LAMPREY TECHNICAL REVIEW COMMITTEE
NH Instream Flow Pilot Program
New Hampshire Department of Environmental Services
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Lamprey TRC Meeting Minutes
Thursday, April 26, 2007
1:00 pm – 4:00 pm
Rooms 111 and 112, NH DES
29 Hazen Drive, Concord, NH

Members Present:	**Representing**
Robert Flynn	US Geological Survey
Brian Gallagher	Business Interests, NH Water Works Association
Vernon Lang	US Fish and Wildlife Service
John Magee	NH Fish & Game
Carl Paulsen, Vice Chair	Conservation Interests, NH Rivers Council
Jim MacCartney, Chair	Conservation Interests, Trout Unlimited

Others Present	**Affiliation**
Piotr Parasiewicz	NEIHP – UMASS
Ray Konisky	The Nature Conservancy
Al Larson	Normandeau Associates
Michael Metcalf	Underwood Engineers
David Cedarholm	WMPAAC Member, Durham
Judith Spang	State Senator, Durham
Mike Kappler	State Representative, Raymond

DES Staff Present:
Wayne Ives, Instream Flow Specialist, Watershed Management Bureau
Lisa Fortier, Executive Secretary, Watershed Management Bureau
Steve Couture, Rivers Coordinator, Watershed Management Bureau
Paul Currier, Administrator, Watershed Management Bureau

1:00 – 1:15
Open Meeting, Introductions and Approve Minutes of March 7, 2007 Meeting
Jim McCartney motioned to approve the minutes, Vernon seconded. Some members who voted were not noted on the attendance. All voted in favor of approving the minutes with corrections to attendance.

The Target Fish Community Report
The TFC report has been posted on web. Jim asked for comments or discussion.
Wayne - Vern had some comments on the American Eel.
Vernon – In a discussion I had with Jeff on the American Eel I suggested that we strictly consider it to be a macrohabitat generalist. I know with the changes he has made he has it as a macrohabitat generalist/whatever. He based it on the notion that they require fresh water. Some recent reviews and research studies suggest to the contrary. It has always been to my understanding that eels are

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completely capable of completing their life cycle in marine or brackish water of estuarine situations and certainly this document substantiates that. To be correct I think that we should just consider it strictly as a macrohabitat generalist. It is probably one of the most successful macrohabitat generalist fish specialists.
Wayne – When I polled the fish people the response that I got was that the American Eel was a macrohabitat generalist with a need for access or route to the sea for spawning. I feel the same way as Vern did in that it really should be classified as a macrohabitat generalist. I will speak to Jeff again about that to figure out why it needs the caveat of fluvial dependant when it only needs passage.
John – I want to make sure that you are saying to get rid of the fluvial dependant term.
Vern – Yes, it is my recommendation to call them strictly a macrohabit generalist.
John – Is there any need to articulate that they need a migratory corridor? Not every individual, some individuals do exist close to fresh water, but in an estuarine environment, and then go back out to sea. We are calling it macrohabitat generalist but we also have to be cognizant that those who live in fresh water have to go through some flowing water.
Vernon – When we first starting doing the Quinebaug, we had that discussion about how to classify then because if they are in freshwater they have to get to their spawning areas they have to exit the freshwater system. They don't require and flowing freshwater system. You can have a situation where eels will come from an estuarine or salt water system into a coastal pond that is either brackish or fresh and you don't have a riverine system but an inlet that flows back and forth with the tide. That is why Jeff was being careful because some of the folks were still concerned that there was a need to identify that link to make clear that eels in freshwater systems have to migrate through those systems into estuarine and salt water systems.
Jim – I think that is a significant point. While you may have populations that do fine in marine brackish situations, if you have fish in freshwater they do need access for spawning.
Piotr – According to of the definition of fluvial dependent, for a specific period of life they need the free flowing water, which I agree is a little stretch of the definition. Talking to people that worked on eel in the Connecticut, they have brought in a specific perspective and the habitats they need and the first thing that they tell us is that they are not associated with sand, which is also associated slower flowing water. I don't think it is changing our conclusions or anything else.
Doug – The preference is to have it listed or identified through the habitat use classification solely as a macrohabitat generalist.
Vernon – I have no objection to making some sort of notation that they have to exit the freshwater system during their migration to the sea.
Wayne – Can we just delete the FD and leave the asterisk with the explanation at the bottom.
Vernon – I have mostly editorial type questions and comments and one of them started on page two. It is the sixth line down. Jeff was not consistent in his use of terminology. I would suggest where he is talking about the target community for the Lamprey that he indicates in each instance that it is the designated reach of the Lamprey. A target fish community a few years ago was looking at the whole river, which is slightly different. He does make it clear in places in here that it is the designated reach and there are other places where he talks about the Lamprey River target community. It is a matter of making sure other people don't get confused when they read it.
Piotr – My understanding was that the community that had been created was purposely called baseline fish community, showing what we had now. It wasn't a target.
Wayne –There has been two groups fish assessments on the Lamprey. The baseline fish community was collected in 2003. Part of that, I think you and several other people were involved in putting together the available data before that baseline fish community using the upland watersheds and it wasn't so concerned with the designated river portion but it shows any sampling within the watershed.

You then developed a target fish community based on that data. That was a target fish community that was watershed-wide. The baseline fish community was focused on the designated river. There are two different groups there and I think it does make sense to clarify that we are talking about the target fish community that was developed for the designated river, the baseline fish community that was created on the designated river, or the target fish community that was created for the watershed-wide assessment. We'll just make sure that is clear. Page two is basically where that is happening.
Vern – Page two and on top of page three. I decided to make a generic comment any place it occurs. The other comment I had is on page four he references Lang et al, 2001. I think what he is referencing here is work we did on Ipswich and Lamprey around that time frame. It doesn't appear back in the bibliography section. On page 5, when he is talking about stream order and the streams selected for reference, one of the questions that popped up in my mind was whether or not Jeff had looked at relative to the position of the streams to connection with the estuary or flowing water. In pursing that, back further in the report, he referenced using the Isinglass or the Cocheco and he classified them both as fourth order streams. The Isinglass dumps into the Cocheco below Rochester. It wasn't clear to me where on the system of the Cocheco the data was coming from.
Piotr – Even if he was using the Nature Conservancy classification for those reaches that he had, if he is referring to this as a fourth order it must be upstream of that. I had a concern with these two rivers are far away from the coast. This is the price to pay for having all that. We have a difficult balancing act because we have such a scarcity of data that if we remove these rivers we would have a model that is much less accurate. The decision was to take into account that it is far away from the coast but still include the data. He reviewed the data and verified that they were not terribly different.
Vern – I didn't know where the data was collected and they both may have been fourth order. It isn't clear when you look at it.
Wayne – We did have a map of the sites previously but it isn't in the report so maybe we need to add that back in. I think the bigger issue was having enough sites to have this make any sense at all. If we limited ourselves to proximity to estuarine and marine waters we may have had trouble getting enough data to have it make sense.
Vern – The next point was on page eight in the middle paragraph. This is a question concerning an arbitrary 50% variation in the numbers. My question was how it was chosen and did Jeff look at what the annual variation was in the fish population of the reference rivers.
Wayne – I don't think there was enough data. Most of these sampling sites were two points and the criteria was that you had to at least have two measurements in that river. It was rare that there was never anything more than that. There were so few samples that I don't think there was a chance to compare on time to another time at all.
Piotr – We had a long discussion on this topic when working on the Souhegan, where to put the break. We tried to follow Mark Bain's idea and fine tune it. After looking through available data and information that we had we decided to go with this number. It is arbitrary.
Vern – I am not objecting to it. In the three or four target fish communities that I have either been involved in or reviewed we have never pushed this point.
Piotr – It was never written down but that is the way it was always calculated.
Vern – I don't remember that Mark or Marcy, when we analyzed the data for the Quinebaug streams, looked at what the variation was in that sampling data to give us a clue to what figure we should be looking at to measure a significant change. Is it 20, 30, 40, or 70%? We are down the road five or six years from when they started this exercise for target fish communities and I don't think we are any closer to agreement or an understanding.

