

**Feasibility Study to Eradicate Aquatic Invasive/Nuisance Species in
Canaan Lake, North Patchogue and Upper and Lower Lakes, Yaphank**

2nd Public Meeting for Upper and Lower Lakes, Yaphank

**September 14, 2010
Brookhaven Town Hall
7:00 – 10:00 PM**

Present:

| <u>Name</u> | <u>Affiliation</u> | <u>E-mail</u> |
|--------------------------|--|---|
| Camilo Salazar | SC DEE | camilo.salazar@suffolkcountyny.gov |
| Tim Rothgang | County Leg. Kate Browning | kate.browning@suffolkcountyny.gov |
| Connie Keppert | Brookhaven Town Council | Ckepert@brookhaven.org |
| Dean Murray | NYS Assemblyman | Molloy@assembly.state.ny.us |
| Mark Alessi | NYS Assemblyman | homans@assembly.state.ny.us |
| Chart Guthrie | NYSDEC | caguthri@gw.dec.state.ny.us |
| Adrienne Esposito | Citizens Campaign for the Environment | aesposito@citizenscampaign.org |
| Nancy Panarese | Suffolk County DHS | Nancy.Panarese@suffolkcountyny.gov |
| Robert Kessler | Coalition to Save the Yaphank Lakes | kesslerstone@optonline.net |
| Doug Swesty | Trout Unlimited – Art Flick Chapter | dswesty@gmail.com |
| Fran Hurley | Yaphank Tax & Civic Assoc. | fanayabout@aol.com |
| Chic Voorhis | NP&V – Consultant Team | cvoorhis@nelsonpope.com |
| Sara da Silva Quintal | NP&V – Consultant Team | sdasilva@nelsonpope.com |
| Mike Bontje | B. Laing Associates – Consultant Team | blaingassoc@optonline.net |
| Dr. Chris Gobler | SUNY – Consultant Team | cgobler@notes.cc.sunysb.edu |
| Dr. Richard Orson | OEC – Consultant Team | raorson@aol.com |
| Claudia DeNatale | Resident | claudiade@optonline.net |
| Russell J. Warren, P.T. | Resident | russpt@optonline.net |
| Charlie Muller | Resident | (631) 345-0739 |
| Thomas Bentivegn | Resident | (631) 775-6835 |
| Raymond Jaeger | Resident | (631) 924-9164 |
| Linda McCarthy | Resident | ljmccarthy@yahoo.com |
| Chad Trusnovec | Yaphank Resident | (631) 924-0514 |
| Sharon Wiesman | Yaphank Civic Assoc. | sharonwiesmann@verizon.net |
| Jim Powers | Resident | qnxuser@optonline.net |
| Naty Powers | Resident | (631) 924-7251 |
| Gail Lynch-Bailey | Longwood Alliance | gailybaily@aol.com; 732-4529 |
| Margaret Malloy | Middle Island Cure | margm@apb.org; 924-0730 |
| Tony Ertola | E. Yaphank | 793-9707 |
| John Stehle | Yaphank | 924-4008 |
| Dam Tomaozewski | Longwood School District | dantski@optonline.net |
| Dave Clemens | Longwood Public Library | dclemens@suffolk.lib.ny.us |
| Tom Talbot | Middle Island Cure | tom_talbot@hotmail.com |
| Liz Krolik-Alexander | Town Council District 4 | lkrolik-alexander@brookhaven.org |
| Hank Benway | Resident | hbenway@chembio.com |
| Alan Jannen | Yaphank | aljannen@gmail.com |
| Richard Bonati | Resident | 924-3785 |
| Janeen Tierney | Resident | jamatiz@yahoo.com |
| Ed Holobob | Resident | edster2321@yahoo.com |
| Dolores Bonati | Resident | cadpack@optonline.net; 924-3785 |
| Denise Speizio | | dspeizio@optonline.net |
| George W. Arrigo | Trout Unlimited | 289-5819 |
| Chris Hanley | MICA | chanley@longwoodcsd.com |
| Rosalie Hanson | | rosalie8@mac.com; 377-0524 |
| Penny & Robert Ascione | Resident | bass1696@aol.com |

| | | |
|------------------|----------|---------------------|
| Chad Trusnovic | Resident | (631) 924-3835 |
| Barbara Hamilton | Resident | bah57@optonline.net |
| James J. Holobob | Resident | Holowang@aol.com; |
| Bob & Peggy Judd | Resident | rwjudd@hotmail.com |

Note: Names in bold are members of steering committee.

