APPENDIX A

Fish Species, Characteristics, and Habitat

Key to Information

(f): Female.

(m): Male.

SL (Standard Length): The measured straight-line distance from the most forward point of the head to the hidden base of the tail, as indicated by the crease formed when the tail is bent to one side.

TL (Total Length): The measured straight-line distance from the most forward point of the head to the end of the tail fin, with the lobes of the tail fin compressed.

Reproductive Guild: A group with similar strategies to raise their young (i.e., parental care).

> *Nonguarders: Open substratum spawners: Pelagophils - Large quantities of non-adhesive, near-neutral or buoyant eggs are scattered in open water. No parental care of eggs.*
>
> *Nonguarders: open substratum spawners: Litho-pelagophils - Eggs are deposited on rocks and gravel, but eggs, embryos or larvae become sufficiently buoyant to be carried away from the spawning substrate by water currents. No parental care of eggs.*
>
> *Nonguarders: Open substratum spawners: Phyto-lithophils - Deposit eggs in relatively clearwater habitats on submerged plants, if available, or on other submerged items such as rocks, logs or gravel, where their embryos and larvae develop. No parental care of eggs.*
>
> *Nonguarders: Open substratum spawners: Phytophils - Scatter or deposit eggs with an adhesive membrane that sticks to submerged, alive or dead, aquatic plants or to recently flooded terrestrial vegetation. Sometimes woody debris. No parental care of eggs.*
>
> *Nonguarders: Open substratum spawners: Psammophils - Usually small eggs with an adhesive membrane that are scattered directly on sand and/or the fine roots of plants that hang over the sandy bottom. No parental care of eggs.*
>
> *Nonguarders: Brood Hiders: Lithophils - Eggs are hidden in specially constructed places. In most cases the hiding places (called redds in salmonids) are excavated in gravel by the female. No parental care of eggs*
>
> *Nonguarders: Brood Hiders: Speleophils - Usually few large eggs with an adhesive membrane that are hidden in crevices. No parental care of eggs.*
>
> *Guarders: Substratum choosers: Lithophils - Choose rocks for attachment of their eggs. Eggs are guarded, and possibly and ventilated.*
>
> *Guarders: Substratum choosers: Phytophils - Choose plants for attachment of their eggs. Eggs are guarded, and possibly and ventilated.*
>
> *Guarders: Nest spawners: Polyphils - No particular nest building material or substrate is chosen, however, a nest is constructed and the nest and eggs are guarded.*
>
> *Guarders: Nest spawners: Lithophils - Eggs are deposited on cleaned areas of rocks or in pits dug in gravel. Nest is guarded.*

Guarders: Nest spawners: Ariadnophils - The nest building male has the ability to spin a viscid thread from a kidney secretion, which binds the nest of different material together. The eggs are guarded and ventilated by the male, who also guards the young once they hatch.

Guarders: Nest spawners: Phytophils - Eggs are deposited in nests constructed above or on a soft muddy bottom, often amid algae or other exposed roots of vascular plants. Nest is guarded.

Guarders: Nest spawners: Speleophils - These fishes guard a clutch of eggs in natural holes or cavities, in specially constructed burrows, or where deposited on a cleaned area of the undersurface of flat stones.

Fresh Water Eel Family *(Anguillidae)*

American Eel *(Anguilla rostrata)*
The American eel has a catadromous life strategy; that is the eggs hatch in the sea, the young migrate to freshwater to grow, and the adults return to the sea to spawn.

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	top carnivore
Habitat Preference	near cover over muddy, silty bottoms of lakes, rivers and creeks; preferred water temperature ~19.0 ºC
Reproductive Guild	Nonguarders: Open substratum spawners: Litho-pelagophils
Spawning Habitat(s)	marine
Spawning Season	winter
Spawning Months	January-March
Spawning Temp	~17º C
Nursery habitat(s)	marine; estuarine; riverine
Diet	na
Age at maturity (yrs)	3-10 (m), 4-18(f)
Adult Length (cm)	25-40 TL (m), 70-100 TL (f)

Carp and Minnow Family *(Cyprinidae)*

Common Shiner *(Luxilus cornutus)*

General Habitat(s)	riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	generalist feeder
Habitat Preference	pools near riffles in clear, cool creeks and small to large rivers; preferred water temperature ~30ºC
Reproductive Guild	Nonguarders: brood hiders: Lithophils
Spawning Habitat(s)	riverine
Spawning Season	spring -summer
Spawning Months	May-July
Spawning Temp	~16- 24ºC
Nursery habitat(s)	riverine
Diet	feed mainly at surface or in midwater; opportunistic feeders: aquatic insects both adults and larvae are primary food source, occasionally small fishes and some plant material
Age at maturity (yrs)	1-3
Adult Length (cm)	7-14 TL

Golden Shiner *(Notemigonous crysoleucas)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	generalist feeder
Habitat Preference	clear, weedy, quiet waters of lakes, ponds, reservoirs, pools in slow moving rivers and streams; preferred water temperature~24ºC
Reproductive Guild	Nonguarders: Open substratum spawners: Phytophils
Spawning Habitat(s)	lacustrine; riverine
Spawning Season	summer
Spawning Months	June-August
Spawning Temp	~20-27ºC
Nursery habitat(s)	lacustrine; riverine
Diet	feed mainly at surface or in midwater, feed mainly on zooplankton, adults sometimes feed on insects and small fishes
Age at maturity (yrs)	2-3
Adult Length (cm)	10-15 TL

Spottail Shiner *(Notropis hudsonius)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	water column insectivore
Habitat Preference	Large lakes and rivers; slow to moderate current; sand, gravel, mud, or silt substrates; preferred temperature 13-22ºC
Reproductive Guild	Nonguarders: Open substratum spawners: Litho-pelagophils
Spawning Habitat(s)	lacustrine; riverine
Spawning Season	spring
Spawning Months	May-June
Spawning Temp	~15-20ºC
Nursery habitat(s)	lacustrine; riverine
Diet	tend to feed near bottom and consume small mollusks, mayflies, and other aquatic or terrestrial insects; adults also feed on fish eggs, including their own
Age at maturity (yrs)	1-2
Adult Length (cm)	6-12.5 TL

Blacknose Dace *(Rhinichthys atratulus)*

General Habitat(s)	riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	generalist feeder
Habitat Preference	runs, pools, and riffles; in clear swiftly flowing creeks and small rivers with gravelly substrate
Reproductive Guild	Nonguarders: Open substratum spawners: Litho-pelagophils
Spawning Habitat(s)	riverine
Spawning Season	spring
Spawning Months	May-June
Spawning Temp	~15-22ºC
Nursery habitat(s)	riverine
Diet	feed on a wide variety of aquatic invertebrates and terrestrial insects, aquatic fly larvae are a favored prey
Age at maturity (yrs)	1-2
Adult Length (cm)	6-7.6 TL

Longnose Dace *(Rhinichthys cataractae)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	benthic insectivore
Habitat Preference	Cobble, boulder or gravel riffles of clean swiftly-flowing, creeks and small to medium rivers; rocky shores of lakes; preferred water temperature ~21ºC
Reproductive Guild	Nonguarders: Open substratum spawners: Litho-pelagophils
Spawning Habitat(s)	riverine
Spawning Season	spring-summer
Spawning Months	May-July
Spawning Temp	~11-23ºC
Nursery habitat(s)	riverine
Diet	diet consists primarily of immature aquatic insects that cling to rocks and boulders; chief predator of larval blackflies and midges, but will also prey on other small aquatic invertebrates
Age at maturity (yrs)	2-3
Adult Length (cm)	6.5-11.8 TL

