Aeration Committee Report to Lake Board

Lake Board President, Tom Joseph, created the Aeration Committee, which was tasked to assess the need for additional aeration in Silver Springs Lake. Committee members include Lake Board VP Mike Fisher, Clean Water Committee Representatives, Terry Klaves and David Lester, past Clean Water Committee members, Tony Mainiero and John Sabljak. This report was written by Aeration Committee Member John Sabljak and Clean Water Committee Member, David Lester.

To achieve the team goal of providing a hard yes/no recommendation to the Lake Board, meetings were conducted with several known and familiar water biologists, who provided the Aeration Committee members an opportunity to ask the "a-z" questions and thereby obtain and present factual, science-based answers.

Aeration Committee Findings:

Lakes and ponds have a geologic aging process, where nutrients collect, plants take root, dead and decayed organic plant matter builds on the lake bottom, and eventually the entire body will become a swampy grassland. See attached article on the science of lake aging, "Lake Eutrophication". {Appendix A}

Shallow and gently sloped lakes and ponds age more quickly than steep sided and deeper lakes and ponds. Silver Springs Lake was constructed as a shallow, gently sloped lake. Original residents remember it being entirely sand bottom and virtually free of invasive and native aquatic plant species. Over the course of 50 years, the nutrient levels in our lake have risen. Aquatic weed growth has increased and decayed plant material is collecting on the lake-bottom (as muck). More recently the thick muck on the bottom of the lake is giving rise to (anaerobic) algae growth.

Left unattended, the ever-increasing water nutrification (nutrient accumulation), aquatic weed growth, and muck build-up will continue to reduce the recreational value of Silver Springs Lake. Weeds will spread and become thicker, adversely affecting boat navigation, fishing, and swimming. Muck and silt accumulation will continue, reducing the desired firm sand bottom in swimming areas. If the artesian springs and the natural wind and wave action become inadequate, overwhelmed by decaying plant matter, oxygenation levels will drop, algal blooms may occur and fish populations will be adversely affected.

As described in lake/waterway management literature {Exhibit A}, the level of maturity, nutrification, and productivity (aquatic plant growth) for a given lake or a pond is described as its 'Trophic State'. Young, nutrient-poor Oligotrophic lakes and ponds have clear water. They are weed-free and do not experience any sort of algal blooms. Their recreational value is perfect. Maturing, Mesotrophic lakes have higher nutrient concentrations, which support more aquatic weed growth. Sediments from the dead and decayed plant vegetation accumulate on the lake bottom as silt and muck.

Aquatic weeds absorb nutrients, release oxygen and provide a protective cover for fish populations. Plant decomposition, on the other hand, consumes oxygen. Thick layers of muck create an anoxic environment (free of dissolved oxygen), which supports anaerobic algae growth.

Higher concentrations of water nutrients promote widespread weed and algae growth. Thick layers of muck on the lake bottom, from the decaying plant matter, further define the matured, Eutrophic state lake, which has reduced recreational value.

Our Lake History:

When Silver Springs Lake was in its youthful Oligotrophic stage (for its first 30 years), the water was clear, the bottom was mostly sand, there were few aquatic weeds. Dissolved oxygen levels were inadequate to support large fish populations. Aeration was warranted.

As the lake aged into the Mesotrophic stage (for the following 20 years), the water had ever-increasing levels of plant nutrients. This (water nutrification) promoted increased aquatic plant/weed growth, and increased sedimentation (silt and muck build-up.)

Plant growth has multiple positive lake effects. Weeds remove nutrients from the water and from the lake bottom. Rigorous plant growth supports clear water, by taking away the nutrients that might otherwise be used by suspended plant algae.

Plant growth increases the amount of dissolved oxygen in the water. Technically, aeration is not needed in a well-balanced Mesotrophic state lake or pond. High oxygen content and moderate weed growth supports larger fish populations.

Unfortunately, boat navigation is adversely affected by weed growth. Residents also have to physically cut and remove weeds (and rake or treat ‘muck’) to maintain their swimming beaches.

Silver Springs Lake is now moving into its Eutrophic (heavy weed growth and muck accumulation) stage.

For the past 5 years the Lake Association has been treating native and invasive aquatic weeds with various aquacides - - knocking down weeds, primarily in the boat navigation lanes. This has provided seasonal improvements to the lake’s recreational value. Fishing, boating, and swimming conditions are improved when the weeds are killed and they drop to the lake bottom.

