# Darrin Freshwater Institute - Report Review

"An Assessment of Aquatic Plant Growth and Filamentous Algae Problems in Galway Lake, Saratoga County, New York"

*Presented to: GLCA Board - 21 April 2010*

# Agenda

- Background
- Darrin Fresh Water Institute Report
- Controls / Tools Available to the GLCA
- Recommendations for 2010
- Discussion

# Background Information

# 2007

- Aggressive increase in the growth/density of Eurasian Milfoil (EMF)
- Large growths of Filamentous Algae
- Primary Areas Impacted:
  - Northwest corner of North Bay
  - West Bay Cove
  - Maywood Cove

# 2008

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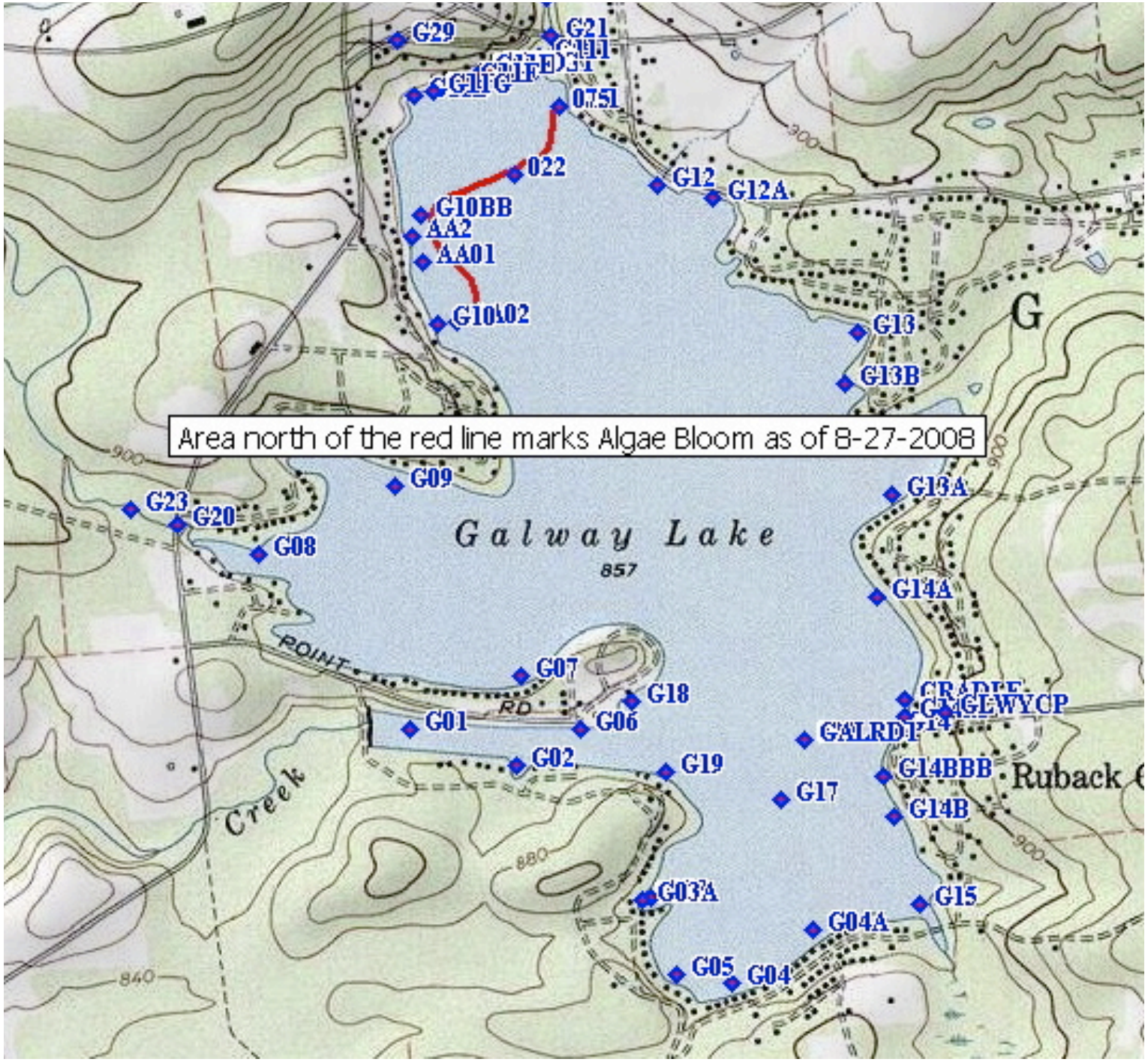
- Large growths of Filamentous Algae
- Primary Areas Impacted:
  - North Bay West to East
  - West Bay Cove
  - Maywood Cove




# 2008 Filamentous Algae Pattern

# Background

- Nutrients = Major factor in controlling algae and weed growth
- Nutrients Sources
  - Internal = fish, decaying weeds etc.
  - External = human/animal waste, waterfowl etc
  - Enter lake via surface or ground water

# Actions taken prior to 2007 season

- **NUTRIENT CONTROL**
  - Special rates for septic pumping
  - Bacteria testing at suspect shoreline locations
  - Participation in CSLAP
  - Yearly notices re: fertilizers, septic, waterfowl
  - Hypolimnetic Withdrawal
  - Expanded Total Phosphorus testing

# Actions taken prior to 2007 season continued

- **WEED CONTROL**
  - 1989/1990 deep draw down (15’-16’)
  - RPI Study / Weed Survey 1989
  - Rowell Studies
  - 2004 Weed Survey
  - 2005/2006 draw down (10’)
  - 2007 Weed Survey

