954.56	$\frac{398.2}{954.56} = \frac{x}{100}$	= 41.8% [42
		PLANT	256.9 × 1.55 = 398.2		
AUG	2003	RIVER	780.6 × 0.785 = 612.77	$\frac{393.5}{612.77} = \frac{x}{100}$	= 64.2% [6
		PLANT	253.9 × 1.55 = 393.5		
SEPT	1995	RIVER	758.2 × 0.785 = 595.19	$\frac{355.47}{595.19} = \frac{x}{100}$	= 59.7% [60
		PLANT	227.4 × 1.55 = 355.47		

	APRIL (YR)	MAY	JUNE	JULY	AUG	SEPT.
MEAN FLOW	3	3	9	16	25	21
MIN FLOW	~~8~~ (YR) 9 (99)	~~24~~ (YR) 8 (95)	24 (YR) ~~42~~ (95)	42 (YR) ~~[illegible]~~ (03)	(YR) 64 (03)	(YR) 60 (95)

DAILY RIVER FLOW

~~JUNE 29, 1999 992 cfs × 0.785 = 778.8 cfs~~
~~JUNE 99 Plant (MEAN)~~

RIVER FLOW [JUNE] 1995 (6/29/95) 775 cfs × 0.785 = 608.38

PLANT FLOW (MEAN) " " 249.3 × 1.55 cfs/mgd = 386.42

$\frac{386.42}{608.38} = \frac{x}{100}$

x = 63.57%

T data pulled from graphs in (Fig 7-17) (ASA 2010)
p.51 + 61 (Fig 7-24)

	N-10 W-top	S-0 W-top	S-4 W-TOP
8/5	21.5	22.0	22.0
8/6	22.0	22.0	22.5
8/7	22.0	24.5	22.5
8/8	21.5	24.0	22.5
8/9	22.0	25.0	22.5
8/10	21.5	24.5	22.0
8/11	22.5	25.0	22.5
8/12	23.0	25.5	24.0
8/13	23.0	25.5	23.0
8/14	22.5	25.0	23.0
8/15	23.5	26.0	23.5
Sum	245	269	250
Mean	22.3 (72.1)	24.5 (76.1)	22.7 (72.9)

RANGE 21.5 - 23.5 RANGE 22-26 RANGE 22.0 - 24.0

	(N10) W-TOP	(S-0) W-TOP	(S-4) W-TOP
7/11	20.0	25.0	20.5
7/12	20.5	26.5	21.5
7/13	21.5	27.5	22.0
7/14	21.0	27.0	22.0
7/15	20.5	27.0	22.0
7/16	21.0	27.5	22.0
7/17	21.5	28.0	22.5
7/18	22.5	28.5	23.0
7/19	22.5	29.0	23.0
7/20	22.5	28.0	23.5
7/21	22.5	25.0	23.0
sum	236	300	245
mean	21.5 (70.7)	27.3 (81.1)	22.3 (72.1)

$ft^3 \rightleftarrows m^3$
0.0283 →
← 35.3144

PLANT T DATA 1984-2004

DATE	STATION N-10 MEAN	N-10 MAX	S-0 MEAN	S-0 MAX	S-4 MEAN	S-4 MAX
7/11	75.0	81.7	89.2	100.0	78.8	90.3
12	74.8	81.7	89.6	101.8	79.3	91.4
13	74.8	81.9	90.7	100.0	80.2	93.2
14	74.8	81.9	90.9	100.2	80.5	90.0
15	75.0	82.2	91.7	99.0	80.7	90.3
16	74.9	82.6	91.6	98.4	80.8	90.9
17	75.0	80.4	92.4	99.1	81.1	90.3
18	75.1	81.1	93.2	99.9	81.3	92.5
19	75.5	81.7	93.6	101.1	81.3	93.0
20	75.5	83.3	92.6	98.6	82.0	94.1
21	75.8	84.0	92.0	98.6	82.0	94.1
TOTAL	826.2	902.5	1007.5	1096.7	888	1010.1
AVG	75.1 (23.9)	82.0 (27.8)	91.6 (33.1)	99.7 (37.6)	80.7 (27.1)	91.8 (33.2)