Our Aeration program is active, with two diffusers placed adjacent to each other at the center of the lake, at its deepest point. Aquatic weed growth, aeration, artesian wells, wind and wave action all contribute to our lake’s excellent overall water oxygenation levels. They are near-to the saturation point for dissolved oxygen.

What can be done to slow and reverse lake aging?

It is unfortunate but true that the chemical weed treatments, aeration programs, and weed cutting programs (without weed removal) employed to date DO NOTHING to slow the lake aging process or to improve its long-term lake health.
As we are seeing, in less than one generation, unabated lake nutrification can turn a new Oligotrophic Lake with excellent recreational value into a matured Eutrophic Lake, with deteriorating recreational value.

Man and mother nature are continuously adding nutrients to our lake, which support aquatic weed and algae growth. Dead weeds fall to the lake bottom, adding nutrients in the form of muck, and promoting further weed and algae growth.

There are multiple natural and manmade nutrient sources that need to be managed to slow and/or reverse the lake maturation rate. The most obvious of these is our water inlet, which is a source of sedimentation, nutrients, and possibly invasive aquatic plant species.

Steps can be taken to reduce (minimize) the amount of nutrients being introduced to the lake, and action can be taken to physically remove nutrients from the lake. To preserve our long-term lake health and property values, a comprehensive long-term Lake Management Program is needed. We all agree that doing nothing will not be an option.

Slowing and Reversing the Lake Maturation Rate:

Nutrients in the water and accumulating on the lake bottom support aquatic weed and algae growth. There is no stopping nutrient introduction to the lake. Nutrient sources include pollen, dust, (dead) aquatic weeds, grass clippings, tree leaves, lawn fertilizer runoff, septic field leaching, and (last but not least) sediment and nutrient rich runoff water from the lake inlet.

A Lake Management Program is designed to effectively limit the various forms of nutrient introduction, and to physically remove nutrients from the lake. It is intended to, slow or stop the lake's rate of maturation, to thereby maximize its recreational value and to protect homeowners' long-term property values.

To slow the lake's rate of maturation, reduce weed and algae growth, reduce muck accumulation, and silt build-up, including the influx of nutrient rich and sediment laden inlet water, the Biologists and the combined Clean Water and Lake Aeration Committee members recommend a Lake Management program, which might include:

1) Continuous lake-wide Weed Harvesting, to physically remove biomass
2) A dredging program to physically remove sediments (muck and silt) from the inlet area and two additional problem-accumulation 'target-sites'
3) Installation and maintenance of a properly engineered and state approved sediment basin at the Inlet Stream (on the lake side of W. Silver Springs Drive.) {See Exhibit B for background-Reference}

4) Continuing chemical treatments, to eradicate invasive weed species (and native weed species in areas that cannot be maintained with weed harvesting alone)
5) Education and guidance for residents wishing to maintain beaches and swimming areas, and for all residents - - to limit nutrient introduction to the lake

Each of these Lake Management Program elements are examined below.

Inlet Water Management
Biologists consulted agree that the inlet water for Silver Springs Lake is likely to be our greatest source of nutrients and sediments. The inlet water provides nutrients for weed growth, a conduit for invasive/undesirable weed species introduction, and silt deposits.

Sediments from erosion and fertilizers from crop field run-off are two items that need to be monitored and managed at the lake water inlet. The DNR and other state agencies may assist in getting up-stream landowners to maintain buffer zones, which are designed to limit erosion, and the farm-crop fertilizer and feed-lot runoff issues.

To limit lake sedimentation, the Lake Association can research, engineer, fund, build and maintain a state approved sediment basin, at the mouth of the inlet stream, on the lake side of W. Silver Springs Drive. {See Exhibit B for background-reference and Exhibit C, the Association's inlet easement map.} By design, the proper sediment basin will retain most of the sediments entering via the inlet stream. This basin would be periodically emptied of its contents, to assure its long-term effectiveness.

Weed Harvesting
Weed Harvesting physically removes plant biomass/nutrients from the lake, while allowing continuing plant growth, which naturally aerates and removes nutrients from the lake water and bottom sediments (muck and silt). Weed growth also contributes to the maintenance of a healthy recreational fish population.

A continuous Weed Harvesting Program promises immediate improvements for boat navigation and long-term de-nutrification effects for the lake. Continuously harvesting the weeds will remove many tens to hundreds of tons of biomass. Muck and silt accumulations can be slowed or even stopped. Over a period of years, the rate of lake maturation could possibly be reversed.