# Actions taken 2007 - 2009

- Revision of OWTS provisions in the Galway Zoning Ordinance
- OWTS Dye Tests
- NYSDA assistance on farm nutrient issues
- Storm water diversion project on Hermance Road
- Egg Addling Program
- Projects:
  - Weed suppression mat - West Bay Cove
  - Barley Straw test
- Septic replacements: Maywood cove, Adabar, Jeffers
- Removal of resident geese (USDA Wildlife Services)
- DFWI Study / Weed Survey

# Darrin Fresh Water Institute Study

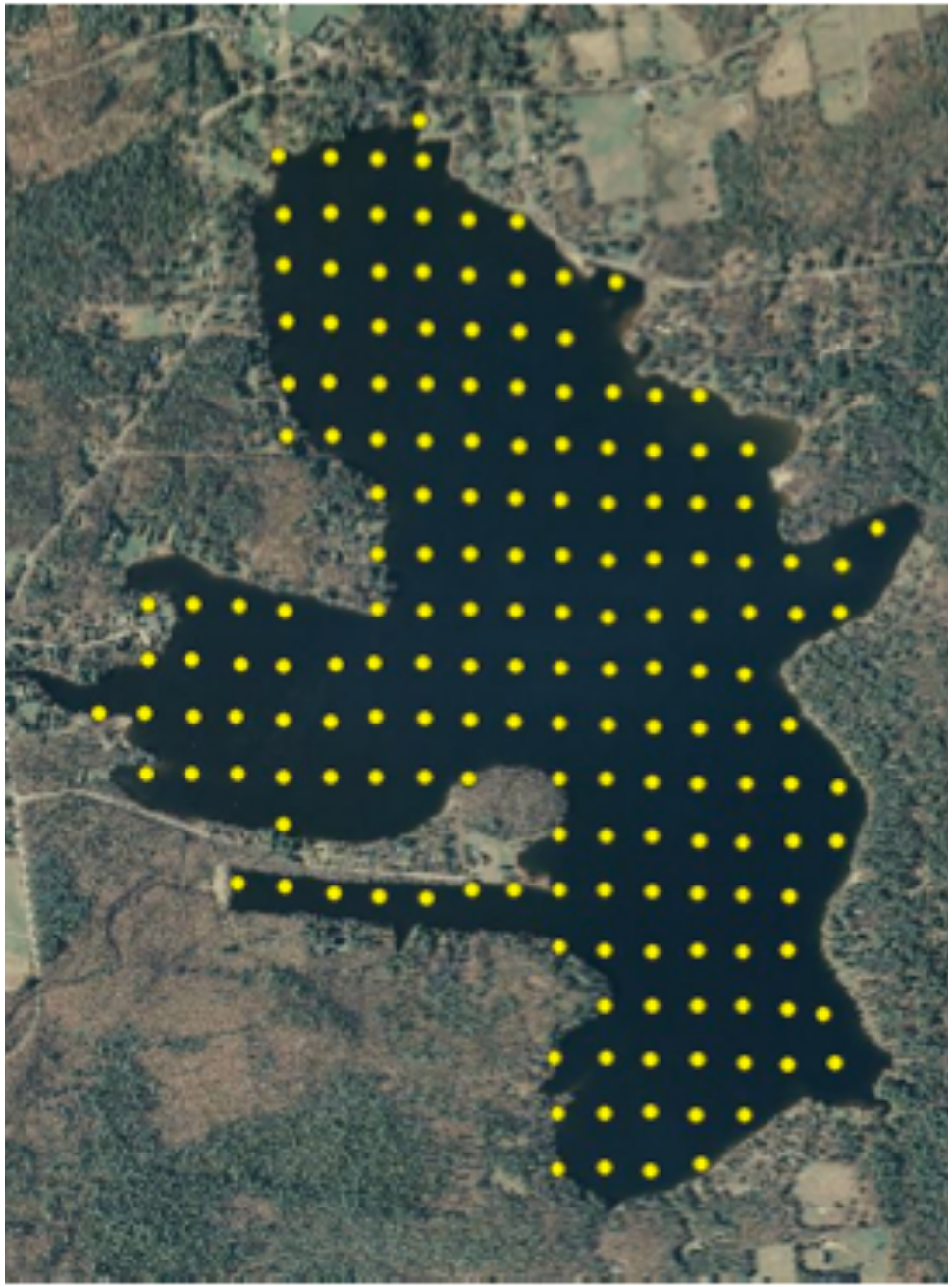
# Scope of Darrin Fresh Water Institute Study

- Conduct an Aquatic Plant Survey
  - Document aquatic plant inventory and distribution
  - Compare results with 1989 survey
  - Review effectiveness of aquatic plan management efforts
  - Conduct survey IAW with DEC requirements
- Conduct chemical and biological tests at 8 sites to identify suspected sources of contamination
- Based on findings, provide guidance on the actions to reduce the cause and effects of aggressive weed and algae growth.

# Aquatic Plant Survey Points

- The point intercept method was used to conduct the weed survey to comply with DEC requirements.

- Survey points are on a 100 meter grid and excluding some points outside the littoral zone, a total of 178 points were surveyed (Figure 2).



# Water Testing

- **HOW DID WE SAMPLE?**
  - We sampled during both **wet** and **dry** periods to quantify the effects of storm water runoff.
  - Two dates were chosen for sample collection during low flow conditions (base flow) and three dates during high flow conditions following rainstorms.
  - All samples were stored on ice and transported to the DFWI Laboratory in Bolton Landing for analysis.
- **WHAT DID WE MEASURE?**
  - Samples were analyzed for **Total and Fecal Coliform Bacteria**, **total phosphorus**, **ammonia** and **specific conductance**.
- **WHY DID WE MEASURE FOR THESE ITEMS?**
  - **Coliform bacteria** are representative of bacteria present in the **digestive tract of warm-blooded animals** and as such can indicate the **presence of nutrients and pathogens** associated with animal wastes; including human.
  - **Phosphorus** is the principal **limiting nutrient or fertilizer** to algal growth in lakes.
  - **Specific conductance** is a measure of how well water can conduct an electrical current and increases with the amount of dissolved materials. Specific conductance serves as an **indirect measure of the presence of dissolved solids** such as **chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron**, and can be used as an **indicator of water pollution**.
  - Waterfowl and other organisms including humans excrete **ammonia**, a decay product of animal proteins. While ammonia can be toxic in sufficient quantities, the principle environmental concern is its **role as a fertilizer of algae**.