Fallfish *(Semotilus corporalis)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	generalist feeder
Habitat Preference	gravel and cobble bottom pools and runs of small to medium rivers; margins of lakes, ponds, or reservoirs; preferred water temperature ~22ºC
Reproductive Guild	Nonguarders: Brood hiders: Lithophils
Spawning Habitat(s)	riverine: gravel, cobbles; adhesive eggs that stick to the nest
Spawning Season	spring
Spawning Months	May-June
Spawning Temp	~14-19ºC
Nursery habitat(s)	riverine
Diet	omnivorous, eating mostly plankton until they reach~ 1.5 inches in TL, gradually switching to larger foods such as: algae, insects, crayfish, and fishes
Age at maturity (yrs)	3 (m), 4 (f)
Adult Length (cm)	15.5-25.5 TL

Sucker Family *(Catostomidae)*

Longnose Sucker *(Catostomus catostomus)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coldwater
Trophic Class	benthic insectivore
Habitat Preference	clear, cold deep water of lakes and tributary streams; occasionally brackish water preferred water temperature ~8-17ºC
Reproductive Guild	Nonguarders: Open substratum spawners: Litho-pelagophils
Spawning Habitat(s)	riverine: gravel, cobbles; adhesive eggs deposited over substrate
Spawning Season	spring
Spawning Months	April-May
Spawning Temp	~5-15ºC
Nursery habitat(s)	lacustrine; riverine
Diet	longnose suckers vacuum a wide variety of aquatic invertebrates and algae off the bottom, including amphipods, copepods, and the lar4vae of blackflies, beetles, mayflies, dragonflies, stoneflies, and caddisflies
Age at maturity (yrs)	4-8 (m), 5-9 (f)
Adult Length (cm)	30.5-46.2 TL

White Sucker *(Catostomus commersoni)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	generalist feeder
Habitat Preference	rocky pools and riffles of creeks and rivers; lake embayments; preferred water temperature ~22ºC
Reproductive Guild	Nonguarders: Open substratum spawners: Litho-pelagophils
Spawning Habitat(s)	lacustrine; riverine, migrate upstream to tributaries, or shoal areas if tributaries are not available
Spawning Season	spring
Spawning Months	April-May
Spawning Temp	~7-10ºC
Nursery habitat(s)	lacustrine; riverine
Diet	benthic invertebrates, fish eggs, larval midges, detritus
Age at maturity (yrs)	2-3 (m), 3-4 (f)
Adult Length (cm)	30.5-50.8 TL

Creek Chubsucker *(Erimyzon oblongus)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	generalist feeder
Habitat Preference	creeks, streams, and lakes with moderate aquatic vegetation
Reproductive Guild	na
Spawning Habitat(s)	lacustrine; riverine, gravel runs; young move to downstream habitats after hatching
Spawning Season	spring
Spawning Months	na
Spawning Temp	na
Nursery habitat(s)	lacustrine; riverine
Diet	plant material, a wide variety of aquatic and terrestrial invertebrates
Age at maturity (yrs)	na
Adult Length (cm)	Usually less than 22.8 TL

<u>Bullhead Catfish Family *(Ictaluridae)*</u>

Yellow Bullhead *(Ameiurus natalis)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	warmwater
Trophic Class	generalist feeder
Habitat Preference	pools and backwaters over soft substrates in sluggish creeks and small to large rivers; oxbows, ponds, impoundments and heavily vegetated areas of shallow bays and small lakes; preferred water temperature ~28ºC
Reproductive Guild	Guarders: Nest spawners: Speleophils
Spawning Habitat(s)	lacustrine; riverine
Spawning Season	Spring
Spawning Months	May-June
Spawning Temp	~23-27ºC
Nursery habitat(s)	lacustrine; riverine
Diet	insects, crustaceans, mollusks, and small fishes, as well as some plant material
Age at maturity (yrs)	2-3
Adult Length (cm)	17.8-34.3 TL

Brown Bullhead *(Ameiurus nebulosus)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	warmwater
Trophic Class	generalist feeder
Habitat Preference	pools and sluggish runs over sand to mud substrates in creeks and small to large rivers; impoundments, ponds and lake embayments; preferred water temperature ~25-27°C
Reproductive Guild	Guarders: Nest spawners: Speleophils
Spawning Habitat(s)	lacustrine; riverine
Spawning Season	Spring
Spawning Months	May-June
Spawning Temp	~21-25ºC
Nursery habitat(s)	lacustrine; riverine; young remain in areas with aquatic vegetation through the end of their first summer
Diet	omnivores feed on wide variety of animal and plant material
Age at maturity (yrs)	2-3
Adult Length (cm)	19.3-35.6 TL

Margined Madtom *(Noturus insignus)*

General Habitat(s)	riverine
Pelagic	no
Thermal Regime	warmwater
Trophic Class	benthic insectivore
Habitat Preference	riffles and runs of clear, fast-flowing creeks and small to medium rivers with cobble, boulder or coarse gravel substrates; lakes
Reproductive Guild	Guarders: Nest spawners: Speleophils
Spawning Habitat(s)	riverine; nest under flat stones
Spawning Season	summer
Spawning Months	June-July
Spawning Temp	na
Nursery habitat(s)	riverine
Diet	nocturnal omnivores feed on wide variety of aquatic insects and other invertebrates
Age at maturity (yrs)	1-2 (m), 2 (f)
Adult Length (cm)	9-12 SL

Pike and Pickerel Family *(Esocidae)*

Chain Pickerel *(Esox niger)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	top carnivore
Habitat Preference	typically live in ponds and quiet backwaters of medium to large rivers, less common in smaller streams, can occur in brackish waters
Reproductive Guild	Nonguarders: Open substratum spawners: Phytophils
Spawning Habitat(s)	lacustrine; riverine
Spawning Season	spring
Spawning Months	March-May
Spawning Temp	~8-11ºC
Nursery habitat(s)	lacustrine; riverine; swampy, marshy, or flooded areas with abundant submerged vegetation
Diet	juveniles feed on smaller invertebrates and fishes, adults are highly picivorous, large pickerel will eat small mammals, frogs, and snakes
Age at maturity (yrs)	na
Adult Lenth (cm)	33.0 TL

Salmon, Char, and Tout Family *(Salmonidae)*

Rainbow Trout *(Oncorhynchus mykiss)*

General Habitat(s)	lacustrine; riverine
Pelagic	yes
Thermal Regime	coldwater
Trophic Class	Top carnivore
Habitat Preference	mid-waters of lakes; creeks and rivers with moderate flow, gravelly bottoms and riffle-pool habitat; preferred water temperature 11.3°C
Reproductive Guild	Nonguarders: Brood hiders: Lithophils
Spawning Habitat(s)	riverine
Spawning Season	spring
Spawning Months	March-May
Spawning Temp	~5-13ºC
Nursery habitat(s)	Hatchery (reproducing populations in New Hampshire na) In Massachusetts reproducing populations are restricted to coldwater streams with high gradient (more than 75 feet per mile)
Diet	
Age at maturity (yrs)	3-5
Adult length (cm)	36.1-73.4 TL

Atlantic Salmon *(Salmo salar)*

The Atlantic Salmon has an anadromous life history. Young salmon remain in freshwater for two or three years, descending to the sea as smolts. At sea, they live for one or two more years before they return to their natal streams to spawn.