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Wayne – I told Paul Currier years ago that we needed four hundred people out in the streams collecting fish all the time before we are ever going to get the kind of numbers to make those determinations.
Piotr – I spoke with Mark Bain when we went through the process of finding the numbers. His response was that at that time it was an arbitrary decision too. It would be great with the data that is now available we could look through the data to determine this number.
Wayne – Would it make sense to document that this is an arbitrary number as opposed to continuing a paper trail of saying 50% is some value that represents something?
Vern – That would make sense.
Wayne – I don't want to perpetuate a value that isn't of any consequence other than someone pulled it out of the air on day. Repeated use of the number does not make it the correct value.
Piotr – We made progress on determining what an affinity index means. What is the value that is bad and the most deviation and what is the value that is the least deviation. Most of the rivers that we are working on, the good ones, were above 67% and the worst rivers are down to 30% with one exception for the Eight Mile River. Eight Mile River had 58% deviation. We suspect the major reason was that the Eight Mile Rive was better than we used to develop the target fish community. We were asked to exclude the Eight Mile River data by our reviewers.
Vern – The next comment I had was on page nine on table 1. Rainbow Smelt were listed in the designated reach. The reason I raised the question because smelt are weak swimmers and they don't go through fish ladders very well. On the Charles River in Boston they don't use that ladder and they get upstream using the locks. Has anyone observed them in that system above the dams in the Lamprey?
John – I don't know if we have data for that.
Wayne – The historical data doesn't have Rainbow Smelt identified in the Lamprey.
Piotr – We are talking about expected proportions. I don't think that existing community we are talking about expected community. Without the dams there is no reason that you wouldn't expect them to be there, right?
Vern – Yes, because there is a pretty high waterfall at Newmarket. That is the reason the question as to whether rainbow smelt made it up through the falls.
Piotr – What is the answer?
Vern – I am raising the question. They probably didn't exist upstream of Newmarket historically. It came from some report somewhere. I don't know where Jeff got it from.
John – Are we talking about anadromous only Rainbow Smelt?
Vern – They came from local ponds there into the river?
John - May they were introduced. I agree that is a big waterfall downstream. All the rivers I worked on in Downeast Maine and I can only think of one Rainbow Smelt that we got in a trap or electric fishing survey and we spent thousands of hours running those traps and surveys but if you went down into the tidal section with a headlamp you could find them. I don't think that the anadromous ones are going to come that far up the river system even if there weren't dams and waterfalls.
Vern – They do in the coastal streams in Massachusetts. There are a number of them that go upstream for some distance.
Wayne – How are we going to evaluate it is the next step.
Piotr- Jeff would have a look where the data came from and just reevaluate it. It is one of the species that is in very small proportions in a community.
Vern – The other question I had was that under Percidae, the last group on Table 1, did Tessellated Darter showed up in any of the data in the reference streams?
John – You would expect them to be there?

Vern – When we were doing the work on the Ipswich we had some data that said there were Johnny Darters present and we automatically assumed that they were missing but in classifying them we found that they were actually Swamp Darters. After we had finished the target fish community we found another report that had been done in the mid-fifties that Mass fisheries people, and it was clear that there were Tessellated Darters there in that series of collections. It is one of those fuzzy areas and we can't be certain that they were native in the Ipswich, but we do have that report saying that they were common in the mid 1950's.
John – In the Southwest corner of NH we found a lot of places where there are Swamp Darters and as far as I know there are no records of Tessellated Darters. Within the boundaries of NH we have never found a Tessellated Darter that has been documented as existing in the Lamprey. I can go back and project the data onto GIS just to be certain but I am pretty sure that we have no Tessellated Darters records for NH. Maybe they have been extricated from that area.
Wayne – Roy, just for your information, these are public meetings so feel free to comment. Don't feel that because you are not a TRC member proper you can't comment. It is so everyone has a voice as a stakeholder and can come and add their voice to their specific stakeholder group. That is what you are doing here.
Vern – My next comment was on page 11, figure 2, Jeff has Redfin Pickerel and Chain Pickerel both showing up as %2. I remember when we were working on the Ipswich target community we used the Lamprey River as a reference. We noticed that when your progress from the Boston area to Cape Elizabeth there is a breakpoint around the mouth of the Merrimack River where to the south of that Redfin Pickerel are the dominant species and to the north of that estuary Chain Pickerel are dominant. Is that what you would expect to see in the Lamprey?
Wayne – Is that in figure 2?
Vern – Yes, it is the Redfin and Chain Pickerel at 2%.
Piotr – Should we lump them and call them Chain Pickerel?
Vern – No, we don't want to lump them.
Al – If data was taken from streams south and west of Boston they would see a relative higher proportion of one pickerel species.
Vern – Yes, particularly near the coastal streams.
Al – This may show where you have two different groupings and have included both in realty there is a geographic divide.
Wayne – It would be a hydrographic divide. We might expect a higher percentage of Chain Pickerel and not see the same percentage as Redfin.
Vern – I would tend to think that you might see 3 or 4% for Chain Pickerel and 1 or 2% for Redfin. There is not going to be a big difference in the numbers but one will dominate over the other. I don't think they will be the same.
Piotr – Chain Pickerel are still dominating because these are rounded percentages. You don't have exactly 2% percent. It might be 2.46 and 2.45.
Carl – If you look at the slices they are definitely a different size, presumably because that is there is a difference in the numbers even though they round the numbers.
Vern – Further back in the report there is a mention of Banded Sunfish. It should be listed and I don't see it listed there in figure 2, banded sunfish
Wayne – Is Banded Sunfish one of those species of concern.
Piotr – I can call Jeff.
Carl – You are saying in the figure it is not listed. It wasn't found?
Vern – In figure 2 it is not listed. My recollection is that they were identified in the coastal streams in the thirties.

Carl – They are still around in that area.
Piotr – So what happened to that Sunfish?
Wayne – That is in the report but isn't in the figures. Is that what you are saying?
Vern – Yes, it is mentioned somewhere here in the report.
Piotr – The numbers are probably so long, since it is an endangered species, it probably ends up in the 1% but it is a good question. We probably just don't have numbers saying it.
Wayne - Shouldn't target include that?
Piotr – Yes, as a footnote.
James – I think it also doesn't show up in table three.
Vern – The next comment was on page 17, table 3, in that first column under represented fish species, he has Redfin Pickerel listed as 1% as a proportion of the target community. If you go back down to figure 2 it is 2%. There is a consistency issue there. On page 18 on the second line from the bottom, he makes a reference to Rainbow Smelt. On page 21 he has common shiner listed twice in the third paragraph. That was all the questions and comments I have.
Jim – We had some people come in late, can you introduce yourselves?
Steve Couture - rivers coordinator
Judith Spang - state legislature, instream flow oversight committee and Lamprey River LAC
Mike Kappler - state legislator, who is also on the Resources, Recreation and Development Committee, Raymond Lamprey LAC member, he takes the places of representative Cooney.
Wayne – Where there any other comments on the Target Fish Community? My response is that if we answer all these questions, respond by email, send out the final version for approval and close out this part of the phase 5 process.
John – I have comments but I need to read through it again.
Judith – In the beginning it talks about the target area. The designated reach is the 11.5 miles that are designated as scenic, but from West Epping Dam to Newmarket are not all are in the Rivers Management Program.
Wayne – There are 23 miles that are wild and scenic. Maybe I need to make that more clear. The wild and scenic designation starts at the Newmarket Dam?
Judith – It starts in Newmarket at the confluence of the Piscasic. It doesn't go all the way up to the dam and it goes up to the West Epping Dam, the Bunker Pond Dam. The wild and scenic designation doesn't include all of Epping. The state River Management Protection Program is within the towns of Lee and Durham.
Wayne – They overlap in the sense the designated is entirely within the wild and scenic stretch but the wild and scenic stretch extends at both ends upstream. I will make a note to clarify the wild and scenic versus the designated reach discussion. What do you think about adding a designated reach to this document? Would that help this process? We are going to add the map of region that shows the selection of the reference sites that were used to define the target fish community. Would it help to clarify the discussion to add a map of the designated river?
James – I think it would if for no other reason than what Vern mentioned. It doesn't apply to the entire river. The designated portion under the wild and scenic is 11.5?
Judith – No, it is 26.
James – I think that may be part of the confusion here. The Park Service designated a 11.5 mile segment between Bunker Pond and the confluence of the Piscassic.
Judith – It says that this is the only reach that will be studied.
Wayne – It seems like that is a mistake altogether. Depending on whose GIS you use, the Lamprey designated mileage changes.