# What are the results? - Bacterial Levels

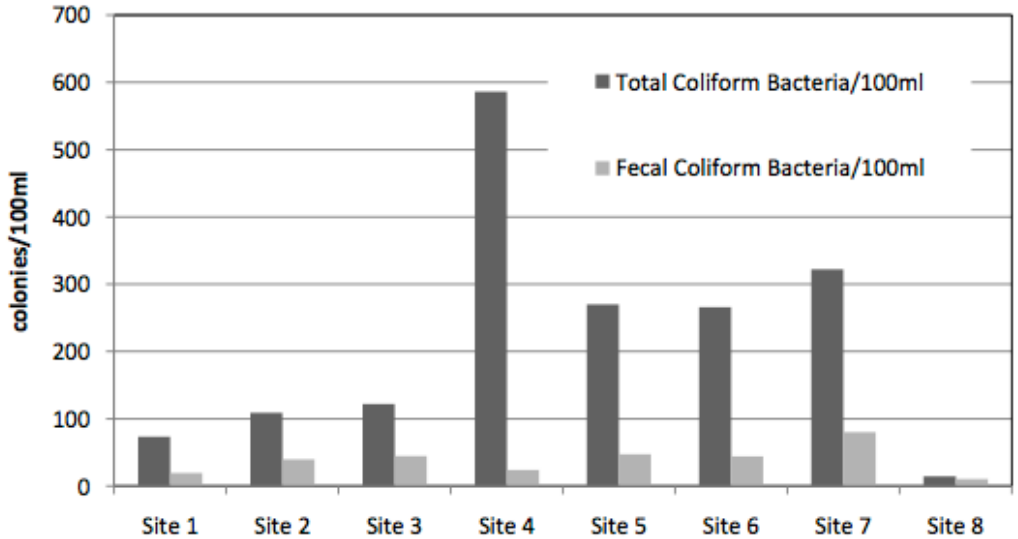
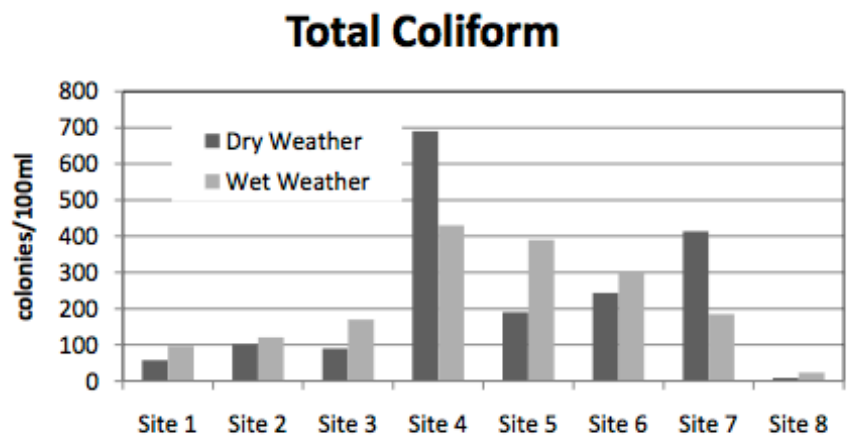
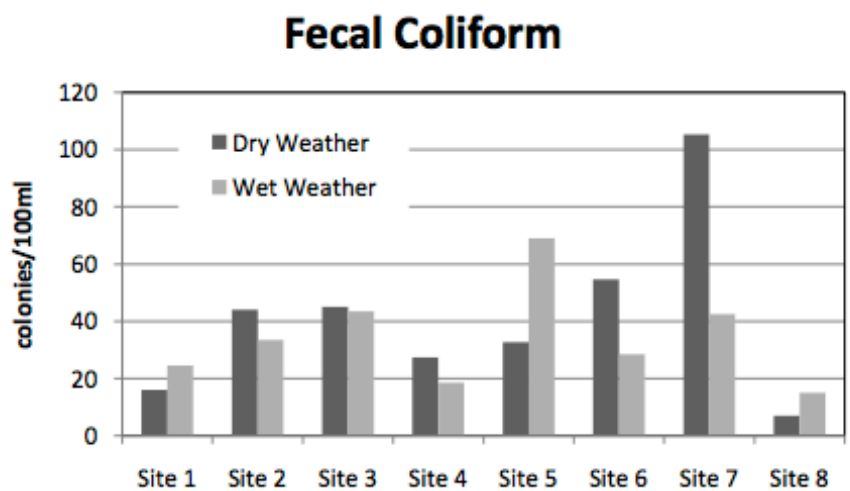



Figure 7. Bacterial levels in Galway Lake sample locations in 2009.

| Maximum Allowable Levels of Coliform Bacteria in Waters Used for Contact Recreation (NYS Dept. of Health) | | |
|---|---|---|
| Bacterial Test | Max. 5 Sample Mean | Max. Single Result |
| Total Coliform | 2400 per 100 mls | 5000 per 100 mls |
| Fecal Coliform | 200 per 100 mls | 1000 per 100 mls |