Camilo Salazar began the meeting at 7:00 and introduced Councilwoman Keppert, Assemblyman Dean Murray and Assemblyman Mark Alessi with a few words from each.

Chic Voorhis began the power point slide presentation, “*Fixing the Problem – A Feasibility Study to Eradicate Aquatic Invasive/Nuisance Species in Upper and Lower Lakes, Yaphank.*” Sara da Silva reminded everyone that all material is on the website: www.suffolkcountylakes.net.

Water Quality

Sara da Silva provided a summary of historic water quality conditions. Dr. Chris Gobler provided a summary of SUNY’s 4-season water quality sampling in the lakes (October 2009 – August 2010) and indicated that they experience elevated nutrient levels (particularly nitrogen) during summer months. Temperatures in Upper Lake remain modest in summer despite the very hot air temperatures, and temperatures increase heading south in the lake system, collectively suggesting a strong groundwater input and rapidly moving water. Chlorophyll levels (indicators of algal blooms) were very low, as were cyanobacteria levels. Microcystin toxins were low and at safe levels. Both lakes were mildly hypoxic (low oxygen) in August.

It was asked what the sources of nitrogen are to the lakes. Septic systems and fertilizers are the primary sources.

Management Alternatives to Control Aquatic Weeds

Team member Mike Bontje of B. Laing Associates next presented information on optimum conditions for invasive plants and what would be needed to make conditions in the lake less optimal for these plants. Upper Lake is dominated by fanwort (*Cabomba caroliniana*). Lower Lake is dominated by variable-leaved milfoil (*Myriophyllum heterophyllum*). It was re-iterated that there is no silver bullet for restoring these systems. Any solution will require an aggressive approach and will require some sort of follow-up or long-term actions.

Developed a matrix to assess/summarize each alternative and its impacts. Impact analysis considered in the matrix:

- Constraints
 - o Engineering constraints surrounding existing development.
 - o Downstream impacts to the Carmans River
 - o Environmental constraints surrounding habitat and water quality
 - o Cultural constraints regarding recreation and history.
- direct and indirect impacts
- maintenance effort/cost for short and long term control
- regulatory requirements/considerations
- community support

Summary matrix was presented of what would be the most effective, feasible, and economic alternatives based upon characteristics of the lakes, personal experience and literature review. Mike presented the pros and cons for the less preferable alternatives/actions, and then the pros/cons for three preferred alternatives.

Alternatives Considered:

- Benthic barriers (blanketing)
 - The lakes are already shallow; this would make them more shallow and not have much benefit.
- Biological control (e.g. grass carp)
 - Carp tear up the bottom; common carp muddy water and don’t eat; triploid carp are non-breeding and eat, but appetites decrease after a couple of years; sterile carp also need to be left contained in the lake until they die (as much as 10 yrs) and not preferable for desired connectivity of the lakes to the rest of the river.

- No known beetles to control fanwort. There is another species known to have some control on Eurasian milfoil, but not known if would have same control on variable-leaved milfoil.
- Dam removal
 - Removing the dams and spillways wouldn't be possible because the historic, cultural and economic impact constraints would not allow for this.
- Hand/suction pulling
 - Problem is too extensive for hand-pulling.
- Mechanical harvesting (*existing*)
 - Was ineffective. Also attempted at Donahue Pond and by Nassau County DPW, but has also not proven to be effective in those locations.
- Shading (chemical dyes)
 - Too much flow for dyes to work in these systems (needs to be completely quiescent).
- Water Level Manipulation
 - Draw-up not possible, would pose a serious problem for restaurants and homes, would cause flooding, and would require substantial reconstruction of adjacent roads.
 - Draw-down would not completely dry out the lakes since they are predominantly groundwater fed, and cannot ensure that the sediments would sufficiently freeze over winter to kill the weeds.