Judith – There has always been a great deal of difficulty in determining where the wild and scenic ends in Newmarket. At what point is it the Piscassic and what part is the backflow of the Lamprey? I think it depends on what Newmarket wants.
James – Wayne, do you think the approval of the changes should be via e-mail?
Wayne – yes, I think most of these things seem to be small changes, edits, and decisions that can be made and verbalized quickly in an e-mail. If we can just document what we did here, I think the decisions were made. Do you have any that were still up in the air? There was one about tessellated darter and rainbow smelt that John was going to check. Were the variations in the percentages in the Redfin Pickerel and the Chain Pickerel satisfactorily resolved?
Vern – As long as it is made clear that Chain Pickerel is the dominant pickerel.
Piotr – It is dominant.
Vern – We need to be consistent.
Wayne – That is more my issue. We need to adjust some of these so they are clearer. What was result of banded sunfish discussion?
John - I would have to look at it.
Wayne – I think what we will do is send out what we think is the right answer then because we have some things that have to be checked and have feedback. We'll send that out before we actually finalize this as a list of issues and resolutions. If they are agreeable we will finalize the report and be done with that part of the process.
Judith - Piotr, you mentioned that the Eight Mile River was kicked out. It sounded like it was because it had too much data and was not considered characteristic.
Piotr – When you are in the process of developing a target fish community you look for rivers that are similar to your target and those rivers should have a relatively low level of impact. In a developed target fish community and compare the community you have in your research river with the target. The problem that we had with Eight Mile was that it had a better community than the developed target because the target was developed from rivers that were more impacted than the Eight Mile.
Judith – It was too natural of a river then?
Piotr – Yes, that is why it causes a great difference between the two communities. That is the only thing it said.
Jim – Just for a point, that was for a study of the Eight Mile?
Piotr – Yes, that was for a study of the Eight Mile.
Jim – This was looking for rivers to use for a similar study of the Eight Mile.
Judith – Yes, but the data is going that way, not this way.
Jim – Right, it was not kicked out but it was for the Lamprey.
Carl – I am a little confused as to where it was not used.
Piotr – It was for a different project on the Eight Mile River when we where evaluating the Eight Mile River and we developed a target fish community for the Eight Mile River and then compared it with the fish community in the Eight Mile River. It is not related to the Lamprey. My point was to show that whenever we make comparisons there is an affinity number that compares one community's distribution to another. You had to make a judgment call. We didn't know exactly. Now we have four or five communities we have developed and we have seen that the rivers that are better when the percent of affinity is within the range of 60-70%. The rivers that are impacted go all the down to 30%. This gives a feel of the possibility of scaling it or standardizing so later you can distinguish between good and bad. The Eight Mile stands out.
Kappler – On the sunfish you were speaking of, that map would be of good assistance because it has always been my understanding that sunfish are only in ponded water, not running water. For sunfish,

you would have to go to any ponded water. Where you have fast running water I have never seen sunfish.
Wayne – When we did the baseline fish community part of the sampling process was to sample the impounded and more pond-like sections of the river after identifying where those were in comparison to the more free-flowing sections. You would go out with a boat shocker.
Vern – When Bob Myeta was doing some of his work in Massachusetts, he described an Eastern Massachusetts lowland coastal stream assembly which included Red Breasted, Banded, swamp darter, and Bridle Shiners. Those were the four fish that fit into that sluggish water system. They didn't find them frequently in impoundments or beaver ponds. They tend to be in some kind of slow moving coastal type stream situation in Eastern Massachusetts.
John – I concur. The Banded Sunfish we find in some ponds we have data that there are billions along the shoreline. The species you mentioned tend to be in streams. Some of them, Redbreast and Bridle Shiners we found in really small streams
Wayne – So that puts it more in a stream as opposed to a pond environment?
John – They use both. Those species that you mentioned are probably species that exist in both but have some type of behavioral or morphology adaptations that allow them to utilize slower flowing stream habitats.
Jim – Are you folks all set on the Target Fish Community Report?
Robert Flynn – I have a question Piotr. I recall one time looking at the Lamprey River gradient and there was a definite gradient change, I believe in believe around the Epping River location where it changes from a high gradient to a generally low gradient stream. I was wondering if you had looked at splitting the Lamprey into two different segments beyond that eleven mile reach?
Jim – We probably did the fish community based on that baseline need because the designated starts in Lee and Durham so it is all in that lower gradient section. What we had at that time, before we did the baseline fish community sampling, was mostly data from all in the uplands and the higher gradient environments that were further off to the west and north. They were only measurements made of fish in the designated river itself. That was part of the reason I decided we needed to go out and see what is going on in the Lamprey and not rely on a lot of the data that was collected and was mainly from the segment of the upland reaches.
Piotr – We considered this to be one section of the low grade portion and have no mandate to go beyond that.
Judith – I believe Jamie Fosburgh said that he had been at one of these earlier meetings where Piotr had done maps that showed areas that faster and slower flowing sites in different colors and he said that it looked like 40% of the Lamprey was classified as impounded and in some instances those were natural impoundments. In looking at page 21, were they are talking about the impacts that non-native species in impounded areas have on the native species and I am wondering if, in this context, impounded includes those natural areas which really are part of the natural expected fish species.
Piotr – Impounded in this case applies means artificial impoundments.
Judith – And those are the McCallan Dam and Wiswall Dam but not Wadleigh Falls?
Piotr – No.
Jim – Let's look for revised report a few weeks out.

1:30 – 2:55 NAI – Technical Presentations - Piotr

Data collection – The majority of field work has been completed from our end. We started our preliminary information gathering from detailed GIS maps that have surficial geology and many layers. On top of this we installed several data loggers that are identified by dots on the map. DL

stands for data logger and TL means temperature logger. They collected temperature last summer. This information is now being processed. We have gathered this information and it will be part of further data analysis. On this map, the red parts are representative sites. The first thing that happened was a reconnaissance survey of the entire river. Based on this survey, we selected sites that have been mapped four times. Every thing that is free flowing is red.
Carl – When you say free flowing you mean not controlled by any water control device.
Piotr – That is right, water control devices or water falls, whatever is not backed up water.
Each of the mappings has been accompanied by an aerial survey. The purpose is to fly the entire river multiple times while we are mapping it and then assign the different patterns of the aerial photographs to different habitat features and have the ability to remap with only aerial photographs once we have enough information. We were cautious and covered everything that we could see. When we mapped the river, we selected target flow conditions that we were looking for and then try to find when there is more than or 10% difference. We were pretty lucky on the Lamprey with one exception. We came close to our target values. You see the dates and the amount of the water that was in the river at the time as well as the beginning and the end flow in the streams. We also document if there was any unexpected water withdrawal or a storm or something. Here is what has been mapped and our mapping includes drawing on the aerial photographs the various hydrologic units, as we called them, which are pools, riffles and runs, and a determination of depth and velocity within them as well as other parameters that are relevant for fish. Of these units that you see here, for example, we would receive information that would tell us if it has an abundance of woody debris, shallow margins, boulders, etc. and what would be the dominant depth and velocity. I am really sorry that the colors are so messed up [on the slide] because you have a hard time seeing the difference. This should be orange and they are sidearms, the backwaters are red. These are ruffles and these are rapids.
Carl – What is the difference between a riffle and a ruffle?
Piotr – It is in between a run and a ruffle. The best definition of it is deep water rapids. We invented it. There were several surveys when my staff came to me and said that they had a problem with a specific situation because it was a run with a lot of ripples on top of it. It is fast flowing and has a lot of turbulence. Our tendency was to lump rather than split. In the future there may be four categories. What you see here is one of our sites, site six, at the flows of 1.5cfsm. That is how it would look at 1 cfsm and 0.2 cfsm. On the other, this is red upstream below Wadleigh Falls, that is 0.51. This is the highest flow and it is dominated by run, glide and pool. The next lowest flow is 1cfsm and we have more riffles here and some rapids. The further down we go, this pool is turning into a glide. We are dealing with different hydraulic conditions. In another study we did, this "spaghetti that you are seeing up there should be different colors representing depths within the Wiswall impoundment. We basically surveyed thousands of depths within the impoundment so we have pretty good idea about thermometry. This would create the base for a bathometric map of the impoundment. As you see here we are getting depths of 1 or 2 meters and we go all the way to five meters closer to the dam. We did the same with Newmarket. In both cases this was less surprising than the Wiswall Dam because it was pretty visible but in Newmarket we could determine that it sits on a waterfall and actually, if you remove the dam the change in the water surface elevation wouldn't be that dramatic.
Judith – How did you measure the thermometry?
Piotr – With acoustic Doppler profiling and zigzagging in the boat.
Judith – You know about the fish ladder that the Army Corps has done that mechanically by boat. If you needed to cross verify that data would be available.
Piotr – We would love to have a look at it.
Judith – That is in the environmental assessment on the fish passage.