# What are the results? - Specific Conductance

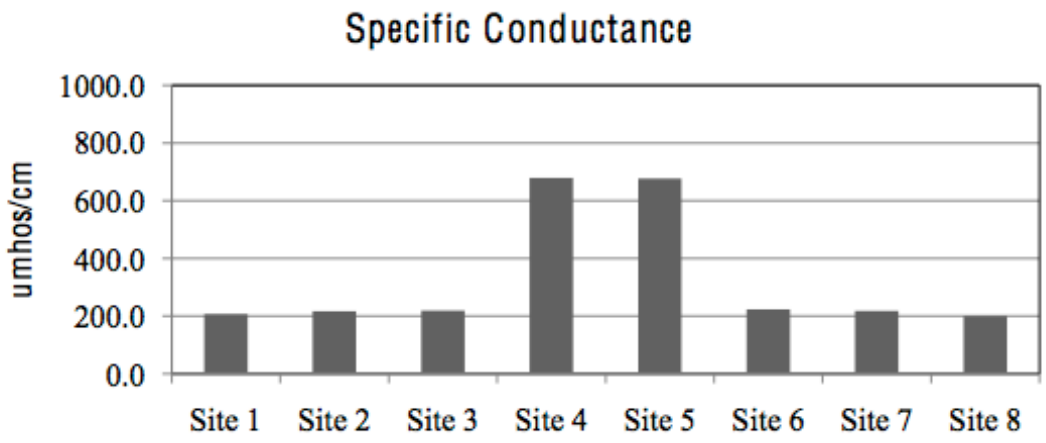



Figure 9. Average specific conductance results for 2009.

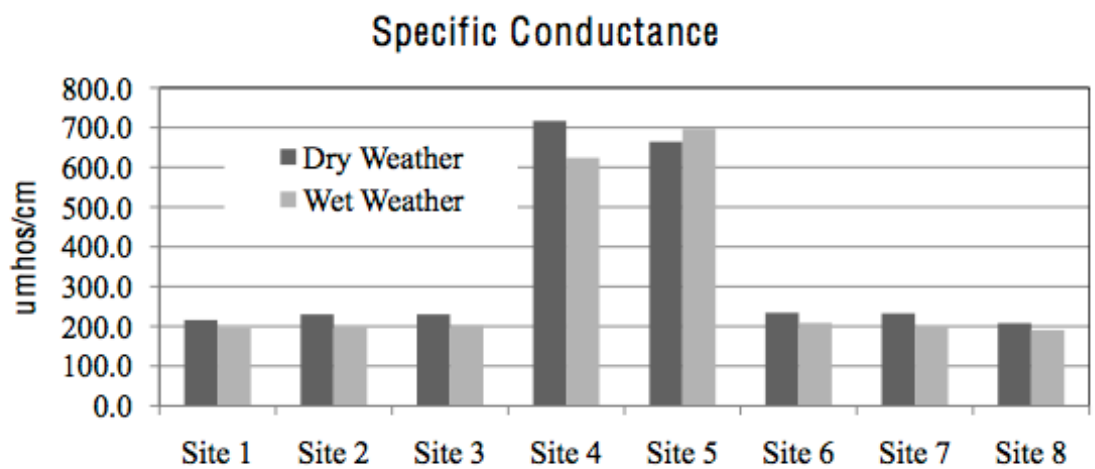



Figure 10. Average specific conductance results for 2009 comparing wet and dry periods.

# What are the results? - Total Phosphorus

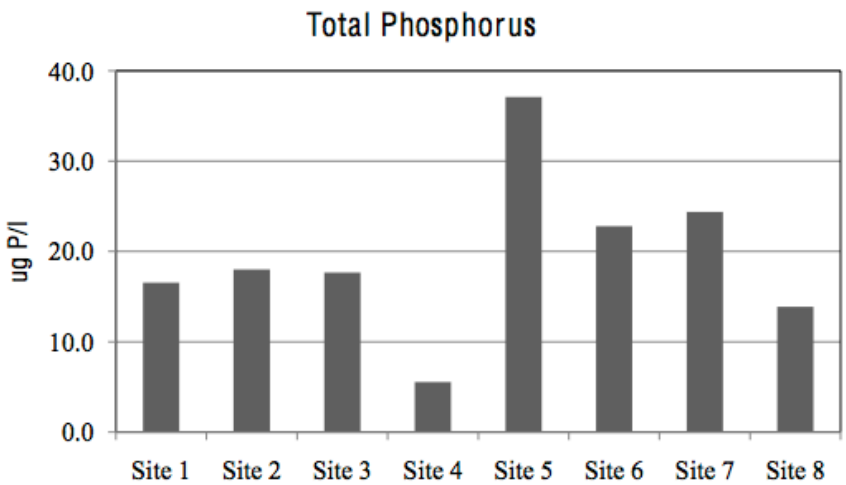



Figure 11. Average total phosphorus results for 2009.

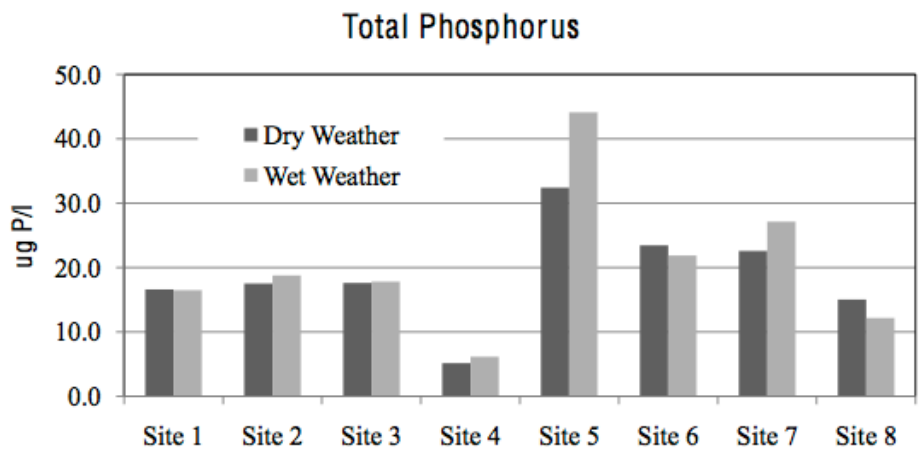



Figure 12. Average total phosphorus results for 2009 comparing wet and dry periods.