Recommended alternatives – Comments and discussion:

- Chemical (Herbicides)
- Dredging
- Combination (Integrated Plant Management)

Option 1: Herbicides (fluridone, under brand name SONAR)

- Donahue Pond (Peconic River) is good local example of control over fanwort using fluridone herbicide treatment (slow-release granules, which are best for use in flow through areas). Photos of Donahue Pond were shown and indicate a very stark contrast between the before and after through June 2010 with only sparse weeds. There were some remaining plants around the edges because they couldn't treat any area that contained less than two feet of water with the slow-release granular form of the herbicide.
- Herbicides are typically not a one-time application, still require follow-up until the weed has been controlled.
- Donahue full-lake treatment had a 4-year effective cycle, but 2' fringe not treated and acting as inoculant for regrowth of fanwort throughout the lake. As of August 2010, significant weed growth returned and will likely need a full lake treatment next year
- Similar to Upper Lake, Donahue was predominantly fanwort (*Cabomba caroliniana*). Lower Lake, however, is predominantly variable-leaved milfoil (*Myriophyllum heterophyllum*). Fluridone will work on milfoil, but less effectively. On fanwort, fluridone is 95% effective, on milfoil it is 85-90% effective.
- Upper Lake good candidate for SONAR. Lower Lake is a better candidate for dredging (particularly in the upper part), but SONAR could potentially be used in the lower half.
- If apply Fluridone early enough (March or mid-April), don't need to harvest dead vegetation because not much of it (didn't have to harvest at Donahue), but dead vegetation from prior years has significantly built up the muck layer in the lakes. Key is to target roots of the plant before rapid growth begins.
- SONAR granules can't be used in <2' water. Liquid form can be used in more shallow areas, but requires no flow otherwise it doesn't stay put long enough to work. Flow may be problematic particularly in Lower Lake where there is more flow and very narrow upper area that is shallow.
- Emergent plants are not affected by fluridone if they have above-ground parts. Fluridone works by interfering with chlorophyll production in submerged leaves, as it is only added to the water column (not sprayed). If weeds are targeted early before they reach the surface, fluridone can have a very targeted effect.
- No known disasters with SONAR.
- Flow can be controlled through lake partitioning using turbidity curtains that float at the water's surface and drop to the bottom.
- Turbidity curtains in Donahue pond were used, but were not aligned to divert flow. Here, we would place the curtains in a manner that would divert flow so there would be less flow through and better containment to optimize contact time on the weeds (maintain concentration) and to keep chemicals from traveling downstream.

- Herbicide is cost-effective option and provides immediate relief, but doesn't treat the problem, only the symptom (excessive weed growth). Herbicide use still leaves the substrate that is favored by the weeds and which acts as a nutrient source.
- Commenter inquired how long SONAR has been in use. Since 1978 in Washington State.
- Another commenter inquired whether or not any resistance to fluridone has been seen. Doug Swesty from TU commented that resistance has been seen in hydrilla in a Florida study and he could point us to the study. *Further review of literature has found evidence of resistance in hydrilla, and suspected but unconfirmed resistance in duckweed, but there has been no confirmed resistance documented for fanwort. Resistance to any chemical treatment requires sexual reproduction in the targeted species, however, in Upper and Lower Lake, the vastly dominant mechanism for reproduction of the aquatic weeds is asexual (e.g. cloning of individual plants by root, shoot or propagule). Furthermore, chemical treatment requires considerable repetition so that successive, sexually-reproduced generations of the targeted species can occur in the presence of the chemical treatment. Therefore, initial treatments would not have any jeopardy of genetic resistance to fluridone.*
- Another hurdle for SONAR use in Lower Lake is Suffolk County Center for Environmental Quality (CEQ). CEQ needs to approve any project on County land (the County owns a significant portion of Lower Lake near the spillway), and they are not in favor of herbicides. The County's Conservation Advisory Committee (CAC) would also need to give approval regarding pesticide application on County land.