Piotr – They only have a few sections and we carpeted the place.
Dave Cedarholm - The time of year when you get to the cfs values, are those seasonal averages?
Piotr – I don't remember what the flow was at this time. Within the impoundment it doesn't make a lot difference, at least in depth, which does not change a lot. We have it recorded what kind of flow it was.
Dave Cedarholm – Are those depths correlated to elevation datum?
??? - What were the dates that the impoundment survey was done?
Piotr – The impoundment survey was done in the fall of 2006 but I don't remember the exact date. It was the last survey we did once we were done with everything else. It was still nice warm weather.
Doug – The attempt to estimate cfs was that an attempt to estimate seasonal average flow rate?
Piotr – No, we are trying to describe the change in habitat conditions within a specific range and our greatest concern is the range of low flows. You see on this figure here, usually on most of the river is1 cfsm, which is use it is our greatest concern. We have a higher density of flows at the lower end than our higher equivalent in our case to 180 cfs. 1 cfs is over the square drainage area. It is the upper end of low flows. We are trying to cover the range of flows that occur in summer and the reason is hydraulics. I always compare it to filling a bathtub with water. When you open the water there is a great change in the water in the beginning until it fills up to some level and there isn't much hydraulic change. From point of hydrologic modeling, it is more important to describe the low flows than the higher. You can interpolate from the higher flows than you can from the lower flows.
Al – The other thing to note from field studies, you can see in the dates that they can span different time periods. There was some difficulty in field trying to get synoptic round of measurements because the field conditions could change. This was there best attempt at trying to get the field measurements done within a consistent flow range. They weren't able to go out and say we need a flow measurement exactly at point 0.2 or 0.5 and get that on a consistent basis. They were watching the hydrograph mobilizing on the water and on some occasions they would actually be on the river and storm would come in and you would see the hydrograph rising. They would have to stop and wait for the hydrograph to drop back down and restart the field effort. That is why you would see a jump in the actual field dates. The other challenge that year was trying to get below 0.2cfsm.
Piotr – we were unable to collect the flows any lower than 200cfs last year because the river never got that low. It got that low in 2005 and the reason why I blame myself is because rather than take the personal risk and start the survey without a contract signed I decided follow the orders of my superiors and not to go to the river.
Judith – Is there any way to correct that? David, are you are probably able to better inform us. It seems to me that 28 is a pretty high flow if you are talking about summer flows in the Lamprey. We get right down to 5 or 10. What would you say is a typical low flow in the Lamprey?
Dave Cedarholm - In 2002, I was measuring flows of 2 to 3cfs above the Lamprey River impoundment.
Judith – That was during a drought. Piotr is talking about getting the upper level of low flow situation. Would you put that around 6 or 10? It is certainly not as high as 87.
Piotr – 47.
Judith – I am talking about cfs.
Piotr – Below cfs was 47 and it was down at the bottom of the gauge. This is the number, that what the flow was in the river and it was on the gauge in Newmarket.
Judith – That is probably four times as high as is typical and that really concerns me.
Piotr – I understand and to answer your question it would be theoretically possible to model and with some hydraulic models we can do it. I am very concerned about for the reason I mentioned before. The further down you go on the hydrograph, the boulders and the roughness are starting to get bigger

and every boulder plays a more important role in the hydraulic conditions. It would be good to have data at low flows. This is valid for any sort of data collection on any sort of hydraulic model. It is valid for one day measure hydraulic models that we used earlier and it is valid for two and three dimensional models. The modeling of the very low end of flows is very susceptible to error so you usually try to get these low flows.
Judith – I am looking at this in terms of it being a true pilot that we are going to be spreading through all the other protected rivers and possibly, eventually, to all the rivers in the state. If we can't iron out these glitches so it is valid and do everything we want it to do in the pilot then we won't really be able to make it viable as we spread it.
Piotr – One option that I see here that is probably the best option is to move on with modeling and model the flows habitat and conditions at the lower flows and then go and validate. So, wait for the opportunity and then go and measure and see what real differences you have.
Jim – I think I am hearing two issues here. One is what the flows actually are in the stream but I am thinking hearing Judith saying the 0.2 cfsm, which you didn't actually meet, isn't really representative of the typical low flow condition of maybe a 0.1 value, or something in that order, which is something that we should be trying to go and capture those flows, whether they showed up last year or not. The question is whether or not the range of values from 0.2 to that 1.5 to 2.0 really captures the sort of conditions that we are interested in looking at.
Piotr – One thing that you can assume is there is no flow there will be no habitat. You can always draw a straight line, and this will be clearer when it comes to the rating curves, between the amount of habitat that you have at 0.2 and 0.
Judith – Does it work equally well no matter what the gradient of the river? Does it work as well for these rippled areas that may be dead dry as it does for these naturally impounded areas where the fish may retreat?
Piotr – It will stay on the conservative side because if you have a low gradient river you have the phenomenon of hysterisis. When drop the flow in the water, it stops flowing, but there still will be water in the stream. It is very different from when you have a dry stream and when you turn the water on.
Judith – It is not geometric, it is linear.
Piotr - It is always linear. It goes in two different directions. In our situation the duration is the key question here. If it is a drought of a short duration there is still a lot of water being left in the river? If duration is becoming long and prolonged then you are facing a situation where you have zero flow and zero habitat. Create model when increase of habitat. If you create a model where you assume that the relationship between the increase of habitat, between 0 and 0.2 cfsm, is linear, you are representing filling the river with water, so you stay on the safe side. That is the way we can simulate it this way and estimate how much off we can be. We will never get more habitat than 2 when we turn the water off and we shouldn't. The best of all worlds would be to do the simulation and then go and see and if the situation appears, then do the mapping. The problem is that we contracted four surveys.
Judith – Is there any way to get verified outside the contract. Let's say we do have a more characteristic low flow, is there a way to verify this linear relationship?
Wayne - I am sure there is a way. The issue comes down to if we will actually get the low flows. We are trying to do this project on a timeline as well as a budget. The issue here is that it may not happen again this year and we may not see flows lower than last year. Last year we did not have a single time that met the criteria. We could wait and not do anything and still not get the answers we are looking for or we could continue and hope that at some point we would have an opportunity to check those answers. I think that what we are saying is that we would continue on with the modeling using what we have at this point and the next step would be, if we do get the opportunity with a period of low

flows, validating the projections that we made. Just the opportunity is a valuable tool in itself. Not knowing the answers, generate what we think is right, and then runs through it, one way or the other, if we were even close.
We don't have a way to manipulate the forecast, which is what we have to work with. The other issue is we wouldn't have a budget for this task in this contract to do the additional flows. We would have to go through a G & C process again.
Judith – Is there a glitch in the procedures for doing this for flow studies. You don't always get the flows that you need at the time you are doing the study.
Wayne – One of the problems that we have is that year to year we cannot count on any one flow happening for us, especially when you are talking about streams. You can't always count on 500 year floods and drought low flows.
John – I have a couple questions. Is there a way we can predict from online gage data from USGS what the cfsm is? Can I go to the lamprey river gauge and look at it and say, "I know the drainage area and I know the cfs. You divide one by the other and you get the cfsm. Is that accurate? Can we determine a couple of days in advance?
Wayne – It is like forecasting the weather, you can expect certain conditions are approaching and on those recessional curves where you are looking for low flows, what you usually see is that stream flow gradually declines. According to those low flows you can sort of predict those a little better than you can predict the moderate flows that sometimes tails through those flows fairly rapidly, especially at the high end of the recession curves. You can guess when the low flows are going to happen.
John – Is there a square mile number associated with each of the gages.
Jim – Sure, it is on the USGS website. The name of the gage and how many square miles.
Al – John, what is also being done by UNH is a series of concurrent flows up the river so we can develop and confirm that ratio method. That data is being collected. Stream stats, which is used in other states, hasn't been implemented yet in the state but there are other measurements being taken to verify that this ratio method of drainage base area can be used.
John – If you are going to go out and validate after modeling, I don't want to see you guys go out there and say, "it's 0.3 cfsm and we made a mistake." Is there a way to click and see that it is going to be 0.5 and the weather says it is going to be dry for the next four days, we can go out?
Piotr – How do you think we got this? You can check online what is going on and we can check the weather forecast and my crew is ready to go and there is one person monitoring the situation who says we have to go next week. It happened right on this project that we went out and in the middle of the day we had to go back out because of a storm.
Jim – You are trying to wait for it to go down to 37 cfs and it hasn't rained in a week and it is getting down, like 47. Then there is a rain storm and it is up to 65.
Piotr – The last time it wasn't a storm, someone just let the water out.
John – Was the intent to hit 0.2 cfsm. We have a lot of gage data from the lamprey river, can we use that data to define a low flow.
Piotr – Yes.
Wayne – We have sixty –seven years worth of data.
John – If that is the case, can we not use that data to estimate what a typical low flow is? I imagine that has been done?
Wayne – We just can't make it happen. That is the problem. We know what the whole of record flows are.
John – Judith lives by the river and probably knows it better than anyone here and she is saying 37 cfs is a lot of flow. I don't much about the Lamprey River but Judith is a resident expert and she is saying 37 cfs is high. What I am trying to figure out is these guys go back out into the field, how can we