DATE	N-10 MEAN	N-10 MAX	S-0 MEAN	S-0 MAX	S-4 MEAN	S-4 MAX
8/5	77.1	83.3	94.5	103.8	85.2	93.7
6	76.9	83.5	92.3	101.8	84.2	93.7
7	76.6	83.5	91.3	101.7	82.7	93.4
8	76.3	83.1	92.2	102.7	82.7	92.5
9	75.9	83.8	92.5	102.2	82.3	91.9
10	76.1	84.0	92.5	102.2	82.9	94.1
11	75.9	83.5	92.9	102.6	83.2	93.6
12	75.6	83.8	90.9	98.6	81.6	93.4
13	75.5	84.0	91.7	100.8	81.1	92.5
14	75.6	84.0	90.4	102.6	81.8	92.5
15	75.1	83.3	89.9	103.3	82.0	95.0
TOTAL	836.6	919.8	1011.1	1122.3	909.7	1026.3
AVG.	76.1 (24.5)	83.6 (28.7)	91.9 (33.3)	102 (38.9)	82.7 (28.2)	93.3 (34.1)

	N-10 (w top)	S-0 (w top)	S-4 (w-top)	ΔT (10→0)	ΔT (10-4)
July (ASA)	21.5 (70.7)	27.3 (81.1)	22.3 (72.1)	5.8 (10.4)	0.8 (1.4)
July (20YR)	23.9 (75.1)	33.1 (91.6)	27.1 (80.7)	9.2 (16.6)	3.2 (5.8)
Aug (ASA)	22.3 (72.1)	24.5 (76.1)	22.7 (72.9)	2.2 (4.0)	0.4 (0.7)
Aug (20YR)	24.5 (76.1)	33.3 (91.9)	28.2 (82.7)	8.8 (15.8)	3.7 (6.7)

NHFGD survey data for Merrimack R. above Garvins Falls Dam
data collected 8/7/2006 - electrofishing
- purpose of survey to target black bass, but collected data on non-target species as well.

- Species # caught

(YP)	yellow perch	𝍸 IIII	(9)
(BG)	bluegill	𝍸 𝍸	(10)
(CSF)	white sucker	𝍸	(5)
(ECP)	chain pickerel	𝍸 II	(7)
(BC)	black crappie	𝍸 I	(6)
(LMB)	largemouth bass	𝍸 𝍸	(10)
(GS)	golden shiner	I	1
(BBH)	brown bullhead.	I	1
(CS)	common(redbreast) sunfish	II	(2)

NHFGD Survey data for Merrimack R. above Garvins
collected 8/6/2007 electrofish. Grant F-50-R-24

	SPECIES	# fish (all lengths)	EA (# fish/hr)	R.A.	S.D.
1	yellow perch	—	214.2	33.0	120.8
2	bluegill	—	111.6	17.2	110.7
3	pumpkinseed	—	102.6	15.8	94.4
4	LM bass	81	94.6	~~[illegible]~~ 14.6	74.1
5	chain Pickerel	—	34.2	5.3	29.6
6	Black Crappie	—	32.4	5.0	41.3
7	Red breast Sun	—	25.2	3.9	25.2
8	Golden shiner	—	12.6	1.9	30.2
9	Sm bass	11	12.4	1.9	20.4
10	C. White Sucker	—	5.4	0.8	10.7
11	Brown Bullhead	—	3.6	0.6	6.7
			648.8	100	

Do entire months so more comparable

USGS FLOW DATA FOR GOFFS FALLS (0.785 correction for Garvins Falls)

July & Aug 2009

FLOW	JULY	FLOW (cfs)	AUG	FLOW
(1)	11	8,110	5	12,000
(2)	12	7,220	6	9,220
(3)	13	6,830	7	7,300
(4)	14	6,420	8	6,010
(5)	15	5460	9	5,370
(6)	16	4810	10	5,050
(7)	17	4450	11	5,060
(8)	18	4660	12	5,880
(9)	19	5,030	13	5,850
(10)	20	4,520	14	5,020
(11)	21	4,080	15	4,680
	sum	61590		71440
	mean	5599.1 cfs (Goffs)		6494.5 cfs (Goffs)
		x 0.785		x 0.785
		4395.3 cfs (Garvins)		5098.2 cfs (Garvins)

AVG. MONTHLY FLOW from 1993 - 2007 (15 years)

	July (entire month)	Aug (entire month)
at Goffs	2,990 cfs	1,940 cfs
	x 0.785	x 0.785
at Garvins	2,347.15 cfs	1522.9 cfs

N-10

July (ASA) 21.5 / 70.7
July (PSNH) 23.9 / 75.1
2.4 / 4.4F

July

4395.3 cfs (2009) / 2347.2 cfs (93-07) = 100 / x ; 4395.3x = 234720 ; x = 53.4 (46.6)