# What are the results? - Ammonia Levels

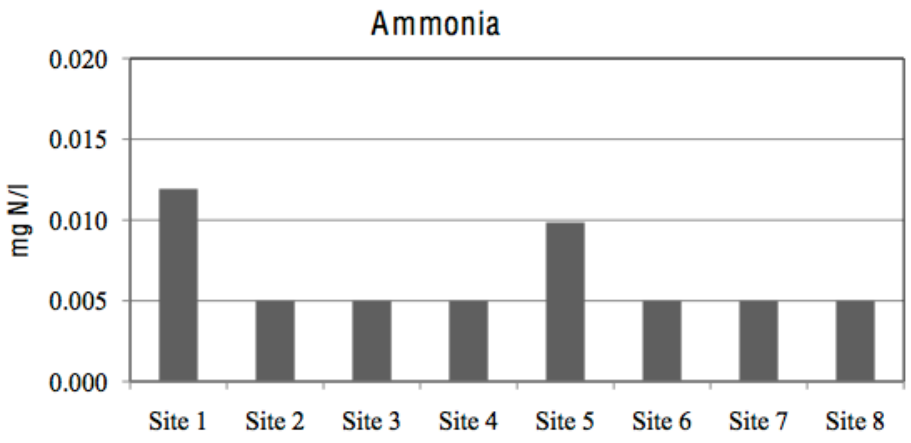



Figure 13. Average ammonia results for 2009.

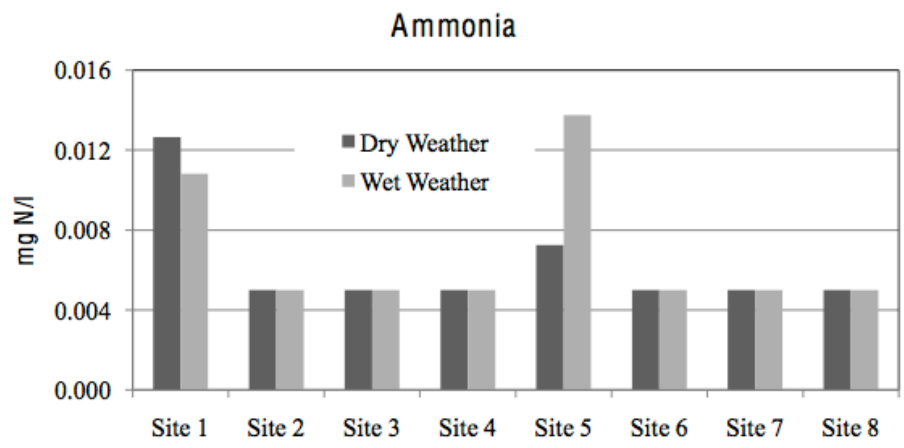



Figure 14. Average ammonia results for 2009 comparing wet and dry periods.

# Results - Aquatic Plant Survey

# Weed Survey Results

- In 2009, a total of 28 species were observed
- This high species richness suggests a healthy aquatic plant population at the present time.
- None of these species is on the New York State Rare Plant list
- Eurasian Water Milfoil (EWM) distribution is significantly less that 1989.
- Much of the EWM decline was in the shore line areas and is attributed to draw down activity.
- Littoral Zone has expanded in greater depths (20 feet). As compared to 18’
- EWM dominated the plant community, present throughout the littoral zone with the largest area of dense growth at the north end of the lake.
- New invasive aquatic plant recorded. Waterchestnut
- Coontail is now most abundant weed

# Weed Distribution - 1989 vs 2009

| Species | Common Name | 1989 | 2009 |
|---|---|---|---|
| | | | |
| *Ceratophyllum demersum* | coontail | 71.4% | 37.6% |
| *Potamogeton praelongus* | white-stem pondweed | 40.0% | 36.0% |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 68.6% | 34.3% |
| *Chara/Nitella* | muskgrass, chara | 37.1% | 32.6% |
| *Potamogeton zosteriformes* | flat-stem pondweed | 28.6% | 30.3% |
| *Najas flexilis* | water naiad | 31.4% | 24.2% |
| *Elodea canadensis* | waterweed | 65.7% | 20.8% |
| *Potamogeton pusillus* | small pondweed | | 13.5% |
| *Vallisneria americana* | wild celery | 20.0% | 10.1% |
| *Potamogeton vaseyii* | narrow-leaf pondweed | 5.7% | 9.0% |
| *Stuckenia pectinata* | sago pondweed | | 5.1% |
| *Potamogeton gramineus* | variable-leaf pondweed | 14.3% | 4.5% |
| *Potamogeton perfoliatus* | clasping pondweed | 5.7% | 3.4% |
| *Zosterella dubia* | water stargrass | 20.0% | 2.8% |
| *Potamogeton illinoensis* | Illinois pondweed | | 1.1% |
| *Potamogeton robbinsii* | Robbins' pondweed | | 1.1% |
| *Sparganium sp.* | Robbins' pondweed | 8.6% | 1.1% |

| Species | Common Name | 1989 | 2009 |
|---|---|---|---|
| | | | |
| *Potamogeton epihydrus* | bushy pondweed | | 0.6% |
| *Trapa natans* | waterchestnut | | 0.6% |
| *Isoetes (macrospora) lacustris* | large-spored quillwort | 11.4% | |
| *Eleocharis acicularis* | needle spike-rush | 5.7% | |
| *Myriophyllum tenellum* | leafless milfoil | 2.9% | |
| *Potamogeton obtusifolius* | pondweed | 5.7% | |
| *Potamogeton crispus* | curly-leaf pondweed | 2.9% | |
| *Sagittaria graminea* | arrowhead | 2.9% | |

*Shaded species are invasives*

# Tributary Sample Sites

1) Butterfield Lake at Crooked St.
2) North Chuctanunda Creek above Hermance Road
3) North Chuctanunda Creek below Hermance Road
4) Gully at Hermance Road and School Street
5) Stream entering lake at Rabuck residence
6) West Bay Inlet before Crooked St.
7) West Bay Inlet after Crooked St.