General Habitat(s)	lacustrine; riverine; marine
Pelagic	yes
Thermal Regime	coldwater
Trophic Class	top carnivore
Habitat Preference	mid-waters of lakes; rocky runs and pools of small to large rivers; preferred water temperature 16.0°C
Reproductive Guild	Nonguarders: Brood hiders: Lithophils
Spawning Habitat(s)	riverine: highly oxegenated, minimal pollution levels, and silt-free rocky or gravel substrate
Spawning Season	fall
Spawning Months	October- November (return to freshwater typically in May or June)
Spawning Temp	~4-10ºC
Nursery habitat(s)	Riverine
Diet	Young Atlantic salmon fees primarily on aquatic and terrestrial insects while they are in freshwater. Adult atlantics salmon do not feed in fresh water prior to spawning.
Age at maturity (yrs)	3-6
Adult Length (cm)	53.8-74.4 TL

Brown Trout *(Salmo trutta)*

General Habitat(s)	lacustrine; riverine
Pelagic	yes
Thermal Regime	coldwater
Trophic Class	top carnivore
Habitat Preference	creeks and rivers with moderate flow, gravelly substrates and riffle-pool habitat, and lake shallows; preferred water temperature ~21°C
Reproductive Guild	Nonguarders: Brood hiders: Lithophils
Spawning Habitat(s)	Riverine: spawning substrate with stones ranging from .25-3 inches in diameter
Spawning Season	fall
Spawning Months	October- December
Spawning Temp	~2-13ºC
Nursery habitat(s)	riverine
Diet	juvenile brown trout are primarily insectivorous, until the onset of picsivory
Age at maturity (yrs)	2-4
Adult Length (cm)	25.8-63 TL

Brook Trout *(Salvelinus fontinalis)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	coldwater
Trophic Class	top carnivore
Habitat Preference	clear, cool, well-oxygenated streams, ponds and lakes with maximum water temperature less than 22°C; preferred water temperature 16.0°C
Reproductive Guild	Nonguarders: Brood hiders: Lithophils
Spawning Habitat(s)	lacustrine; riverine: gravel riffles coarse sand and stone up to 4 inches in diameter
Spawning Season	fall
Spawning Months	September-November
Spawning Temp	~4-10ºC
Nursery habitat(s)	lacustrine; riverine
Diet	stream dwelling brook trout are primarily insectivores,
Age at maturity (yrs)	15.2-44.2 TL
Adult Length (cm)	2-3

Sunfish and Black Bass Family *(Centrarchidae)*

Redbreast Sunfish *(Lepomis auritus)*

General Habitat(s)	lacustrine; riverine
Pelagic	na
Thermal Regime	warmwater
Trophic Class	generalist feeder
Habitat Preference	clean water with rocky substrates; ponds, lakes, slow moving sections of streams and rivers; tend to avoid heavily vegetated areas
Reproductive Guild	Guarders: Nest spawners: Polyphils
Spawning Habitat(s)	sheltered areas: rocks and woody debris; build nests in sand or gravel substrate
Spawning Season	spring-summer
Spawning Months	May-august
Spawning Temp	na
Nursery habitat(s)	lacustrine; riverine
Diet	wide variety of larval and adult aquatic insects, including mayflies, caddisflies, midges, flies, mosquitoes, beetles, and dragonflies; scuds, aquatic snowbugs, mollusks, and small fishes occasionally eaten
Age at maturity (yrs)	na
Adult Length (cm)	10.1-20.3 TL

Pumpkinseed *(Lepomis gibbosus)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	warmwater
Trophic Class	generalist feeder
Habitat Preference	warm, shallow, vegetated lakes and ponds; quiet vegetated pools of creeks and small rivers; preferred water temperature ~26.0°C
Reproductive Guild	Guarders: Nest spawners: Polyphils
Spawning Habitat(s)	lacustrine; riverine; sand or gravel substrate
Spawning Season	spring-summer
Spawning Months	May-August
Spawning Temp	~20-28ºC
Nursery habitat(s)	lacustrine; riverine
Diet	wide range of aquatic invertebrates, especially those bottom dwelling or in vegetation
Age at maturity (yrs)	1-3
Adult Length (cm)	12.7-19.0 TL

Smallmouth Bass *(Micropterus dolomieu)*

General Habitat(s)	lacustrine; riverine
Pelagic	no
Thermal Regime	warmwater
Trophic Class	top carnivore
Habitat Preference	clear, gravel-bottomed runs and flowing pools of small to large rivers; shallow, rocky and sandy areas of lakes; preferred water temperature ~30°C
Reproductive Guild	Guarders: Nest spawners: Polyphils
Spawning Habitat(s)	lacustrine; riverine
Spawning Season	spring
Spawning Months	May-June
Spawning Temp	~13-20ºC
Nursery habitat(s)	lacustrine; riverine
Diet	generally, smaller individuals consume aquatic invertebrates, primarily zooplankton, and occasionally small fish, larger smallmouths mainly feed on crayfishes and fishes
Age at maturity (yrs)	3-5 (m), 4-6 (f)
Adult Length (cm)	25.4-40.6 TL

Largemouth Bass (*Micropterus salmoides*)

General Habitat(s)	Lacustrine; riverine
Pelagic	no
Thermal Regime	warmwater
Trophic Class	Top carnivore
Habitat Preference	clear, warm, shallow lakes, bays, ponds, marshes and backwaters and pools of creeks and small to large rivers; often associated with soft mud or sand substrate and dense aquatic vegetation; usually at depths <6 m; preferred water temperature ~30°C
Reproductive Guild	Guarders: Nest spawners: Polyphils
Spawning Habitat(s)	Lacustrine; riverine
Spawning Season	Spring
Spawning Months	May-June
Spawning Temp	~17-22ºC
Nursery habitat(s)	Lacustrine; riverine
Diet	Young feed primarily on aquatic invertebrates and small fishes, as they mature fish become a greater part of their diet, sometimes larger individuals consume small mammals and birds
Age at maturity (yrs)	3-4(m), 4-5 (f)
Adult Length (cm)	30.5-53.3 TL

Perch Family *(Percidae)*

Yellow Perch *(Perca flavescens)*

General Habitat(s)	Lacustrine; riverine
Pelagic	no
Thermal Regime	coolwater
Trophic Class	Top carnivore
Habitat Preference	lakes, ponds and pools of creeks and small to large rivers with moderate aquatic vegetation and clear water, young inhabit weedy shallows, while adults prefer rock ledges usually at depths less than 9 m; preferred water temperature ~ 21°C
Reproductive Guild	Nonguarders: Open substratum spawners: Phyto-lithophils
Spawning Habitat(s)	Lacustrine; riverine: weedy areas
Spawning Season	Spring
Spawning Months	April-May
Spawning Temp	~6-12ºC
Nursery habitat(s)	Lacustrine; riverine
Diet	Diurnal carnivores, feeding on small aquatic insects, crustaceans, and small fishes
Age at maturity (yrs)	2-3 (m), 3-4 (f)
Adult Length (cm)	15.2-30.5 TL

APPENDIX B

Comments Received on the 27 July 2004 Draft IPUOCR Report

And Responses to those Comments

Department's responses to comments
to UNH's draft IPUOCR and ISF Assessment Methods Report

Department responses are highlighted in gray.

From: Angela Rapp [mailto:angier@nashuarpc.org]
Sent: Friday, August 13, 2004 12:08 PM
To: Loskamp, Marie
Subject: Comments on IPUOCR Draft

Hello,

Overall, a lot of really good information! A lot of work was done in a small amount of time. This impressive.