make sure that if they go back out to validate some sort of model that it really is a typical low flow. Definitions are a big deal to me.
Piotr – All this information is being processed and we will know the duration. It just isn't happening yet. The bottom line is that we want to go as low as possible. If this is 1 cfs in the river because once it got down I can always interpolate further up. It is more difficult to extrapolate down. The lower flow I get the better. The problem is the longer you wait the higher the risk. That is why what I am proposing is verification. If we don't get these flows this year then we will wait until next year. Sooner or later we will have the opportunity to verify.
Wayne – The reason that some of these low flows are called Q99 and Q95 flows. It means that there is a one to five percent chance that those things are ever going to happen. That is the kind of ranges we are looking for. Here is an event that happens either a day at a time or a few days at a time, one or five percent of the time in the whole period of rain.
Jim – The lowest recorded flow is 4 cfs?
Judith – I think it is around 2.
Jim – It gets pretty low sometimes. I will probably ask Vern to explain it but where some of those numbers came from is looking at what is used as surrogates for seasonal flows in the NE interim aquatic base flow policy. You have a 0.5, 1.0, and a 4.0 cfsm value that are used as surrogates toward the seasonal averages with 0.5 representing the median August flow. That gives you a ballpark of what the 0.5 represents and how 0.2cfsm relates to that. Are there flows in the Lamprey that are less than 37 cfs? Absolutely, they get down to 2 cfs or 4, but it is in 60 or 70 years of record. You have one instance where it is 2 and one instance where it is 4 so those are fairly low flows. Can you actually get out there in the field and a) capture that in the field to document what the conditions are like and b) if you are able to get something close to 0.2 do you need to get down to 0.1 or something less than that to get a handle on what the habitat looks like at some of the lower ranges of those flows?
Piotr – Maybe we should finish slides before we finish the discussion. I have twenty minutes left and quite a few slides left. Maybe we should go through the process and it will be easier to figure all this out.
Jim – You can go through those first ten just like that.
Piotr – What is happening is that we have this mapping of the Lamprey River. The second step is to develop biological filters. We try to ask what the conditions are that fish like. We try to translate it to the green, yellow and red conditions for fish and then summarize the green and yellow area and develop a rating curve that will show you, for specific flow, what percent of the channel is in green and yellow. The channel area is whatever you can draw on a map as a channel of the Lamprey River. It is our baseline. As we increase our flows we will have seventy to eighty percent of the channel area filled with water. This line would tell us how much habitat for all fish we would have available. Most of that would be available for green or yellow. This is the community habitat. How does it correspond with the target fish community? I will tell you a little bit more about it later. The entire process is not that simple. On the Souhegan there was a request for a diagram. I came up with what I call Goulash Soup diagram with the different parts of the project as the meatballs. We start with the project conception. Here what you don't see on the slide is that there are two parts; the left one is pink and the right is green. On the left side are data and the processes that are happening on the river that we are working on. We do reconnaissance survey and then divide the river into sections that have a particular character and then within the section we select the representative sites that we then map multiple times, defining hydro-morphology and hydrological conditions. We also performed a lot of GIS analysis on our stream, collected data, measured length and areas of habitat units. We also try to go and fish on the river to see the places that should have more fish really have more fish. Another part of this is gathering flow data, historic flow records and then correcting them for human impact, developing a

flow time series that represent historic conditions. The second part of this process is developing training data and the filter, where we train a computer to determine the quality of habitat. We start with whatever we know and then develop target and reference fish communities and from those a list of clients that we will be dealing with, a list of indicator species. For each of them there will be a list of species that will show us how habitat should look like in specific bio-periods and seasons that have biological significance. Then we will develop criteria that will allow us to distinguish between the bad and good habitat based on literature as well as the database. We have 2000 grids that we measured in the last five years. All this going into MesoHABSIM where it is being mangled together and run through mathematical and statistical formulas. Then we produce suitability maps that represent present conditions and tell us what is good and bad habitat as well as perform simulation and try to identify some deficits in the river for fish. If we go to the river and there is not enough woody debris or varying size channels or it is made out of concreted then on the concrete we can remove the concrete and see how the habitat maps improve. Another step that is summarized on the rating curves that I showed you before and time series analysis, or u-cuts. From this we develop flow criteria, reports and reports on the recommendations. All these processes happened at different stages and they usually happen in parallel. This is an attempt to describe process sequentially so it will be easier to understand what we are doing and the individual steps. The first step is to identify our biological clients, the reference or fish community, then the identification such as bio-periods such as spawning. Each individual species would tell us what habitat conditions they need. The next step is developing biological filters for the species and step three is trying to analyze the patient. We break the river into parts that are relevant for fish. Fish don't care what is happening at Wiswall Dam if they are sitting at Wadleigh Falls. We apply the filters and try to put it back together to put it at the level of the entire river. That is what we call upscaling. We aggregate the amount of suitable area and the habitat across the species into communities. We are developing a model of available habitat presently. One thing that we know for sure is that before the rivers have been modified for what we now know the present theory of river ecological science says that over thousands and millions of years that animals just follow the laws of nature and are adapted to the physical conditions so that there is a perfect match between the physical template that is predictable for fauna and the biological template. Every specific niche will have an inhabitant. What we try to do is recreate it to accommodate the species that we want to protect. Because our river today may not be supporting all the species that it should from the target community we adjust this template, by removing concrete for example, and try to combine the improved physical conditions with improved flows. We call it pristine, but it is not really pristine but simulated flows with the fish fauna that is close to natural. This can be combined with a time series. The duration and frequency of events needs to be predictable. What are the usually conditions for fauna and when is something that they expect to happen and when are we running into unexpected, rare, or catastrophic conditions. This is something that allows us to tell what flows should be in the river and when. Step six is to synthesize it and present it as a restoration recommendation or flow management criteria. Here are some photos and graphics to illustrate. This is a complicated process and people are getting lost along the way so I am trying to repeat it with some diagrams. Here are some bioperiods developed for rivers in the NE and they were very similar. We are looking for biological information and written information and learning that shad or blue-back herring are spawning at the end of spring and the beginning of summer and then other species, the resident fauna, will be spawning a little bit longer. Take this window and slide it over the hydrograph and what you see in the background is the median hydrograph, it shows us how much water is in a river typically in one day in a year. This is what we expect the river to be from historical flow time series. From this time on, to when the flows level out, will be a spawning season. We know resident fauna is trying to spawn right at the end of the higher flows in order to provide a longer growing season for the juvenile

fish. In summer, we have times of low flows and that is when the fish are eating other fish and all the fish are trying to accumulate enough energy to survive the next winter. When flows increase, we have salmon spawning. Determination of bio-periods is based on what we know in literature about the life history and biology as well as what we see on the flow records. In winter they all have to survive somewhere and then we have the spring flood season that we do not know much about. For every one of these bio-periods there is an indicator group of species with the highest needs. What we are trying to do is select one species, or a group of species, that would be using the river at this time and would have the highest water needs. For salmon spawning season, salmon is our driving indicator species. In summer there will be a whole bunch of species in the stream. That is what we are selecting from our target fish community. That is the selection that we decided for in the Lamprey River, the fallfish, common shiner and white sucker, both banded and redbreast sunfish I believe. Salmon, brook trout and maybe American eel are species that are not on the top but are of specific interest. This is the summer selection. We are trying habitat conditions for all the species, but not everybody. Not everybody, just those because they are the most dominant or are fluvial specialists and have the highest flow needs. There is a criteria and in the summer we are using data collected in the stream to develop criteria for every one of the species. The criteria was developed using multi-variable statistics. We know that there are about 46 to 50 parameters that are relevant to fish. Not every fish will be sensitive to flow or woody debris, each fish will have something different that is relevant. We tried to observe them under specific conditions and correlate the physical parameters with their presence or high abundance. We developed regression that selects the attributes that are associated with the presence of long-nosed dace, in this case, and also gives us the waiting factor of these attributes. Correlation coefficients are then entered in the regression formula and allow us to compute the probability of the presence of this fish. Out of the 46 attributes that was selected, each is getting regression coefficient. In this case, a riffle, the riffle will either be present or absent and if it is present it will increase the probability positively and proportionately to the value of 2.3. Overhanging vegetation would be a negative value. If there will be overhanging vegetation it is correlated with the presence of this species. There is a second model for abundance. We use various tricks to define how much probability is needed to tell if this habitat has a chance of being suitable for this fish. In this particular case the cut-off value is 0.1. If the probability is lower than 0.1, we call it not suitable habitat. If the probability is higher than 0.1, then it is suitable habitat. When it is suitable then we are checking if it is present and if there is a high abundance of this fish and then we apply the second model. Here the cut-off value will be low. I anticipate the question, "Why do you go with such low values?" The reason is the structure of our data. We have a lot of data. Let's assume that we have a thousand grids, or units of fish, and only a hundred of them have long-nosed dace. Our highest probability might be 0.1. We collect the data in such a way that it will be 50/50 distribution of various present or not present. We have to take what we get and adjust a cut-off value and the probability.