# Results Water Testing

- Nutrients, in the form of phosphorus, are directly responsible for the excessive algae growth noted in 2007 and 2008.
- Testing at the 7 sites on the North Chuctanunda Creek, West Bay Inlet Stream and the Storm water creek **did not** suggest that these tributaries were the primary source of nutrients necessary to produce the aggressive algae and weed growth noted in the 2007 and 2008 seasons. However, even though aggressive algae growth was not noted in 2009, these sites cannot be excluded.
- Factors that may have had impact on the 2009 results;
  - manure mitigation measures implemented at the Glenn farm in 2008
  - The early season weather was wetter and cooler than normal
  - Testing started after the spring run off
- Hypolimnetic Withdrawal is an effective method for reducing internal phosphorus cycling. This is especially true in the deeper regions of the lake.

# Conclusions and Recommendations

- Galway Lake is Mesotrophic ( P 10 - 20 ppb) or moderately productive for Algae growth
- The North Bay of the lake has historically had a heavy growth of weeds
- The tributary tests conducted during this study did not illuminate the source of "P" responsible for the aggressive algae and weed growth noted in 2007 and 2008. In order to control algae and plant growth sources of phosphorus to Galway Lake needs to be identified and curtailed. More testing is required. (Note: Septic and fertilizer along the Adabar B, Harts A, Maywood Cove and West Bay Cove shoreline could be sources.)
- Draw downs are an effective way to control the growth of EWM and annual draw downs at Galway Lake have limited EWM growth in water depths less than 7 feet.
- Galway is a candidate for the use of deep draw downs to control EWM in a significant segment of the littoral zone. These draw downs can be conducted every 3-5 years to a depth of 12 Ft. The draw down rate should not exceed 2"/ day and should be completed before a freeze or snow pack.

# Controls / Tools Available to the GLCA

# Options For Addressing EWM and General Weeds

- Aquatic Herbicides
- Harvesting (Mechanical)
- Rotovating & Hydroraking
- Dredging
- Weed Suppression Mats
- Draw Down

# Aquatic Herbicides

- Chemicals that kill or inhibit the growth of aquatic plants through direct toxic reaction or by hampering their photosynthetic ability.
- Nearly all herbicides approved for use in NY State carry at least 1 water use restriction.
- These restrictions address factors such as time delay periods for various types of water usage.
- Studies to date indicate that humans and most animals have a high tolerance to the short-term toxic effects of currently approved herbicides, <u>however</u>, *The long-term effects of herbicides on humans and other organisms has not been well studied!*

# Aquatic Herbicides
# Considerations For The Use Of Herbicides

- A permit is required to use herbicides in a NY State lake and only licensed applicators are allowed to dispense the permitted herbicide.
- Herbicides have been successfully used to target and kill exotic and invasive plants such as Eurasian Water Milfoil (EWM) and Curly-Leafed Pondweed, but, a maintenance or new treatment is usually required within 2 years to maintain control of the targeted plant(s).
- The effectiveness of a treatment is impacted by several factors to include seasonal timing, accuracy of the dosage and weather.
- Impacted plants die in the lake and contribute to sediment nutrients.
- Areas cleared of targeted plants are usually quickly filled with other plants.

# Aquatic Herbicides
# Cost

- For planning purposes the cost of applying a herbicide, such as Renovate, will run approximately $1,300.00 per acre.
- There are approximately 200 acres of EWM  in Galway Lake at the present time.
- Budgetary cost for one treatment $260,000

# Saratoga Lake Weed Management Experience with Renovate

- Saratoga Lake has had a long standing weed control problem involving EWM.
- Weed harvesters have been used to control aggressive weed growth since the 1980's.
- During the period 2007 to 2009 a contractor treated the lakes' extensive EWM growing areas with herbicides. The last treatment involved 292 acres upon which 66,920 lbs of the herbicide "Renovate" was applied at a cost of $330,000.00.
- Weed surveys following the herbicide treatment found:
  - Only 3% of the sample points contained EWM.
  - Weed Surveys prior to the treatment found EWM at 80% of the sample points.
  - Native plants replaced EWM in the treated areas and grew so robustly that harvesting was required to create boating lanes.
  - Spot herbicide treatments will be required to control new EWM growth areas and a full re treatment may become necessary in a few years.

# Harvesting (Mechanical)

- Cutting the upper portion (fronds) of  rooted aquatic plants and removing them from the lake.
- A **Single Stage Harvester** cuts a 6 to 10 ft wide swath through all aquatic vegetation to a depth of  6 to 8 ft deep and then moves them to the harvester via conveyer belt. When the harvester has a full load of weeds, it transports them to the shore for unloading to a truck for disposal.
- A **Multi Stage Harvester** system is a two stage process. The harvester cuts a swath up to 12 ft wide by up to 10 ft deep. The cuttings are left to float to the surface where they are they are raked up by a second  machine for transport to shore and loading on a truck for disposal.