My Comments: In general (and I get into the specifics for some sections where it was particularly obvious), the document needs to be formatted so that there is an obvious heirarchy of sections. Using Roman numerals with Letters (Large and Small) is really helpful in a document like this which is the first of it's kind for the Souhegan River. It's presenting information that is important for us to understand how it is being affected, especially considering all of the categories of resources and users that can be affected. It would have helped me read this report a lot easier.
The Department noted the need to organize the report in our review. The need to revise the overall organization and the formatting of the text was acknowledged by both parties. The draft document was reformatted in the final draft version. Many of the editorial changes discussed in the comments below were incorporated. UNH is aware of all comments and has made appropriate edits.

1. Figure 2.1 on page 8: I understand the column heading for Flow Dep. but are the values: F, P and N? I am assuming that's supposed to be F for Yes it is flow dependent, P for Potentially and N for No? I think it would make more sense it if it was Y, P and N.

The status of Potentially (P) flow-dependent entities were determined as either flow-dependent or not flow-dependent so there is no further use for the P classification.

2. Figure 2.1 on page 8: It might make it easier to read if it had lines on it...

3. Table 3.1 on page 13: Heading should be bolded to stand out.

4. Table 3.2 on page 14: Format of the tables is a little funky (i.e., headings capitalized/non-capitalized, extra spaces with no text in them, Table heading inside of a box when it wasn't inside of a box on page 13, etc.). It helps to have all of the tables and figures (including their headings and references to fish names...capitalized or not) consistent.

5. Table 3.2 on page 14: I think McQuade Brook is spelled with a capital Q.

6. On page 20, there is reference to Appendix 1. The Appendices are labeled with Roman numerals though...

7. Page 22: Figure 3.2's name isn't distinguishable from the rest of the text...the page has a confusing set up. The text and figure need to be separate and sections that are calling out specific attention (such as the conclusion drawn from the literature review) need to be clearer.

8. On page 23, there is a reference to Figure 2 towards the bottom...where is Figure 2?

9. On page 26, the font starts getting smaller towards the bottom of the page and stays smaller until page 36.

10. On page 37, at the beginning of the Hydrological/Geological/Habitat section it says River Morphology and Aquatic Habitat. Same comment as before, I would try and keep all section headings different from the rest of the text so that the reader can follow where you are. Keep the font and italic or non-italic the same too...

11. Where are the "reaches" mapped? Are those the transects? If so, they should be called one or the other. If not, I think they should be mapped so the reader can visually see where you are taking about.
The Designated River was divided into sections and reaches. Each reach is made up of several sections. The report attachment “Souhegan Representative Sites3.pdf” is a map that shows the sections in either red or blue depending on whether the section was chosen as a site representative of the reach or not. The map needs to be viewed at full-scale in order to read the yellow section numbers which the report text refers to. The map will be larger than an 8½x11 page when viewed at this scale.

12. It would be helpful to see the exact source of some of the tables/figures that you are using. For instance, under the section on Storage on page 42 you discuss the 12 dams and mention it is from NHDES in 2004. I would source that table with the link to where you found that information. Also, that table should have a Table number.
Where non-sensitive information is presented, the original source materials are presented as attachments to the final draft. Sensitive information will not be presented.

13. On Page 43: I would bullet the "Other" locations used for hiking, nature study, etc....it is hard to read right now. Same with the Conservation/Open Space items.

14. On Page 43/44: Seems like a map might be a good visual to break up some of the text in this section. And provide a visual placement of these locations.
Maps in the report are limited to flow-dependent entities. Maps have been provided in several cases where appropriate. The locations of some of these entities are either not flow dependent or have been evaluated as protected at flows which will be set for other entities.

15. On page 45: Why is the section called Vegetation called Vegetation when it is referring to Rhododendrons and the other sections are named appropriately for their subject matter (i.e., Siberian Chives, etc.).

16. On page 46: The section on Water Quality Protection/Public health should be italicized or something to distinguish it from the previous

section on Maintenance and Enhancement of Aquatic Life.

Thanks for the opportunity to comment,

Angie

Angela J Rapp
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angier@nashuarpc.org - www.nashuarpc.org Tel. 603-883-0366 x15 Fax. 603-883-6572

From: S Brookes [mailto:sbrookes@tds.net]
Sent: Friday, July 30, 2004 7:57 AM
To: Ives, Wayne
Subject: Old Wilton Dump

The old Wilton Dump at the site of the Wilton Recling Center has had studies in the last 20 years. There were monitoring wells installed at the time of the closing of the dump. The dump prehaps should be noted in the report. The location is just West of RT 31N turn into Wilton Downtown on Gibbons Highway, RT 101 and just East of where the Souhegan River Bridge is located on the RT 101.

The potential of leaching into the river from the old dump may be worthy of note in the report.

Spencer Brookes

The Department has determined that stream flow will not be regulated to support solid and hazardous waste site remediation. The remedies for these sites will need to take into account normal stream flow and normal variations. Water quality issues related to these sites will be regulated under other programs.

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10 July 2004

Marie Loskamp
NHDES Watershed Management Bureau
29 Hazen Drive
Concord, NH 03301

Dear Marie,

Thank you for the opportunity to comment on the report, Instream Protected Uses, Outstanding Characteristics, and Resources (IPUOCRs) of the Souhegan River, and Proposed Flow Measures for Flow Dependent Resources, July 2004. These comments reflect both information in the July 2004 report and the presentation by the Protected Instream Flow project team (UNH, UMASS, Normandeau) on July 30, 2004.

The Project Team has proposed a strong approach for conducting the Protected Instream Flow (PISF) field studies, based on the final IPOUCR list. They have offered a thoughtful, thorough, and integrated approach to studying the full suite of IPOUCRs and should be able to provide depth and breadth of information on which to base recommendations for the Water Management Plan. We fully support using the Natural Flow Paradigm as an organizing principle for the PISF studies. In addition, while we offer fairly specific comments below, we generally support the proposed methods to develop science-based PISF recommendations.

Regarding Table 2.1 and the section of **Flow Dependence and Critical Flow Related Characteristics of IPOUCR Entities**, there were some inconsistencies between the text and the Table. For example, it was confusing to read that categories in the matrix (Table) included "the resource, the reason for inclusion, the local, regional, and national importance of the resource, and the flow requirement of the resource . . ." Information on the reason for inclusion and the importance of the resource were not in the Table. The text and the table have been revised to present the relevant information and to eliminate inconsistencies.

Secondly, there was no clear explanation of what constituted a "Critical Flow" for each resource and whether a flow is "critical" due to potential negative or positive impacts. For example, Critical Flows for Native Fish, Introduced Fish, Freshwater Mussels, Insects, Fish and Wildlife Habitat, Banded Sunfish, and others are listed as Low, when in fact High and Average flows may be equally critical to maintaining a full suite of habitat conditions for their maintenance and survival. Critical Flows for these species have been expanded to include High and Average Flows. Table 2.1 may be used in future decision-making settings, and it should reflect not only how IPOUCRs may be addressed in the PISF study, it should also reflect the ecological range of critical flows for each IPOUCR. We would encourage a short paragraph explanation of what constitutes Critical Flows; how they were assigned for each IPOUCR; and perhaps a revision of the Critical Flow categories for each based on the ecological requirements of each IPOUCR. The report text was expanded to clarify the definition of Critical Flow as used in Table 2.1.