2048.1 cfs

~~Aug (ASA)~~

Aug

5098.2 cfs (2009) / 1522.9 cfs (93-07) = 100 / x ; 5098.2x = 152290 ; x = 29.9 (

Flow data continued from p. 11. from USGS Goffs Falls.

date	July	& Aug. 2009.
1	13,700	18,400
2	15,400	18,500
3	19,400	15,200
4	22,000	14,600
5	18,700	12,000
6	15,500	9,220
7	12,300	7,300
8	11,000	6,010
9	10,800	5,370
10	9,840	5,050
11	8,110	5,060
12	7,220	5,880
13	6,830	5,850
14	6,420	5,020
15	5,460 SUB 182680 ✓	4,680 SUB 138,140 ✓
16	4,810	4,270
17	4,450	3,810
18	4,660	3,560
19	5,030	3,460
20	4,520	3,040
21	4,080	3,190
22	4,790	3,890
23	5,540	5,680
24	8,070	6,670
25	14,500	6,700
26	15,100	5,490
27	12,800	4,360
28	11,200	4,140
29	8,940	5,570
30	9,130 ~~300315~~	8,840
31	15,100	9,600 82,270 ✓
Sum	~~315315~~ 315300 ✓	220,410 ✓
MEAN	10,171.0	7,110

X 0.785 Goffs Falls to Garvins Falls correction

GARVINS FALLS 7984.2 cfs 5,581.4 cfs

MEAN July Flow GARV. (93-07) 2347.2 / (2009) 7984.2 = x / 100 = 3.4 x's

234720 = 7984.2 x

x = 29.4%

MEAN AUG FLOW GARV. (93-07) 1522.9 / (2009) 5581.4 = x / 100 3.7 x's

152290 = 5581.4 x

x = 27.3

July
182680
132620
315,300

FLOW DATA. USGS MAY 2009 "EARLY" (May 1-10)
Goffs Falls corrected for Garvins Falls (0.785)

MAY: ~~cfs Goff~~

1	6,930
2	6,220
3	6,840
4	6,330
5	5,170
6	4,780
7	6,350
8	8,940
9	9,110
10	8,570
sum	69,240
mean	6924 cfs (Goffs)

× 0.785
5435.34 cfs (Garvins)

mean monthly discharge for May from 1993-2007

8,920 cfs (Goffs)
× 0.785
7,002.2 cfs (Garvins)

- Grid Bathymetry data from HSA 2010 report p.29

Color code indicates that area near intakes is
3.6 - 4.0 m × 3.2808 ft/m = 11.8 → 13.1 ft.

Percentage of demersal species identified in sampling May 2006 – June 2007 (Table 3-6, Normandeau 2007c).

both units	2006	2007	
brn bullhead	67,772	0	
margined madtom	33,934	0	
tessellated darter	22,944	81,989	
white sucker	1,160,036	1,120,929	
			MEAN
	1,284,686 +	1,202,918 /2 =	1,243,802
TOTAL OF ALL SPECIES (From Table 3-6)	2,786,283 +	2,449,268 /2 =	2,617775.5

$$\frac{1,243,802}{2,617,776} = \frac{x}{100}$$

x = 47.5%

48%

Number of WWS required, according to PSNH

2007 Unit 1 7 @ 3' diam 44 (9.0 m)

2 16 @ 3' diam 76 (1.5 mm)

23

UNUSUAL IMPINGEMENT EVENT - BASIS

NUMBER OF FISH COLLECTED DURING 24-HR SAMPLES JUNE 05 - JUNE 07
FROM APPENDIX TABLE B-3, B-4. NORMANDEAU 2007c

UNIT 1

NUMBER FISH COLLECTED (TOTALS FROM EACH PAGE)		NUMBER OF 24-HR SAMPLES PER PAGE		PAGE #	
UNIT 1	UNIT 2	UNIT 1	UNIT 2	UNIT 1	UNIT 2
26	50	21	23	B-17	B-23
75	52	25	25	18	24
86	380	22	22	19	25
8	43	17	26	20	26
20	14	16	10	21	27
7	13	5	5	22	28
222	552	106	111		

222 / 106 = ~~[illegible]~~ 2.1

		UNIT 1	UNIT 2
2.1	MEAN	2.1	5.0
0	MIN	0	0
	MAX	39/24HR	~~380~~ 263/24HR
		~~20/12HR~~	~~131/12HR~~
		~~20/8HR~~	88/8HR

~~Leave @ 40/8 hr.~~

39/3 = 13/8HR