# Harvesting (Mechanical) Advantages & Disadvantages

- **ADVANTAGES**
  - Reduces nutrients if weeds are removed from the water.
  - Cuts weeds to a level that supports recreation, but, not in dock and shoreline areas.
  - No permit required.
- **DISADVANTAGES**
  - Temporary solution with no long term benefits.
  - Cutting may have to be repeated during the season.
  - Fragmentation spreads weeds to new growth areas.
  - Encourages expansion of Eurasian Water Milfoil (EWM) growth areas.
  - Requires multiple shore locations to launch / store equipment and load waste on trucks.
  - Requires a disposal site for all the weed waste.
  - Harvesting equipment cannot be operated in shallow areas around docks and shorelines.
  - The harvesting, collection and disposal of weeds is a slow process.
  - Harvesters and barges are large gas powered items of equipment.

# Harvesting (Mechanical) Productivity & Cost

- **PRODUCTIVITY**
  - For planning purposes 1 acre of weeds can be cut every 4 to 8 hours. The productivity of the mechanical harvesting process depends on several factors, such as the: type/ size of the machine, depth of cut, type/density of weeds and time to unload waste.
- **COST FOR IN-HOUSE OPERATION**
  - Purchase and maintenance of equipment.*(harvester, barge, conveyors, trailers)
  - Labor for equipment operation.
  - Preparation and maintenance of sites for to launch/ storage of equip, load waste.
  - Transportation and disposal of weed waste.
  - Fuel and Insurance
  - Disposal site.
  - The cost of a new harvester and shore conveyer would be approximately $200,000.

# Harvesting (Mechanical)
# Cost Continued

- **CONTRACTING COSTS**
  - Contracting weed cutting services would cost approximately $1,500.00 per day*.
  - This does not Include the removal, transportation or disposal of waste.

**Contractor cutting could improve productivity*

# Rotovating & Hydroraking Advantages

- The use of a barge mounted roto-tilling machine or mechanical rake to cut and remove lake weeds. The aquatic plant root system is disrupted in this process.
- **ADVANTAGES**
  - Longer term weed control ,when compared to cutting.
  - Can control EMF up to 2yrs.
  - Reduces nutrients when weed waste is removed from lake.
  - Can remove weed growth close to docks and shoreline areas.

# Rotovating & Hydroraking Disadvantages

- **DISADVANTAGES**
  - Removes both good and bad plants and can disrupt the lake ecology.
  - Promotes the spread of EMF and other plants that grow from plant fragments.
  - Promotes a growth of fast growing exotic plants versus native plants.
  - Requires a permit.
  - Requires multiple shoreline sites to launch equipment and load waste.
  - Requires a disposal site for weed waste.
  - Gas powered equipment

# Rotovating & Hydroraking Productivity

- **PRODUCTIVITY**
  - For planning purposes, approximately 1 acre can be tilled or raked per day. Productivity is impacted by the density and type of weeds as well as the time required to travel to/ from work sites and unload / dispose of waste.

# Rotovating & Hydroraking Costs

- **IN-HOUSE COST FACTORS**
  - Purchase and maintenance of equipment.* (barge mounted rake or tiller, waste barge, conveyor, trailers)
  - Labor for equipment operation.
  - Preparation and maintenance of sites to launch/ store equipment and load waste.
  - Transportation and disposal of waste.
  - Fuel and insurance.
  - Disposal site.

  * The cost of a new tiller or rake barge would be approximately $200,000.00

- **CONTRACTING COSTS**
  - Contracting the tilling or raking services would cost approximately $1,500.00 per day. This does not include the removal transport or disposal of waste.

# Dredging

- Removing the top layer of sediment in a body of water.
- This process requires a significant permitting process and  the excavation, transportation and disposal of sediment material can be a very expensive project (excavating 1 acre to about 3 ft could cost $40,000.00).
- Case Studies have shown mixed results in the use of dredging to control aquatic plants. In some cases it has reduced excessive vegetation levels in other cases it has been concluded that dredging is not likely to reduce the extent of plant coverage unless the water depth is increased to a depth that prevents sunlight penetration.

# Weed Suppression Mats

- Primarily useful to individual homeowners for weed control in spot locations
- May be best managed by individual camp owners.
- Gas production is a consequence of this control which may cause mats to float or become uncontrollable if too large.
- Recommend individuals using mats are responsible for proper management of mat usage and its consequences.

# Draw Down

- Reducing the water level in a lake to expose rooted aquatic plants and sediment to the freezing and drying action of winter temperatures.
- Some species of aquatic plants can be killed or damaged by this process. Two of these aquatic plants are Eurasian Water Milfoil and Coontail which are prominent in Galway Lake.

# Draw Down Considerations

- To be effective, the draw down must be gradual and started early enough to allow the exposed sediment to dry before it is exposed to freezing or snow cover.
- Reducing the water level too quickly will harm aquatic animals and negatively impact lake ecology.
- Sediment must freeze to a minimum depth of 4 inches, which is difficult unless the sediment is somewhat dry.
- Ice or snow cover, which occurs prior to completing the lake level drop or sediment drying process, will insulate the sediment and inhibit the ability to properly freeze it.
- A draw down is most effective when the entire littoral zone is exposed. The Littoral Zone is defined as the area of the lake bottom which supports plant life. This usually is an area that extends from the shoreline to the maximum depth of light penetration.
- The success of a draw down is highly dependent upon weather!

# Draw Down Considerations

- **TIMING**
  - Start the draw down process early enough to:
    - Permit a draw down rate that protects animal life.
    - Attain target depth date that will facilitate sediment drying prior a deep freeze or formation of ice.
  - Start the refill when the impact of freezing temperatures has been optimized and early enough to enhance the probability of a refill prior to the start of the following season.

# Draw Down Considerations

- **LEVEL**
  - The optimal draw down level would be below the deepest level at which EWM is actively growing (16 feet). Problems with a draw down of this magnitude are: potential ecological impacts; the potential inability to achieve a full lake in a timely manner and future lake management implications.
  - A draw down of less than 16 feet will reduce risk ,but, will limit the impact on EWM and require more frequent draw downs to achieve some level of EWM control.