Option 2: Dredging

- Bontje explained that the harder the lake bottom is, the harder it is for weeds to become established and thrive. Weed control through substantial deepening is very effective. Natural bottoms of these lakes were sand and gravel, whereas now there are several feet of built-up muck.
- Shallow (less than 10 ft) dredging to remove built up organic materials would be better here due to shallow nature of lakes and very high cost to deepen further. Built up organic sediments would be removed to reveal the natural hard bottom which existed prior to the weed infestation.
- Sediments have built up over time as a result of sediment inputs, nutrient inputs (septics, fertilizers) that fuel plant growth, and restricted flow caused by the dams, which causing sediments and organic material to settle to the bottom instead of washing downstream.
- If dredging occurred, hydraulic dredging would be preferred. This would help avoid breaking plants into smaller pieces. It would remove both sediments and weed species. As with Option 1, there would also be use of a turbidity curtain to separate the lake into workable halves.
- Dredging would ideally occur in early spring, after ice melts.
- Geotubes would be used to take the material and de-water it with as little sediment as possible escaping back into the lake. They have a smaller footprint than sediment basins because they can be stacked if we have to work in a small area.
- Geotubes were successfully used in Patchogue River as well as often used by Nassau County DPW when conducting pond dredging. Nassau County DPW has had very good success with dredging to alleviate weed conditions.
- One of the issues we have to deal with is water access and geotube dewatering locations – on Upper Lake, we have Swezey Park on the southeast corner where disturbed areas could be used, but it might be necessary to find further adjacent land to stage the dredging/geotubes on the western side (e.g. restaurant) and/or private land further north on the lake.
- The owner of Chase Bank was present at the meeting and gave his permission for using of the rear end of the property for access or use as a staging area.
- In Lower Lake, dredging would be most expensive due to larger area, but would have additional benefit of increased depth for recreation in upper part of lake.
- Dredging may take 6-8 weeks for one side of Upper Lake. Prior to dredging, sediment would have to be tested for contamination and to assess potential for beneficial reuse. There is always the option to dredge the lakes at different times to save money on having to buy multiple sections of boom.
- The tubes would likely take 6-8 weeks per tube to de-water because of the finer materials.
- A commenter asked how CY estimates were calculated. They are in place volume estimates. The dredged material would "fluff" more when pumped into a geotube, but would become compressed as it dewatered and decomposed.

- Despite the narrowness of Lower Lake, there is still a need to divide it to limit the flow and prevent turbidity.
- Potential problem with dredging is that the value of the dredging could be negated in a short period of time if there are many nutrient inputs, but these inputs have been cut back over the years – less agriculture, better BMPs, and opportunities to further decrease stormwater and septic system inputs.
- Concern with dredging is we don't know if the sediments will be contaminated, and so don't know if dredging would be cost prohibitive.
 - Sediment toxicity testing required by NYSDEC prior to issuance of a dredging permit has not yet been done.
 - Most of the sediment is assumed to be clean material, but if contaminated sediment is encountered it could be very costly to deal with. Higher potential for contamination near storm pipes.
 - NYSDEC will weigh in on sampling and disposal requirements. Until sampling is done and characterized, best use, disposal, or more exact costs cannot be determined. However, the sampling itself is expensive (more than \$20-32k just in lab costs alone to sample Upper and Lower Lake; Canaan sampling could run as high as \$28-43k for lab costs alone because of potential for contamination near western tributary). Entire \$50k pilot project budget is not enough to cover all sediment toxicity testing costs. If DEC loosens their sampling requirements, # of required samples and parameters may be reduced to help lower costs. Use of County lab to do the testing may be another option to help lower these costs.