Regarding the **Resident Native Fish Community** Section, we support this approach to defining the suite of native fish species in the river. It was unclear what specific methods will be used to sample fish, other than a brief mention on page 26: "To verify our habitat database, we propose to include an instream community survey using underwater observation . . ." We encourage a more specific set of goals and methods to clarify what will be sampled, how it will be conducted and when. For example, will all fish be documented to species? Will there be sampling to verify current data on relative fish abundance? Will only dominant species be recorded? Will there be a focus on species that serve as host fish for freshwater mussels? The Target Fish Community will be verified using underwater observation and electroshocking methods to observe the presence, locations and conditions under which the fish exist. All the study reaches identified will be observed and all fish captured or observed will be counted and identified to species. This is not an exhaustive fish survey, but a corroboration of habitat model predictions and Target Fish Community determined by the methods in the report.

A recent paper in Fisheries Journal provides an excellent review of the utility and accuracy of Basin Visual Estimation Techniques, including a review of the accuracy and usefulness of snorkeling and fish shocking techniques[1]. We would recommend reviewing this paper to guide the refinement of field methods for the resident native fish community sampling.
UNH has reviewed this paper.

Regarding freshwater mussels and insect (Odonate) sampling, we welcome the addition of these taxa to help represent a fuller range of aquatic biodiversity in making instream flow recommendations. Currently it is unclear how these IPOUCRs will be sampled in the field. While sampling them in the defined Hydrogeomorphic Units (HMUs) may be sufficient, both mussels and Odonates likely respond to habitat factors at a finer scale than fish. For example, mussel presence has been shown by Dr. David Strayer to be strongly influenced by local flow refugia which are at a scale smaller than a hydrogeomorphic unit. Identifying mussel beds and sampling microhabitat scale aquatic habitat characteristics (for example, substrate, flow velocity, and shear stress), and modeling changes in these characteristics over a range of flow magnitudes may shed light on their habitat needs. In addition, identifying and sampling for critical host fish should be an important part of the target native fish community sampling. Finally, a more complete set of goals and methods for Odonates should be developed and made available for review.
Current knowledge of habitat use by freshwater mussels is still very limited (Dave Strayer, pers. comm.) To a large extent, this is also the state of our knowledge of habitat scales or host fish species. In UNH's mussel survey, they will gather information on habitat attributes relevant to mussels. Because they will record all of the attributes associated with HMU's, the elements of flow refugia will most likely also be captured. Even given possible shortcomings, the data gathered by this investigation will be valuable. Similarly, a quantitative survey of habitat for Odonata has not been commonly applied and we expect methodological challenges which will be addressed as they become apparent. More detail on the proposed survey methods, which are based on a review of the relevant current literature, has been included in the report. Regarding the goals for macroinvertebrates; they are not different from the goals identified for fish. We concur with a suggestion for inclusion of other insects in addition to Odonata, however, budget constraints currently will not allow this. We will be archiving all collected macroinvertebrates, so these data will not be lost, but only Odonata will be included in the model.

If it turns out that there are limited options to complete sampling of these taxa, the Project Team should propose alternative or surrogate methods or models to ensure Odonates and mussels are sufficiently considered. The proposal mentions developing a generic model for mussels and dragonflies, but it is unclear what this would entail.
The proposed methods for mussels and invertebrates assessments have been described in the report.

We support the selection of the MesoHABSIM approach, and the use of CUT curves to depict flow thresholds. We also support the use of habitat modeling using cross sections of various riparian natural communities and wetlands. For the High-Energy Riverbank Community, it may be important to also consider winter ice scouring in the Water Management Plan, in addition to periodic high flows; both processes may be important to maintain these communities.
UNH will incorporate single-event flow needs such as channel-forming flows into the assessment. These assessments are made using the Floodplain Model.

While we understand the reasoning to not include impoundments as low-flow dependent IPOUCRs, it is curious that several of the research reaches include, and in one case is dominated by, impounded water. While this may be characteristic of the river, it will be important to reflect the influence of dams within the context of the Natural Flow Paradigm.

None of the research reaches are dominated by impounded water. The text will be revised to clarify this point.

While we recognize that the RFP limited the number of groundwater wells to be assessed, we would encourage (1) a broader assessment of the wells' potential impacts on instream flow, and (2) a survey and assessment of the potential effect of additional wells (i.e. those outside the 500 foot limit) along the Souhegan mainstem and the within the Watershed. For (1), an assessment limited to induced recharge / infiltration will likely underestimate the full impacts of wells on minimum instream flow. In particular, groundwater withdrawals affect base flows not only by inducing recharge directly from the river but also by intercepting groundwater that would have reached the river during critical low flow times. These impacts may in fact have an overall larger impact over the course of a year than just the induced infiltration. We strongly encourage an estimate of the full range of impacts from groundwater wells be included in the study. For (2), the water withdrawals from wells outside the 500' limit, whether along the mainstem or along tributaries, may combine to significantly reduce instream flow more than is reflected by the current list of AWUs. While we understand that a full assessment of all wells in the watershed may not be feasible under this scope of work, a management plan to protect the IPOUCRs may well include the need to understand the potential impacts from these withdrawals outside the 500' limit. We would encourage an approach that at least considers additional wells, and additional effects (beyond induced recharge) for groundwater withdrawals. The Water Management Plan may be the best tool for addressing this issue, but additional field studies may be required for the PISF report as well.

The definition of affected water users was determined based on discussions with stakeholders during rulemaking. The definition includes registered water users (those who use 140,000 gallons or more per week). There are very few registered wells that do not fall within 500 feet of the Designated River or one of its tributaries. In the Souhegan WMPA, two registered water users are exempted from the process because they have no source or discharge within 500 feet of the Designated River or one of its tributaries.

Well withdrawals have impact on stream flow greater than the water induced from the stream. The Department has determined that groundwater withdrawals will have an assessment of the induced recharge as part of the Protected Instream Flow Study. Under management, i.e., when changes in flow may be needed, wells that are farther away from a tributary have delayed response compared with those nearer the tributary. The management of stream flow is less effective using wells further from the tributaries. The induced recharge component may be an important part of the Water Management Planning process.

The discussion of Invasive Species was in the **Preliminary List of Non-Flow Dependent Entities** section, but in the text it stated that "these species are specifically flow dependent." These species are fundamentally different than IPOUCRs for which the state may wish to manage as they are a threat to the ecological integrity of many other IPOUCRs and should be addressed as such. We believe it may be more appropriate to have the IPOUCR be the "control of invasive species" rather than the invasive species themselves. We recommend that the control of both aquatic and riparian invasive species be addressed as flow dependent species, and that their presence and abundance is recorded during field studies.

The flow dependent conditions that prevent the expansion of invasive species are expected to be created by using the Natural Flow Paradigm. Under natural flows the native species adapted to these flows are given the conditions needed to maintain these species. The report has been revised to clarify the role of the protected flows in controlling invasive species.

Thank you. Please do not hesitate to call me with questions.

Sincerely,

Doug Bechtel
Director of Conservation Science, The Nature Conservancy
Souhegan Technical Review Committee

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[1] Williams, L.R. et al. 2004. Basin Visual Estimation Technique (BVET) and representative reach approaches to wadeable stream surveys: methodological limitations and future directions. Fisheries 29(8), 12-22.