# Draw Down Considerations

- **OTHER PLANNING FACTORS**
  - Shoreline Maintenance
  - Monitor to track and optimize DD process
  - Remove weed waste
  - Mechanically expose weed roots where possible
  - Protect fish
    - Eliminate small ponds
  - Dredge / Excavate, Install settling basins (WBC, NC inlet)

# Draw Down
# Advantages, Disadvantages & Cost

- **ADVANTAGES**:
  - Most cost effective way to control Eurasian Water Milfoil.
  - Assists in drawing sediment from the shoreline
  - Permits shoreline maintenance
- **DISADVANTAGES**:
  - Risks associated with the weather supporting draw down objectives and lake refill.
- **COST**:
  - There are few, if any, costs related to the draw down process.

# Control Comparison

| Control | Advantages | Disadvantages | Considerations | Budgetary Costs |
|---|---|---|---|---|
| **Aquatic Herbicides** | - Proven effective<br>- Targeted<br>- Approved for use in NY | - Permit Required<br>- Multiple treatment needed<br>- Long-term effect unknown<br>- High cost | - 200 acres of EWM<br>- Long-term commitment<br>- Sensitivity of topic | - **Initial Year** = $260,000 |
| **Harvesting (Mechanical)** | - Reduces nutrients if weeds removed<br>- Supports recreation<br>- No permit required | - No long-term benefit<br>- "Mowing the Lawn"<br>- Fragmentation<br>- Difficult in shallows | - Planning & Operation<br>- Disposal of weeds<br>- Maintenance<br>- Large gas powered<br>- Equity & timing of cutting | - **In-house** = $200,000 + operational costs TBD<br>- **Contracting** = ($1500 +/ Day) * 120 days / year = $180,000 + Disposal TBD |
| **Rotovating & Hydroraking** | - Long term versus cutting<br>- Can control EMF for 2yrs<br>- Remove nutrients w/ waste<br>- Works in shallows | - Indiscriminate<br>- Fragmentation<br>- Permit Required | - Planning & Operation<br>- Disposal of Weeds<br>- Maintenance<br>- Large gas powered<br>- Equity & timing of cutting | - In-house = $200,000 + operational costs TBD<br>- Contracting = ($1500 +/ Day) * (200 DPY) = $300,000 + Disposal TBD |
| **Dredging / Excavating** | - Removes nutrient rich sediment<br>- Increases water depth<br>- Long-term effect | - Permit Required<br>- Mixed results for weeds<br>-Cost | - Large area<br>- Planning & Operation<br>- Disposal of Sediment | - Estimated cost to date is $40,000 / acre for 3' removal of sediment |
| **Draw Down** | - Proven effective<br>- No capital cost<br>- Affects EWM & Coontail<br>- Draws nutrients from shoreline sediments | - Shortens lake season<br>- Impact on lake Biota<br>- Long-term commitment<br>- Weather impacts success | - Start early - go slow<br>- Weather<br>- DD 12' every 3 - 5 years<br>- Shoreline maintenance | - Management cost only |

# Herbivorous Insects

- The milfoil moth and weevil have shown promise in controlling Eurasian Water Milfoil (EWM) without impacting the aquatic eco system, but, thus far results have been mixed.

- Continued research is required to improve this application as an EWM management tool.

- The use of these insects requires a permit and the recommended stocking level for an acre of EWM is 1,000 insects at $1.00 each.

# Grass Carp

- White Amur eat 20 to 100 % of their body weight each day.
- They weigh 1 lb when stocked and grow up to 6lbs/ yr.
- Grass carp are stocked at rate of 10-15 fish per vegetated acre and cost approx $15.00 each. The stocking of these fish requires an approved Environmental Impact Statement (EIS) and permit.
- Based on the inventory of plants in Galway Lake, there are 6-8 varieties of plants that the grass carp prefers before it is likely to be attracted to EWM or White Stem Pond weed which are the two  problem plants in Galway Lake.
- In addition, the large volume of material excreted by the carp can drastically impact the ecology of a lake by stimulating plant growth, causing algal blooms and reducing oxygen levels.
- THE USE OF GRASS CARP IN GALWAY LAKE WOULD NOT BE PERMITTED UNDER CURRENT NY STATE POLICY BECAUSE THE LAKE IS CONTAINED WHOLLY WITHIN THE BOUNDARIES OF PRIVATELY OWNED LAND AND IS AN IMPOUNDMENT ON A STREAM SHOWN ON A USGS TOPOGRAPHICAL MAP.

# Plan of Action for 2010

- Develop an integrated Lake Management Plan
- **NUTRIENTS**
  - OWTS
    - Consider alternatives for determining nutrient impact of OWTS in Adabar B, Harts A and West Bay Cove
    - Insure Association members and real estate agents are aware of all OWTS inspection requirements.
    - Work with Galway Code Enforcement Officer on compliance with OWTS provisions in the town ordinance.
    - Assist the Code Enforcement Officer with the identification of properties being transferred in the lake district.
    - Encourage the reporting of potential OWTS problems
    - Continue biological and chemical monitoring in potential problem areas.
  - Storm Water
    - Work with the Town Highway Dept. to complete the storm water diversion project on Hermance Rd.
    - Attempt to complete the 2009 Skidmore Intern Storm Water Study.
    - Continue to evaluate the feasibility of a dredging pilot test?

# Plan of Action for 2010 Continued

- **WEEDS**
  - Conduct a Deep Draw Down in the Fall of 2010 in accordance with the parameters suggested by DFWI.
  - Develop a plan for optimizing the 2010 Draw Down to include shoreline enhancement, weed barrier installation, clearing and disposal of exposed lake weeds etc.
  - Investigate other weed control alternatives as directed by the GLCA Board.
- **OTHER**
  - Plan for and implement, if possible, sediment control basins in West Bay Cove and North Bay Cove

# Q&A Session