Judith – On the Souhegan, it is my impression, you found that the most important parameters was temperature. Are you extrapolating temperature from all of these?

Piotr – No. Temperature works on a different scale than this works so if the water is cold, then it is cold. If it is hot, then it is hot in most of the designation reach.

Judith – The temperature is also flow dependent.

Piotr – It is flow dependent but it does not change within our sites that dramatically that it would have to be measured at every single point. From this pool to this run the temperature will stay the same. Temperature is coming as a limiting factor at the top of this model. The purpose of this model is to determine if there is physical habitat to support the fish if water quality and temperature were fine and there was enough food.

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Jim – How are the ten variables are selected among the 50, or is that just representative? Are you plugging all fifty in?
Piotr – Yes, we are plugging all fifty in and then there is a likelihood ratio.
Jim – Each one is assigned a value? You just have ten or so listed here.
Piotr – Yes, the others were not significant. The other parameters are not having a significant correlation with the presence of fish.
Jim – How is that being determined?
Piotr – It is a step-wise approach. You return them all to the model and the model picks up the first one that has the highest likelihood ratio, creates a model that takes the next one and it does it until it doesn't improve anymore.
Jim – What are you using for your data source?
Piotr – The data source for that is our data collection from the last five years. This is the data collected on the Eight Mile River, Pomperaug River, and Souhegan River. In this case, the Stony Grove, sometimes we have the situation where a fish isn't present so we will not use the data from this river for the model.
Jim – You are assigning either a negative or positive correlation, depending on whether it is present or absent in that particular habitat and then relative abundance for that particular species in that same habitat?
Piotr – That is right. Based on our data, we determine the type of bodies when we say when that we only have a presence and when we have a high abundance of species. For most fish we know that when we have more than three than it is a crowd, if it is less than three it is an individual catch. These are a function of size and life history. Sunfish don't like see other sunfish. There are three different seasons of spawning seasons of different species. Shad will spawn in the beginning of summer and white sucker and American shad will be spawning at the same time but we use American shad for guidance in this period of time because in our eyes they need more water. We do not have good empirical data for the spawning stage so we are developing similar models based on literature and are developing criteria to tell us what is corresponding to the presence or abundance of this species. Here this procedure is a little different. The procedure of defining suitable and optimum habitat is such that we may define some of the criteria to be critical. For example, for salmon if a specific substrate doesn't occur it doesn't matter what other parameters are, it is not suitable habitat. If two more parameters are at the site we looked at then we can say it is suitable habitat and if all four criteria are there we say it is optimum habitat and it has a high probability of spawning. They are all conservative models. Black should be red and this is actually green so what you see on the left side is an example of another project we are working on the Pomperaug River, a map of the distribution of hydro-morphological units after the application of a filter for tessellated darters. It tells you which habitat is optimal and which is not suitable and which one is suitable. The green area is a metric that tells us how much channel area there will be with certain flows. Brook trout habitat, with the increase of flow, gets greener and more optimal and the red, or not suitable habitat, disappears with 0.7cfsm. That is an example from the Souhegan. That is one of the sites on the Souhegan that has three flows that we map. We had a situation on the Souhegan that was much worse because the project started late and we were not able to get into the river until the end of July. We had a limited window of opportunity and we had a hard time to get the flows that we were targeting. We have a wide distribution of flows. There is a lot of unsuitable habitat at low flows that turns to optimal relatively quickly and then we have a mixture of optimal and suitable habitat at higher flows. When you take these three points and develop rating curves out of it by linear interpolation you come up with this red line. The red line is showing you how much suitable habitat you had at site 4 across the level of flows. The green line tells you how the optimal habitat would develop. It is increasing and staying stable in this case. It is difficult to

understand multiple numbers, suitable and optimal, and we collapse it further and that is where the process of aggregation or upscaling actually begins. On the next slide you see something similar, suitable and optimal and something that we call effective habitat that has been developed by weighting these two habitats, suitable by 25% and optimal by 75% and adding them together. We call that effective habitat. The reason we do it is that in former studies there was criteria used that was on the siding scale. You had probability factors and you multiplied them by these probability factors and you would get a number that was called a weighted usable area. The big problem was it did not differentiate between a lot of poor habitat and very little of very good habitat. I would have to give you a number to help you understand. For example, if you had a hundred square meters of habitat with a value of 0.2 and you multiple it you will end up with 20 square meters of weighted usable area. On the contrary, if you use only 20 square meters of habitat with suitability value of 1, which is perfect, you will still have 20 square meters. That is a management problem because you could get away with a lot of very poor habitat and not see the difference. I am trying to stress the availability of optimal habitats. That is why it is weighted four times in our equation before we call it effective habitat. There has to be a lot of optimal habitat before we can accept it. If you would have all this as suitable habitat, it would never be more than thirty-five percent of effective habitat.
Jim – Can you go back to the previous line? Picking on the discussion that we had before on values at below 0.2csm, it is interesting to note that site four on the Souhegan that 0.2 or something slightly above that represents a break point in suitable and optimal habitat in the slope of the line.
Piotr – Yes, it is and it has to be treated with caution because we had limited ability of gathering flows within this range. I cannot guarantee that there isn't a breakpoint going in here and it doesn't go down. It could happen and if you are applying traditional approaches and looking for minimum and stable flow conditions to be the peak of the curve, then there would be a problem. Because we are also analyzing the frequency of occurrences of similar habitats it doesn't make that much of a difference. I will show you an example at the end of the talk.
Jim – I was thinking about projecting in the opposite direction.
Piotr – That is effective habitat for the same site. That is where we would be ending up and asking how to go down. We could easily assume that zero is zero.
Jim – I guess my point is that at the start of your line you had a flow of 0.7. Had you not had the 0.7 on there you might make the assumption that the line went fairly flat from 0.2 and up.
Piotr – Exempt for the fact that you know zero is zero. You could make another assumption, as we frequently do, and say, "If I have a point here and I draw a straight line from here to this point, I know it is increasing, which in the case of reducing the amount water, is wrong. If we would be reducing the amount of water in the stream you would just extend the line and at zero flow you would still have a lot of habitat. Then you let it sit for a week and you have zero. When you turn the water on it will go up. We don't know if it will spike up. Most likely it will go along a straight line. It is not perfectly accurate but it is a relative and safe approximation.
Jim - How are we doing on the number of slides? It is 3:15. I am trying to get a sense of what we have left.
Piotr – I will try to run through them quickly and if not we will have to make it another time.
Jim – How are folks doing on time? Can we get through it in fifteen or twenty minutes?
Piotr – I will run through it quickly. Here are examples from the project on the Eight Mile River, numerous rating curves. We are also doing a rating curve for the end of the year fish. This is another side of this project. We compute when we can aggregate the amount of habitat for something that we call generic fish. That is basically aggregating all these curves together in such a way that whenever habitat is suitable for any one of those species, we consider it suitable. The line on the top tells you, regardless of which species have more habitat, for all of them there will be all this habitat available.

The community habitat makes a difference and tells you the fish that should be more dominant. If the distribution of habitat would be like the distribution of species in the community these two curves would be identical. That is the measure of habitat quantity versus habitat quality and we strive to close this gap between the community habitat and the generic fish habitat. One thing that this is being used for is compare the proportion of species expected in the target community with the proportion of species that we found in the river and the amounts of habitat for different species. That reasons for that determine, for example brook trout, if there are any habitat limitations. That is the relative abundance of brook trout that we would expect in the target community. On the Souhegan we didn't have any brook trout but we had a lot of habitat for brook trout so we could immediately say that if there is no brook trout, then there is another reason for that. This helps us make a simulation and say that if there are some species that have limited habitat, like the white sucker, then we improve the habitat and have more white suckers.