From: Doug Bechtel [mailto:dbechtel@tnc.org]
Sent: Monday, August 02, 2004 2:11 PM
To: piotrp@forwild.umass.edu
Cc: William C. Ingham ; Alden Greenwood; Brian R. Mrazik; Carl Paulsen; Couture, Steve; Currier, Paul M.; Donald L. Ware; Ives, Wayne; James MacCartney; John R. Nelson; Kenneth D. Kimball; Ralph W. Abele
Subject: Mussels in Souhegan

Hello Piotr,

Thanks for a good presentation on Friday.

As we discussed, I have attached an MSWord and Excel table with information on Souhegan freshwater mussels. Excel from the NH Heritage program and the Mussel Atlas from Mike Marchand (wetlands biologist with Nongame Program / NH Fish and Game, (603) 271-3016, michael.marchand@WILDLIFE.STATE.NH.US). I hope they are helpful. The spreadsheet has decimal Lat-Long for locations, as well as source and date of inventories.

-Doug

Douglas A. Bechtel
Director of Conservation Science
The Nature Conservancy - NH Chapter
603-224-5853 x16 FAX:603-228-2459

The Nature Conservancy has helped to permanently conserve more than 116 million acres of critical habitat in the United States and abroad.

From: William Ingham [mailto:WIngham@WILDLIFE.STATE.NH.US]
Sent: Tuesday, August 03, 2004 1:19 PM
To: Loskamp, Marie
Subject:

Marie,

The Preliminary Review Draft for the Instream Protected Uses, Outstanding Characteristics, and Resources of the Souhegan River and Protective Flow Measures for Flow Dependent Resources July 2004 should also include anadromous river herring and American shad in those species that are being evaluated. Reference to these species is found in the Anadromous Fish Restoration Plan for the Merrimack River Watershed.

Bill Ingham

These species have been included in the IPUOCR lists and assessment process.

From: Brian R Mrazik [mailto:bmrazik@usgs.gov]
Sent: Monday, August 02, 2004 3:23 PM
To: Loskamp, Marie
Cc: kkimball@amcinfo.org; tjmack@usgs.gov; ktoppin@usgs.gov; kwrobins@usgs.gov
Subject: Comments on the proposed methodology presentations at the July 30 Souhegan meeting

Hi Marie,

Here are a few comments for consideration:

1. USGS/NHDES/USEPA have conducted significant ground-water investigations and modeling at the Savage Well Superfund site in Milford. This work has demonstrated that aquifer materials at this site are highly transmissive, and that ground-water flow through the contaminated area is highly affected by transients in river stage. The Souhegan River at the upstream end of the site is a loosing (to ground water) reach and below the site, is a gaining (from ground-water) reach. Thus, the ground-water flux through the plume area varies considerably during the year. Alterations in the flow regime of the Souhegan River have the potential to affect the efficiency of remedial operations at the superfund site, and thus the cost and duration of the cleanup effort. Likewise, natural attenuation processes could be affected by alteration of the flow characteristics of the river.
`See response to earlier comment above in regard to hazardous and solid waste site remedial actions.`

2. The selection of a targeted native fish community and other native 'living resource' IPUOCRs will be a major consideration in establishing the Protected In-Stream Flow value for the Souhegan. On the other end of the spectrum, however, the project should consider the extent to which invasive species have, or are likely to become established in the Souhegan and its riparian zones, and how flow alteration could impact the relative competitiveness and abundance of native versus exotic species.
`See response to earlier comment above in regard to invasive species control by protected flows.`

3. The contractor proposes to limit the investigation of ground-water withdrawls to wells within 500 feet of a stream channel <u>and</u> to where ground-water recharge is directly <u>induced</u> from the stream channel. Wells beyond 500 feet <u>and</u> wells within 500 feet that only <u>intercept</u> regional ground-water flow on its way to the river are proposed to be excluded from analysis. We are concerned that each of these simplifying assumptions will result in an underestimation of the impacts of ground-water withdrawls on the low flows of the Souhegan River, and that in combination, the underestimation may be quite significant. All ground-water withdrawls which are consumed, or diverted to other locations (e.g. downstream) in the basin will result in reduced river baseflows in the affected reach, regardless of whether the flow is lost directly from the stream channel (induced infiltration) or diverted to a well on its way to the stream channel. The rationale proposed, for not considering wells which are not directly inducing infiltration from the stream, is that there is a time lag between changes in withdrawal rates and subsequent changes in streamflow. Thus, 'management' of ground-water withdrawls from such wells will not have an immediate effect on flows in the Souhegan River. This rationale may be an unacceptable simplification. During periods of drought, flows in the protected reaches of the Souhegan may be below PISF levels for days, weeks, or longer periods that may well exceed the 'lag' time of regional ground-water flow between the well and the river. In other words, although a reduction in pumping may not have an immediate effect on river flows, the effect, in terms of increased river baseflows, could be realized in days or weeks....well before the critical low-flow situation in the river has ended.
`See responses to earlier comments above in regard to the 500 foot limitation and induced recharge from streams by wells.`

4. The contractor is proposing to obtain concurrent flow measurements at the USGS gage(s) and several other sites in the basin in order to develop regression equations to predict flows at those sites based on flows at the USGS gage. During periods of critical low flow (i.e. at or near the PISF), reliance on flows from a gage at the downstream end of the basin to predict flows considerably upstream is likely to be highly unreliable.

Flows at the PISF are most likely to occurr during mid- to late summer and early fall. Precipitation during these periods is likely to be dominated by convective rather than frontal storms. Precipitation from convective storms over basins the size of the Souhegan is extremely variable. Thus, to be reliable, any flow-prediction strategy for daily low-flows should include a component that accounts for variability in recent precipitation patterns over the basin.
The concurrent flow measurements will be taken, as much as possible, during periods of stable gage conditions, i.e., sufficiently after a storm event for the runoff to pass through the system. These flow measurements events will also be conducted each time during a single day. The collection of flow measurements during a single day and under stable gage conditions will provide the best data available.

Brian

U.S. Department of the Interior
U.S. Geological Survey

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From: Ken Kimball [mailto:kkimball@outdoors.org]
Sent: Thursday, August 12, 2004 10:56 PM
To: Ives, Wayne; Loskamp, Marie
Cc: Currier, Paul M.; Couture, Steve; tom.ballestero@unh.edu
Subject: Re: Comments on UNH proposed ISF methods

Re: Appalachian Mountain Club Comments on the UNH ISF Souhegan Methodology

As a member of the Technical Review Committee overall I thought the UNH, U of MA and Normandeau Team have organized a tight and disciplined strategy. I offer the following comments and suggestions for the proposed ISF Study.

1) The selection of Habitat Suitability Indices (HSI) to be used for the organisms selected should show documented acceptance of them from federal and state resource agencies. It is my understanding that these will be the same /similar as the HSI used in similar studies in the immediate region by team members. But since HSI choice can strongly influence the modeling results, and the results when applied could be legally challenged at some point, the documentation of how the HSI were selected and that they had agency consultation in at least those processes would be beneficial.
UNH will support its selection of Habitat Suitability Indices with discussion of the strengths and weaknesses of this data type. Habitat suitability will be developed in context of on-stream fish observations that will verify these indexes. Fish observations will be made by underwater observation or by electroshocking where the stream configuration is not conducive to underwater access. Fish occurrences will be correlated with hydraulic and habitat attributes that will verify habitat model predictions.

2) I strongly urge that the flow requirements for navigation and recreational boating, a flow dependent value, be semi-quantitatively analyzed. This analysis should be conducted relative to flow needs to provide boating opportunities on a use by reach basis (flat water versus white water) under natural flow conditions. It is not necessary to study the issue from a water store and release perspective to provide an artificial opportunity.