Option 3: Combination of Dredging and Herbicide Treatment

- There is a chance that weeds would come back after a few years following dredging or treatment with Sonar. The ideal situation would be to treat with Sonar to kill the plants, then follow with dredging to remove the organic sediments favored by the invasive plants.
- Concern that if use SONAR, won't be able to raise additional \$ to do dredging but will likely have to retreat every few years.
- SONAR is a quick solution that would provide immediate results at relatively low cost. No sediment sampling needed.
- Long-term, dredging is preferable as longer lasting results. But, it is much more costly and would take longer to permit (requires detailed sediment sampling, analyses, specific dewatering locations). Funding is likely to be the most difficult component. Dredged material could be used for compost or as cover at the Town landfill.
- Question asked as to why do both. Either one or the other could be used, but both could be used as part of a long-term maintenance program. Sonar would enable immediate results because would be easier to fund, but dredging desirable as long-term solution. Even with dredging, there may be need for spot control long-term, for which Sonar could be used depending upon the circumstances of where and which weeds grew back.

Overall

- There is enough info to proceed with a full lake treatment as a pilot project. Donahue served as pilot for SONAR, and dredging is a straightforward physical process. Pilot plots in Canaan Lake originally recommended, but reconsidered with help of steering committee and deemed not necessary. It is already known that dredging will work to remove weeds and sediment, and it is known that the herbicide can effectively work on fanwort.
- Sediment depth was not likely done on Donahue Pond, but Chart Guthrie thinks Donahue is a little deeper than Lower and similar to Upper Lake. If use SONAR, the fanwort would die back and not be as massive a part of the sediment.
- Any action will require long-term maintenance, particularly control of nutrients and sediments into the lake – the creation of a watershed districts for the Carmans River has been previously discussed to manage nutrients/implement BMPs/upgrade septic. Babylon also has a program for low-interest loans for septic system upgrades.
- If application submitted in Fall, SONAR could begin as soon as Spring 2011 (mid-April target). A dredging application may take longer because of the need for sediment sampling and possible problems if contamination found.
- It was acknowledged that the NYSDEC recommended utilizing existing pilot money to start the permitting process and do the sediment toxicity testing on each of the lakes.
- There was a comment that the opening of the boat ramp 8-9 years ago marked the beginning of the weed problem. However, Chart Guthrie noted that there was evidence of dumping from home aquariums (e.g. bright blue fish

tank gravel) into Lower Lake at the lake's southeast corner when the boat ramp was first opened. Therefore, it is very possible that the current weeds may have first entered the lakes via dumping of home aquariums.