Jim – That is where temperature plays in.

Piotr – Exactly, here we concluded that this is not habitat, it is most likely temperature. This creates a base for what is river restoration simulation. We say, "What do white suckers need?" They need more deep areas and pools, specific substrate. Let's just mess around with our data on the computer and see what happens. If this would be in the right colors you would see that the picture to the left for Atlantic Salmon shows a lot of red and to the right shows a lot of green after this treatment. In this way we are creating this rating curve, that is in green right here, that represents relatively low impact habitat conditions. This is being combined with a flow time series that are also simulated for a lack of people in a valley. This flow time series would show you how much water would be in the river on specific day if there were no human impact on the stream. The next step is to combine those two and we translate it to the amount of habitat in the river on a specific day. That is habitat runs. That is first when we are starting to make decisions on how much water should be in the stream, mainly analyzing duration and frequency of specific events and habitat. How do we do it? Arbitrarily, we select the number of thresholds and try to figure out how long did the habitat stay under this threshold and measure this distance. I would do it for a number of thresholds. As you see, if I take a very low threshold, summer for example, it will be only for one very short period that the habitat is under this threshold. If I go further, it will be zero. If I go higher, everything will be under this threshold. There will a long period of time that we were below this threshold. This is like saying we are having a drought of specific duration. Now we are using metric, which is being developed in a lot of French studies, to try to quantify these differences and try figure out what are the specific thresholds that the habitat is always above, and what are the thresholds that the habitat is always below? What are the thresholds that the habitat is below only rarely, or is below very often? How do you quantify this? Basically what is happening is we take this figure and develop a diagram that has continuous duration under this threshold. This, on the y-axis, would display this number of days. On the x-axis, there is a cumulative duration of the entire season. This was 90 days, so 100% on the x-axis means the entire 90 days. If you plot these 15 days, it makes 20% of the entire season. The next shorter period was 14 days. Together with period before, it makes 40%. It means that the habitat is lower than 31% of the channel area, for longer or equal than 14 days, or about 40%. About half of the time the habitat was lower than that for longer than fourteen days. That is what that curve is telling us. When you take this period, and these periods are getting shorter and shorter. One occurrence of one day of one event will not make a lot of difference on the x-axis. In order to have a flat curve at the bottom you need to have durations of four or five days. The flatter the curve, the higher the frequency and the steeper the curve, the lower the frequency. The curves that are here in this corner show the thresholds that have all the habitats under them. The same thing that you see here has been developed for multiple thresholds, not for one season, but all summers in the thirty years record. So at the moment, this 100% doesn't mean

ninety days, it will be thirty times ninety days. It is all the summers that we measured. That is why I don't have the same thing for 30%, therefore 15 days duration will only make a small fraction of the duration of all the summers. The example here before was only one summer, one season. The very same process applies across all the seasons. Some seasons it will never go under (the threshold) and some other summers you will have a lot of this. We need to figure out what is the average.
Vern – Each of those lines represents all of those summers. Not all those summers on all those lines. One threshold is on one line for all of those summers.
Piotr – Yes, this is representing the occurrence of all those summers. So this is the threshold of 12% of weighted usable area, or channel, across all the summers. When you see them, the duration of ten days, was under this threshold. Not more frequently than 2%, or very seldom. I set these thresholds up to have equal increments. What is interesting is that the distance between the thresholds is dramatically increasing. What does it mean if it goes more to the right? If the graph is growing, then these conditions are becoming more frequent than these other conditions, so I increase the threshold by 5 and all of a sudden I face the situations that are much more common. This is what helps us to analyze these patterns and separate the conditions that happen rarely, in red, and then we have conditions that are very common, where the habitat is almost always under this threshold. You can increase this threshold all you want and it won't become more common. The only reason why this isn't at 100% is because there are times, always the flows are way beyond the range that we are working on, that we don't count. Then there is a period where there are a lot changes. As we increase the threshold there is a lot of increase of frequency. The first of those is the one we are calling critical. There is something interesting on this next figure, on the next diagram. Remember what I was saying about the currents getting flat? We have realized that these inflection points are showing us when we are getting into more common conditions. When you think about it and stare at it as long as I did, you will figure out that you can actually connect all these inflection points. For simplification, we are not connecting every single inflection point, but all inflection points at the thresholds determined to be significant and draw a straight line. You would some frequencies that are very seldom, so whatever you have here at the top are happening maybe once or twice in your time series. We would call them catastrophic durations. When you do it you can determine what are typical conditions and durations, areas of catastrophic conditions, something that is very rare and doesn't happen more than 2% or 3% of time, or every ten years. It is defined by frequency and duration. Something that is an unusually long period and you can therefore call it persistent. We'll get back to this later. It is a very difficult, but important step. It is a completely new approach.
Carl – I don't remember seeing this on the Souhegan. Did you do the same process?
Piotr – Yes, the very same thing happened. I am just getting better and better at explaining it. Let's assume that the two figures are the same. We have one threshold that we usually call rare conditions. The second we call critical threshold and the lowest one, that stick on top of each other are common thresholds. Each of them we are looking for the inflection point and then connect them. That is what is happening here. There is a rare, critical and common threshold and an inflection point on each of them and we connect this. This area is something that we call allowable duration under the threshold. That is how long habitat could stay under this threshold. Above the allowable durations we have persistent conditions. If we wait a little longer then we are getting into catastrophic conditions. This figure has been translated into numbers where the inflection point, the habitat values for individual thresholds for the rare, critical and common habitat. Each of those received persistent or allowable durations. On the Eight Mile River the habitat was commonly under 64% for no longer than twenty-two days. If it is longer than twenty-two days it is a persistent condition and if it lasts for sixty-two days then it is catastrophic. The table also includes the amount of water that is necessary to accomplish this number in cfs and cfsm and also the amount of water that we would need if we did the

restoration. The numbers from the tables are used to develop actigrams. On the y-axis of the actigram are the flows from this table. The inflection points on the actigram are the durations. The green part represent typical conditions, the yellow are critical, the red are catastrophic. The way the actigrams work is that you can go to the flow time series today and say, "Today on August 1, 2005, on the Eight Mile River, the flows were under 14cfs for 25 days and this was a critical situation. At the very same time on the very same day they also under 8cfs and it was critical. At ten days they were still under 1.5, two days later the flows were under 8cfs.

Carl – I understand what you are doing here but is there a way to develop a real simple tool for water users to be able to keep an eye on flows.

Piotr – Yes, we are incorporating it into our SimStream Software. Another ability that we recently developed is being able to analyze various scenarios and compare the river as it was in the past, or restored, with a river under climate conditions. What you don't see in the red parts are percent increases of stress days. On the Pomperaug River, we simulated full development of the watershed. Build all the roads that were possible, put all the people and let them use all the water they want on the computer and then determine by counting, how much longer those durations under critical thresholds and determine that it could become ten times or more longer for these periods. For critical and rare levels during raining and growth on the Pomperaug there were very dramatic increases of stress days, interestingly enough, during the spawning season. It did not change much otherwise, which is significant because it tells us what we think that we know, that if you withdraw water all the time you will have more low flows and therefore more drought and critical conditions. This is a new tool and ability that we have of simulating future scenarios. That is the essence. Time is late. I have a few more slides and I will bring them in only for questions we pull up.

Carl – Can the 0.2, 0.5 and 1cfsm be indicative of an average for the rivers you studied?

Piotr – Yes, when we do hydrological analysis we usually use T&C indices of hydrological alteration. What I've realized in most of my studies is 1cfsm, is the low pulse threshold. That is were the low flows are beginning. Anything that is lower than 1cfsm is usually low flow. We are zooming in these specific flows and then trying to distribute our surveys so that we cover it in the best possible way and draw a straight line between it. There is one thing that I would like point on my slide. On the Souhegan Project the issue of the flat curves popped up. Why are they so flat and what does it mean? On this example, from the Pomperaug River, the rating curves that we obtained for the present conditions (red line) for the rain and drought season, these are the thresholds that were established with help of time series analysis. Using the red line, for example, if you like to determine the amount of water necessary to accomplish this threshold we would go along here to this inflection point and pick up maybe 0.8cfsm as the amount of water that is necessary. Usually when you do these restored conditions you may get away with less water to accomplish the same amount of habitat, having less water, so you usually end up with 0.6cfsm. Assuming that you have a situation where you would have a flat line by having flows collect far in the back, instead of having a straight line. You would have a dataset where the flows would be collected at 0.5cfsm and your curve would be flat. You would still end up with having similar common thresholds for habitat and you would look for the flows that give you this amount of habitat. In our process we are always selecting the highest flow that is necessary to provide the same amount of habitat so you will eventually end up with a very similar conclusion. The time-series analysis in the habitat studies was always underappreciated and not very frequently used. Usually people end up at the rating curves and say they are done. Here we are introducing two additional dimensions to the problem and the rating curve is only a way to get there. Every model and curve is only as accurate as the data that is introduced and analyzing the frequencies and durations allows us to better zoom in and be more precise and take into account this variation.