The purpose of the study should be to gain insight on how much natural flow can be removed through water removals before it impedes the general boating experience under natural flow conditions. I agree that current water withdrawals in this river likely have minimal effect on recreational boating. But even if the null hypothesis that current water withdrawals have no significant impact on recreational boating in this river at this time, this is the first NH river to be studied and this important parameter should be conceptually addressed and the precedence for a method established.

Considering that funds are not available for an extensive, quantitative boater study at different flows, and varying the flows artificially for a study is not a reasonable option, I suggest you use a Delphi or "professional judgment questionnaire using boaters experienced with the river to estimate flow ranges needed for the different boating experiences. George May, who is on the WMP, is an experienced boater who knows the river. He might be able to help identify other boaters familiar with the river to interview as to what flow ranges provide what types of boating experience on different parts of the river. In the whitewater reaches this should be divided into kayak versus open canoe, though I suspect for this river the differences would not be great.

The study teams float trips can also provide data on what levels provided boatable conditions by river reach and qualitative information -- scratchy, had to drag canoe, etc. in reach x or y during their studies for fisheries.
Boating flows will be defined quantitatively. Several of the suggestions above are part of the boating use assessment for flows. UNH will incorporate the observations from of one or more of its field surveys with advice from local boating experts. Table 2.1 was revised to document this assessment method.

Thanks for considering these comments.

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From: Carl Paulsen [mailto:c_paulsen@nhrivers.org]
Sent: Saturday, August 14, 2004 11:10 AM
To: Couture, Steve; Ives, Wayne; Loskamp, Marie
Cc: c_paulsen@nhrivers.org
Subject: Souhegan comments

Following are my comments for the Souhegan IPUOCR draft report. I was unable to submit by Friday due to lack of internet access. I hope you can still use my comments. I'll send a Word attachment when I return to the office on Tuesday. Thanks. Carl Paulsen, NH Rivers Council.

Wayne Ives
Instream Flow Specialist
NHDES Watershed Management Bureau
29 Hazen Drive
Concord, NH 03302-0095

Dear Wayne,

The following are my brief comments on the draft IPUOCR report for the Souhegan pilot study. In general I'm pleased with the work on the IPUOCR report, for example, the discussion of rare, threatened and endangered species which is quite thorough. My comments below focus on seven areas of concern I have with the report.

1. There appears to be a bias toward low flow protection and an assumption that summer low flows are the only important consideration (note that the discussion under Table 2.1 for aquatic life identifies only low flows as a concern, whereas there may be issues with spawning or incubation flows - while this too is a "low flow" issue for the species, it occurs at a non-low flow time in the river). While this may not be the intent of the contractor (they do mention, on p. 41, that the species with the "highest flow needs in particular (sic) season (e.g. spawning salmon in the fall) will be selected as indicators for PISF needs"), it should be clear that the protected flows could contain flushing flows, seasonal whitewater flows, spawning flows, etc.
There are several assessment methods that will be used. The assessment for fish will not cover whitewater boating flow needs. Whitewater boating will be assessed using field observations and expert opinion. The fish assessment will be made on a seasonal or bioperiod time-scale that incorporates flow needs during other times of the year than summer low flows. This assessment will identify protected flow needs during the biologically significant periods other than summer low flows. UNH chose bioperiods by analysis of life history and corresponding hydrograph. The text was changed to clearly state how each flow need was to be determined. Selection of a species with highest flow needs in a bioperiod does not meet the objective of providing flows for a reference biological condition if that species is only marginally appropriate/successful in the reference ecosystem.

2. It is unclear if the contractors reviewed municipal documents such as master plans, open space and recreation plans and related local documents to identify resources of community significance. While the preliminary review of the IPUOCR list by the TRC and the WMPAAC should have provided a reasonable source of this information, I'm

concerned in particular that recent revisions of these documents may have been missed. I would recommend that the contractor review those documents to make sure flow dependent resources of particular concern to municipalities aren't missed.

The Department is not aware of any recent revisions to these documents and there were no such comments from members of the WMPAAC The existing documents were used and the WMPAAC reviewed the resultant list of both IPUOCRs and their sources. WMPAAC members did contribute information from other sources, that were used to create the IPUOCR list.

3. There appears to be no examination of the role of hydrologic variability itself as an IPUOCR. We know that the full range of flow variability is important for hydrology, morphology, aquatic life support and so much more, and a focus on relieving low flows and (potentially) shaving high flows for storage runs the risk of severely leveling flows and destroying flow variability. Variability needs to be considered when management plans are developed, and it should therefore be discussed relative to it's importance as an IPUOCR and in support of other IPUOCRs. The report does discuss hydrology, geology and habitat, but does not indicate any consideration of flow variability in their proposal for how to protect these features. Treating variability as an IPUOCR would ensure it's consideration.

Variability of flows is an important part of the assessment. The report has been expanded to emphasize the role of hydrology in the assessment processes described. The Natural Flow Paradigm is an overriding concept within the assessment, which is based on the need to maintain a streams natural cycle of variability as well as volume of flow. The assessment methods include a process for describing the protection of habitat by identifying the historical streamflow variability. These assessments identify reference habitat availability and its variation due to stream flow. The variations are then assessed for frequency and duration during the period of seasonal evaluation. The result is a description of required flows and their durations.

4. Under the discussion of insects, there is no discussion of the flow needs of benthic macroinvertebrates. I am not well versed in invertebrate zoology, but I would like to be certain that flow needs of these resources (vital to the full aquatic food web) are considered.

The Department considers invertebrates as important indicators of stream health, but also considers invertebrates more dynamic than fish in their response to flow changes. Fish are considered more stable indicators multi-year stream flow conditions. Complete assessment of invertebrates is also a greater effort than the available funding will support. Because of this UNH has incorporated into the assessment evaluation of Odonates (dragonflies) to act as a surrogate for other benthic invertebrate habitat requirements.

5. With #4 above in mind, I'd like to see some discussion of what is known (or predictable) about the broader ecological effects of flow alteration, such as trophic effects, changes in species distribution, etc. If, for example, a PISF to protect certain life stages of a fish along with management measures (such as skimming of peak flows) to meet that PISF result in increased abundance of other species, might they out-compete the species of concern (or other resources) and therefore undo the benefit of the PISF (or cause other problems)?

The protected flow will be assessed based on flow needs of the flow-dependent IPUOCRS and without consideration, at this stage, of management concerns. Given the assumption is correct that the Natural Flow Paradigm protects native species and their proportions and density, then when the Target Fish Community for the Souhegan River is assessed for its flow needs, the expected result is flows that maintain these proportions and densities. The assessments of flows needed to maintain habitats is designed to identify the timing and periods of critical flows.

6. The statement on p. 23 about balancing flow needs for aquatic life vs public and private water uses concerns me. It was my understanding that the flow stetting process under the pilot rules was to identify and establish protected flows for the resources of concern to the river. Water supply itself is indirectly identified in the statute as a protected resource (at least basic “emergency” needs), while the remainder of human use is subject to the protected flow needs of the resources. It was very important in the negotiation process of the pilot projects that the science of flow needs be separated from the management decisions, and it should remain that way.

The protected flows will be determined that maintain flow for flow-dependent protected entities. The determination will be made outside of the need to balance on-stream and off-stream uses—the balancing will be conducted during the Water Management Plan development. However, an assessment of the impact of the proposed flows on off-stream water use will be conducted during the PISF development process prior to establishing these flow requirements. This is an important step and will illustrate the conditions that will be created under the proposed flows. The statement has been revised in the text to clarify this process.