- It is necessary to inventory local aquatic plant sellers to make sure they are not still selling invasive weeds. The County could report violations to consumer affairs.
- The yellow flower observed growing along the bank and out over the milfoil in the upper part of Lower Lake is sneezeweed (*Helenium autumnale*).
- Question was asked whether hand suction harvesting had been considered. It was briefly considered under the hand-pulling option, but not originally thought to be viable for Upper/Lower Lake because of the 1) expense entailed with hiring divers to conduct the work over such a large area, and 2) the silty conditions under which the work would be conducted. Commenter indicated hand-suction harvesting with divers had been conducted on 20-acre stand in a Connecticut Lake and that this option should be further considered. *NP&V followed-up on Diver-Assisted Suction Harvesting (DASH) conducted at Crystal Lake in the Town of Ellington, CT. 8 acres were harvested at cost greater than \$67,000 (final cost being researched), but conditions were ideal for harvesting because the sediments were sand and gravel, resulting in easier root removal and less turbidity. Nassau County DPW has also used DASH for weed control in areas of sand/gravel bottoms, but dredging elsewhere. At Upper/Lower Lakes, conditions are not ideal for DASH, would result in significant turbidity, and may still require sediment toxicity sampling because a substantial amount of sediment would be stirred up, sucked up, and would have to be disposed of along with the plant material.*
- Question concerning how our costs were determined for harvesting – they were based upon Town labor rates from when harvesting was being conducted in Lower (Lily) Lake. It was suggested that alternative costs and outsourcing also be considered to see if costs could be reduced.
- Question regarding whether the Town's mechanical harvester could be considered for maintenance if it was done in a methodical way. There is hesitation for this method because the lakes are shallow and the harvester will still create propagules that could continue to reinnoculate the sediment. Connie Keppert also commented that the harvester's past use was limited by funding and therefore it could not be done effectively. Therefore, there is hesitation to rely on the harvester for controlling the weeds.
- It was commented that the dams have been in place for hundreds of years (1700's) and have never been dredged, therefore it is time to do so.
- Another person commented that over the past 8 years, he has observed significant increase in built up of mud within Lower Lake and that the weeds are accelerating sediment buildup. It was also commented that phonecalls concerning the weeds started to be made 15 years ago, but that over the last 4-5 years, the weeds have hit critical mass, drastically accelerating sediment buildup, reducing flow, and allow even faster buildup. For this reason, dredging is favored in order to reverse succession.
- Another person commented, "Dredge it and be done with it."
- If contamination of sediments is found, it will have to be handled appropriately.
- Question as to how much funding is available. Keppert indicated there is \$625k available from the Town, including for various items such as runoff improvements and fish passage, and an additional \$252k from the County. Adrienne thinks the Town has approximately \$125k allocated for weed control.
- Question as to time frames once project implementation is started. Bontje indicated 3-4 months for implementation. Fluridone treatment would require 30-90 days over 2 seasons, because it could only be done one half of the lake at a time. Turbidity curtains/booms could be reused for the 2nd season and for the 2nd lake.
- Chart Guthrie indicated that if it was decided tonight to conduct SONAR in Upper Lake that, regardless of funding, there is no reason that a permit could not be ready for a 2011 treatment.
- It would be preferable to do Upper Lake 1st (top down approach), so that potential propagules/inoculants would not wash downstream and reinfest Lower Lake if that Lower Lake were done first.
- This feasibility study is not to lay out exactly the when/how, but to provide options, identify funding hurdles and provide recommendations given the constraints.
- Question as to whether a dredger could be bought to save on costs. County may have a small Mudcat that could be used and the County could look into this to see if it may save on costs. Would need to do sediment sampling regardless. Approximately 12 samples needed on Upper Lake, and 14 each on Lower Lake and majority of Canaan Lake (areas not suspected of contamination). Potentially contaminated section of Canaan Lake itself may require another 21 samples.

- Several people commented that it is likely not all of the sediment will be clean, and may be likely to find metals, cars, etc. at the bottom of the lakes. Private lab testing alone could cost ~\$32k (\$75k including Canaan Lake) if follow standard NYSDEC sediment sampling protocols for # of samples and typical parameters (based on updated 2010 lab pricing costs and DEC-required parameters).
- Any movement of sediment within the lakes would require sampling of sediment.
- One person commented they worry that if the entire lake is not dredged soon it will convert to swamp instead of open water and not be able to dredge or use SONAR. It is important to proceed quickly and reverse the succession.
- The final decision will be a collaboration between the County and Town with input being received from the steering committee and from this public meeting.
- County DPW may be able to be involved with their time put toward in-kind services (e.g. County lab) to reduce costs.
- If dredge, DEC and Town will need to issue permits.
- There was a comment as to whether *Phragmites* removal would be included in the recommendations. With the SONAR option, *Phragmites* would not be treated. If dredge, there is better opportunity to excavate out the existing stands of *Phragmites* when removing the muck from along the side slopes. Dredging will make it more difficult for the *Phragmites* to further expand. Shallowing in recent years has been helping it spread. If not pursued in this study, separate funding sources may be available to specifically deal with the *Phragmites*.
- Next steps: Reaching a decision, finding funding, and starting the pilot project. Sources of funding are the biggest factors for implementation. However, there tends to be significant federal funding available for shovel-ready projects (less so for feasibility studies). Therefore, it is important to be creative to find funding from sources other than Town/County. It is also important to be aware that funding sources vary depending on the focus of the project – some funding is available specifically for control of invasive species, while other funding is specifically for fish passage projects.