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Wayne – That is one part of figuring out the flows that we need for this. There is also the rare, threatened and endangered species and the human parts of this stuff. This is one component of the overall task and it is a little complicated.
Carl – Where are we now on the actual analysis for the Lamprey?
Piotr – We are presently developing filters. We already have the maps and the delineation. We are presently redesigning our database so we started from scratch and are developing a completely new database with all our fish data. Once this is in we will create filters and apply them. Then we are up and running. It doesn't take much time anymore with the software.
Jim – Are there any other questions?
David Cedarholm – I have a couple questions that are related to this. The town of Durham is looking at doing a drawdown of Wiswall impoundment sometime in June to do an inspection of the abutments on the Wiswall Bridge. I wanted to throw it out there and see if anyone had anybody has any objections or comments. Would that be interrupting any field work?
Jim – I can check with Lee Carbonneau who is doing terrestrial rare, threatened and endangered species, but I think her work is pretty much done. The response is that I don't think it is an impact any field investigations.
Vern – What kind of drawdown are you talking about? Are you talking about the dam itself?
David – We are going to go as far as we can go. We are going to look at the abutments and see if they can be reused or not.
Vern – Is the Dam Bureau coordinating that?
Dave – We will be working with and discussing this with the Dam Bureau. I already had a conversion with Grace Levergood about it. The other question I had, and this came up at a meeting I had with Paul Currier and Wayne Ives a few weeks ago regarding the 401 certificate. The question came up of whether the Instream Flow Study would consider the effects of UNH/Durham's drawdown.
Wayne – I believe we have a rare, threatened and endangered species assessment transect through that impoundment so that will probably be part and parcel of that.
Al - We had observations during the last year but the work that Lee is doing is primary streambed. We will document it along that transect with the land and conditions as to whether you are looking at alteration of flows, specifically, due to water supply operations outside of the existing hydrograph. We are going to be using hydrograph information that has already been collected. We could talk about that a little further.
Wayne – With Durham/UNH withdrawal I would say they are an affected water user and public water supply, so it is also a protected entity so that is going to be an issue of balance for both roles and it will be part of water management plan. The question is how do is it play into the protected instream flows? Being an impoundment it is a squishy area between the riverine conditions and the impoundment conditions so we need to address that some more.
Vern – Who is managing that 401?
Wayne – Paul Piszczek is the 401 manager but he wasn't here when that first came about so Paul Currier has been handling it as well.
Al – Unfortunately Paul couldn't be here to answer that question.
Dave – It is question today because Paul Currier was under the impression that the Instream Flow Study did not consider the effects of a drawdown within the Wiswall Impoundment/
Al – Right, what I am aware of at least, we are not going to be looking at those drawdown events specifically.
Piotr – Of more concern to us will be the effects of river downstream of the Wiswall Dam as a result. Basically, you dump at the water and sediments at once

Wayne – Paul has made it clear that the Water Management Plan for this project will supercede the 401. It will become the conditions for the operations of this. In some way we need to address this as an issue. I'm not sure exactly how that will happen. I think Paul and I need to talk about some details.
Al – Protected instream flows are being derived from the hydrologic analysis as well as the riparian rare, threatened, and endangered species and the MesoHABSIM analysis. The MesoHABSIM analysis is based on the 0.2, the 0.5, and the 0.1.
Piotr – Last year we observe a lot of mussel straining because of drawdown. There is an endangered species question.
Al – Sampling was done and I don't believe there were endangered mussels identified or impacted as part of that. There were observations relative to the impacts of a complete drawdown, which is not something that is going to happen on a regular basis as part of the water withdrawals.
Dave – That is bigger question. There will be periodic complete drawdowns just to do inspections and maintenance on the infrastructure of the dam and the pump station. We are more interested if the study is going to look at the effects of a more permanent (or permitted), which right now is only six inches.
Judith – I have a more generic question relative to the main impoundment. If we are looking at fish as the species of concerns, what happens in impounded areas where Blanding's Turtles, the state endangered turtles, whose habitat may be an impacted? The level of the impoundment has a critical impact on an endangered species that has nothing to do with the fish species that we are looking at in terms of protecting it. How do we deal with that?
Al – That is the other component, which it sounds like we will have Lee come in to do a presentation. There are a number of transects that have been established through the designated reach, in which we have done a survey across the transect of plant species and Lee Carbonneau at our firm, Normandeau Associates, is doing that work. It is not merely the aquatic habitat that is being evaluated as part of this project we will also being looking at rare, threatened and endangered species, riparian vegetation, wetland vegetation, along selected transects, so that will be evaluated.
Judith – Would a plant that requires a certain level of water, not a certain flow, be given the same weight as some of these fish species?
Wayne – In the Souhegan process, you saw in the table, there are similar bioperiods for these rare, threatened and endangered specie, but the presentation explanation of the flows that are needed to support them are different and then you don't have common, rare and critical flows and durations. You tend to have things like during certain months you need to maintain some level of flow. In this case it sounds like you are describing elevation. Those flows are based on elevations are relative to flows in rivers. The prescription for protecting flows then is during these months or some other seven months there will be a requisite flow is related to those rare, threatened and endangered species, or in the case of scour needs, like for certain riparian forest, there is a need for a certain frequency of high flow events to clear out the understory and recreate the seeding grounds They are described somewhat differently and what we should do next is have Lee come in and give us a description of that whole process.
Judith – I noticed in the segments that you showed us, you didn't show any natural impounded areas, like around the Lee Hook Bridge. It was the riffle area downstream not the naturally impounded area upstream.
Piotr – There is one here that is naturally impounded.
Judith – I think it is slow moving. It is real deep there.
Piotr – There is a naturally impounded area upstream of the waterfalls.
Judith – It is slower but I wouldn't call it impounded. That is where Goodman Brook comes in.

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Piotr – What we need is a sample of the habitat in these areas. We don't need a lot. There isn't a lot of variability. If you've seen it once, you've seen everything. They are not changing with flows very dramatically within our range.
Judith – That area below Wadleigh that is slow moving and a little deeper, the banks come straight down, whereas up around the impoundment at Wiswall, it is more gradual, like where the water intake is a wetlands area. It tends to be flatter. I think the flora is very different there and the impacts on the flora would be different
Piotr – These reaches that you see here are specifically for instream habitats. We are not going in the riparian areas. Lee is having her cross sections defined in the area based on completely different principals and they will also be accompanied by aerial photography.
Jim – We will be giving a presentation on that another time, at the next meeting?
Wayne – It sounds like people are interested enough. We certainly ought to.
Jim – It is almost 4:00. We've gone over by about an hour and I would like to wrap things up unless there is pressing questions that people have.
Wayne – We'll have to start planning Lamprey TRC meetings for three hours instead of two.
Al – I guess the emphasis on the running water sections is their sensitivity to the flows as opposed to the impounded.
Dave – Will the committee consider my question and answer it later?
Wayne – Yes, I am not sure if that is a committee issue or how it should be handled. I guess it would be a committee issue.
Jim – It sounds like you may want to start something between the department and a consulting team.
Wayne – We need to put some kind of discussion together first and bring it to the committee.
Jim – I will look to you to carry the flag on that. Is there any other business? Do you have thoughts about a next meeting date, Wayne and Al?
Wayne – The only criteria is how frequently to people want to meet. To do the next steps in the target fish community by e-mail. It is just a matter of getting Lee when she is available and working on the Wiswall Dam issue.
Jim – I guess the question is when might Lee be prepared to do something.
Al – If she would be doing a similar presentation, she is in the process of doing analysis so it would be a summary. Here are references and this is how it is done. She may have some results but I am thinking a one month time frame.
Jim – Are you are so inclined to go ahead and set up a meeting date?
John – I think we should do it via e-mail since we have lost a number of people.
Jim – Yes, that would give you an opportunity to touch base with Lee and coordinate with Wayne and pick out some dates.
Wayne – It takes a few weeks for me to pull a meeting together just to find when people are available. If we can put this together in the next month or month and a half.
Jim – Thank you Piotr, it was a terrific presentation. Can I get a motion to adjourn?

A motion to adjourn was made and seconded. Meeting adjourned.

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