7. While the report discusses recreation, it seems to do so only from the standpoint of boating. That discussion is fairly good (though it’s unclear if they are proposing that certain summer flows should be protected for flat water boating in the lower reaches - a factor that may be important but for which I don’t have any personal knowledge), but it does not address swimming. In fact, Table 2.1 does not appear to list swimming at all, and subsequent discussions of recreation and community resources make no mention of swimming. I know that there are a number of traditional swimming holes along the Souhegan that are of local importance (though perhaps not specifically identified in municipal planning documents) that should be considered.

Consideration of swimming will be limited to designated swimming areas as defined by Department guidelines. Under the Clean Water Act designated uses, the Department applies Primary Contact Recreation water quality standards to Designated Beaches. Designated beaches are swimming facilities maintained by some person or group as a facility for the purpose of swimming. At this time, no Designated Beaches have been identified on the Designated River.

Once again, aside from these issues, the draft is quite good.

Carl Paulsen

August 10, 2004

Ms. Marie Loskamp
NH DES Watershed Management Bureau
29 Hazen Driven
Concord, NH 03302-0095

Dear Ms. Loskamp:

In accordance with the recent request for review and comments on the draft Souhegan River Flow Study, July 2004, we have the following comments to offer.

Page 2. We are concerned that the flow-dependent aquatic species/life stages are limited to the summer period. Native fall spawning fish such as brook trout and Atlantic salmon need to be considered during the fall/winter period. If spring spawning stocks are dependent on overbank flooding or flooding of backwater areas, this could also be a critical flow period.
The flow needs of fisheries will be assessed for bioperiods relating to these significant life stages. The low flow needs will be determined during these periods not only during the summer using MesoHABSIM. High flow needs will be determined by the other assessment methods like Transect/Seasonal Water Level Assessments or Floodplain Model. In some cases like in the winter months there is little or no data for habitat needs of species. Habitat needs may need to be determined based on reference flow conditions for these months.

Page 9. The line for aquatic and fish life in Table 2.1 needs to be modified to account for the discussion above. In addition, the method assessment column would need to be modified since hydraulic simulation techniques are not reliable under ice conditions. Critical flows may also include fluctuating flows.

Page 10. The wood turtle should be evaluated for fluctuating flows and low flows.
Will be done

Page 13. The native fish community is proposed to be divided into two separate communities. We agree that it should be at least two communities and remain undecided if a third is appropriate for the Wilton-Milford reach.
Noted.

Page 16. We suggest that American eel be deleted from Table 3.3. American eel was deleted from this table. Spawning for this species is not a riverine process. The spawning period for brook and brown trout appear to be overly broad for this part of their range. This period was revised in the final version to match local conditions prevalent in the Souhegan of late October to November .We would expect a late October-November time period for these species.

The discussion on native fish species should be considered a works-in-progress topic. We are uncertain about the status of spottail shiner, burbot, slimey sculpin, sea lamprey and brook lamprey in the Souhegan.
Native species will be continually reviewed during the field studies. These species will be retained or removed based on the results of the field work.

Page 17. We do not believe sufficient reason has been given to support the conclusion that Odonates are the most important insect order for purposes of this study. Certainly, they are an important order in the reach below Milford, but do they take priority over all insects? Our limited exposure to the river suggests that the EPT group (mayflies, stoneflies, and caddisflies) would be a sensitive group, especially in the reaches above Milford. Keep Odonates with supporting rationale or go to EPT? Odonates will remain as part of the program. All other taxa will be archived for future reference.

Page 22. We are not in agreement with the current construction of Figure 3.2. In our view, 7Q10 should be deleted. Natural flow/run-of-river should be put in its place. Tennant is acceptable as a generic standard setting method. IHA is acceptable as a generic standard setting plus method. We assume the acronym ROV is range of variation, however, both IHA and ROV should be spelled. Under the horizontal axis, the words resource importance should be deleted and in their place, insert negotiation process.
This figure has been removed from the report.

These changes are intended to make it clear that less tinkering is better. We ordinarily recommend a natural flow condition as the best means of protecting native aquatic life. Incremental and simulation techniques were developed to better integrate flow studies with institutional analysis and negotiation processes. The incremental and simulation techniques are not the first choice of the Service to protect important resources.
The proposed assessment techniques are supposed to define protected instream flows within the concept of the Natural Flow Paradigm and under the requirements of the statutes and rules without concern for management issues. The MesoHabsim process is predicated on natural or reference flow conditions.

Page 23. In the first paragraph under selected methods, we are puzzled by the reference to "balancing" in this instream flow study. Our understanding is that "balancing" would be considered in the water management plan phase.
The balancing portion will be done under the Water Management Planning portion of the Pilot Program. The text has been revised to clarify that these are two distinct steps.

In the last paragraph, the acronym HM should be spelled.

Page 26. Task 3 may need to be expanded to include fish collection work to verify the existing fish community. It should not be limited just to fish observations.
UNH will collect fish and observe fish as part of a verification process. These alternatives will be applied based on access for underwater observation. Where this is not possible, electrofishing using 6-meter, pre-positioned grids will be conducted at selected sites. This is not intended to be defining the Target Fish Community, but verification of predictions of habitat suitability by physical habitat model.

Page 28. The proposal to determine wood turtle hibernacula and protective flows during the emergent wetland survey is cause for some concern. A more appropriate time may be late fall before ice cover when turtles are using their hibernacula. We would like to know more about the process the team will utilize to determine protective flows for wood turtles and other aquatic life under ice conditions.
Under ice conditions will be based on hydrologic assessments rather than habitat assessments. Ice conditions are the least reliable for gage measurements and little is known about habitat needs during the winter. Resulting protected flows for this period will be less certain than other bioperiods or seasons.

Page 36. The discussion on floodplain forest could benefit from some minor editorial change. Our observation is that below Milford, the silver maple floodplain forest is dominant, while above Milford, the red maple floodplain forest is dominant.
This revision was made.

While not listed in the draft report, we learned at the July 30 meeting that the Souhegan watershed may have been subjected to a flood control project by the Soil Conservation Service PL 566 program during the 1950-60 decade. If flood retention structures were built, this could affect stream temperature, hydrology and aquatic communities.

Dams have a number of effects on streams by trapping sediment, modifying the flow response, increasing temperatures and changing habitat. There were four flood control dams built in the mid 1960s in the Souhegan WMPA. Their impacts will be assessed to determine the reference conditions.

Questions should be directed to me at 603-223-2541 or email vernon_lang@fws.gov.

Sincerely yours,

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Non-editorial Department comments

The Department directed UNH to change the status of the two Superfund sites in Table 2.1 from flow dependent to not flow dependent. The remedies for these sites must take into account the flow variability of the river. Instream flows will not be managed for site remediation needs.

The report should be clearly describe the process for selecting species and life stages for defining the habitat suitability requirements. This should include describing how the Target Fish Community will be use, including whether the habitat needs for these species will be used together or, in part (e.g., top five species), or individually, under what criteria will this decision be made and if it is to be based on the future results of the Target Fish Community.

Describe either the seasonal periods or bioperiods to be used under the MesoHabsim assessment or the method to be used to define them. The Department's seasons based on hydrology were defined as January 1 through March 15 (Winter), March 16 through May 31 (Spring), June 1 through October 31 (Summer), and November 1 through December 31 (Fall). Biologically appropriate time periods should be used.