Task 4: Fish Passage

Richard Orson took us through the challenges with fish barriers in the Carmans River system and his recommendations for solutions. Five barriers along the Carmans River:

- Hard's Lake (fish ladder installed in March 2008) - *remediated*
- Southaven Park (C-Gate) Dam – *barrier partly remediated through partial removal of center weir boards, and further inspection revealed additional remediation could be easily conducted through full removal of center weir boards during migration periods.*
- USGS Gauge (partial barrier) – *notching the weir needs to be done to enhance fish passage; not passable by alewife during most flows, but it is a simple process that has been done before.*
- Lower Lake Dam (major barrier)
- Upper Lake Dam (major barrier)

- As with most fish passage projects in the northeast, native alewife were the target species considered during assessment and design, as they have the greatest swimming constraints. Alewife are strong swimmers, but can't jump or tolerate too strong of a current. Therefore, if you concentrate on passing alewife, you can pass the other fish, too.
- Optimal choice is to always remove the fish barriers, but not always feasible. In this case, there are many constraints which make full removal of the barriers a highly problematic option. Removal is impractical because of historic, recreational, economic, and aesthetic reasons. Also if the sediments are found to be contaminated, it may cost up to \$6 million just to dispose of the sediments depending on their level of contamination.
- Obtaining a dam removal permit is very difficult, as extensive modeling and sediment testing is needed. There is also a significant amount of infrastructure downstream from the lakes that makes dam removal difficult. Dam removal would change the flow characteristics of the river. It could affect several road crossings and two railroad crossings. It would also expose muck which may have to be re-contoured and/or planted and heavily monitored to prevent it from *Phragmites* infestation. Extensive sampling would first need to be done to determine potential for contaminated sediments to flow downstream.

- There are other options, such as fish ladders, that can be considered to alleviate fish barriers. Fish ladder options include:
 - steep pass units (aluminum rectangle systems that break water flow)
 - step pool system (pool and weir system with each one at an increased elevation; not enough room to do this here).
- Alaskan steep pass units were determined to be the most feasible at Upper and Lower Lake dams. The units have to be designed long enough to achieve a critical slope while traversing the significant drop from the dams to the stream bed below. Also, we need the fish to be able to find the entrance to the ladder easily, and so need to account for this in the design to make the entrance attractive to the fish.
- The fish ladders will not have the full flow of the spillways, and will be designed to not impede culvert function.
- Eels can be assisted by putting netting over the spillway.
- Conceptual designs have been completed given the constraints of each of the dams and were presented.
- For cleaning out debris, a side plate design enables cleaning and a “trash rack” grate at entrance helps to capture debris before it enters the unit.
- For alewife, the ladder would only be needed from approximately the 1st week in March through mid-June, and then could either be closed off with weir boards or left open all year to accommodate other fish spawning seasons.
- The proposed fishwalk at Lily Lake was mentioned. NP&V has already been in contact with Greg Green at Cashin Associates, who has been made aware of the proposed fish ladder and design and will incorporate it into the fish walk design.
- Upper Lake fish passage is estimated to cost approximately \$250K.
- Lower Lake fish passage is estimated to cost approximately \$450k because of significantly more constraints that needed to be considered in the design (i.e. steepness and design of the existing culvert below the roadway, as well as the non-functioning bypass structures).
- Usually, getting fish up a fish ladder is the greatest concern, but at Lower Lake, getting the fish back down safely is even harder because of the flat and steep concrete floor with high sheet flow.
- Commenter indicated they want the weeds to be dealt with first before the fish ladder.

The meeting ended at 10:00 pm