Weed Harvesting can take place on a continuing basis (Monday through Thursday, 9AM-4PM?) from Memorial Day to Labor Day, with an additional (shoreline) weed harvest in September, after most of the boats, piers, and lawn-irrigation suction hoses/pipes have been removed.

Weed harvesters offload their contents into trucks at the boat launch, who take the weeds to approved dump sites. During non-operating hours, the harvester(s) would be tied up at the Association's boat dock, or anchored. Bottom muck and silt are not removed by weed harvesting. Localized lake bottom agitation and increased water

turbidity are to be expected. Lake oxygenation should be monitored and addressed with aeration, as indicated.

Diver Assisted Weed, Silt and Muck Removal
For invasive weeds, where eradication is the goal, there is the Diver Assisted Suction Harvesting (DASH) method, which is a method of extracting plants using a diver, suction tube, a unique set of pumps mounted on a boat and a bagging or filtration system. The diver identifies and removes each plant in its path. The plants and muck, roots-and-all, are suctioned out and collected on the shoreline in silt collection bags. The de-watered silt collection bags are later disposed of in approved dump sites.

Localized water turbidity should be minimal and lake oxygenation levels should be mostly unaffected by hydraulic suctioning. Runoff from the silt bag de-watering area should have suitable buffer zones in place, to block the return of nutrients to the lake.

Dredging
Many residents would argue that muck accumulations are an issue throughout the lake.

Data from the latest muck depth survey (May, 2023) compared to an earlier survey (June, 2016) indicates that the rate of muck accumulation in Silver Springs Lake would not be considered 'excessive'.

Our aquatic biologists and service providers have suggested dredging for mechanical muck, silt, and weed removal around the lake-water inlet and for two (2) additional primary-target areas. Dredging removes weeds and the nutrient-rich muck and silt accumulations, and reverses the aging progress for the lake, on a localized-effect-basis.

A traditional dredge uses cutter-heads and hydraulic pumps to remove all plants, plant roots, muck, silt, sand and debris in its path. Another method is Diver Assisted Hydraulic Dredging (DAHD), which uses a diver to target accumulated muck and a simpler set-up (hydraulic pumps and hoses without cutter-heads.)

DAHD dredging equipment is generally smaller-scale and less invasive. DAHD Programs are more expensive (on a per acre basis) than the larger and more invasive traditional dredging equipment-programs.

Using either technique, the slurried debris is suctioned up and pushed out through long lengths of flexible hoses to the shoreline, where it is collected in silt bags. De-watered silt collection bags are later disposed of in approved dump sites. Buffer zones around the shoreline 'de-watering fields' prevent nutrient rich water from returning to the lake.

Dredging programs reverse the geologic age of the treated area, leaving the lake bottom in its original 'barren' state. This condition will persist for a season or two. Healthy aquatic weeds and sediments return from the surrounding, untreated areas. There are many dredging equipment designs and service options to research. While in operation, dredging operations tend to be noisy. Adjacent water will be turbid. Pump-

out hoses disrupt recreational boating navigation. There are inconveniences surrounding the (on land) silt collection and silt bag de-watering fields. Identifying, leasing, and licensing silt disposal sites also takes ‘considerable’ time and effort.

Muck Pellets

Reducing muck build-up is also possible using “Muck Pellet” treatments. In simple terms, “Muck Pellets” digest accumulated silt and muck - - by enzymatically converting plant detritus into water soluble nutrients, which are then utilized by microbes, plants (aquatic weeds and algae), and fish.

The Lake Association may elect to treat specific ‘target areas’ with muck pellets to locally improve the recreational value of the waterway. This would be an alternative to dredging in those target areas. Nutrients are converted, NOT REMOVED from the lake, by using muck pellets. The long-term lake health is NOT IMPROVED directly by muck pellets. The nutrients liberated by the muck pellets are eventually consumed by plants and algae. These nutrients might be removed from the lake (at a later time) by weed harvesting or dredging activity.

The cost-benefit of wide-range muck pellet treatments needs to be calculated and compared to the cost of dredging programs. Each pellet has a limited and variable treatment area - - up to a foot (more or less) surrounding each pellet. Biologists believe that by controlling sedimentation (nutrient influx) and treating identified locations with muck pellets and aerators, results could be seen in approximately five (5) years. They recommend pellet treatments three (3) times per year in the two (2) noted muck accumulation areas, and five (5) times per year near the lake-water inlet.

Beyond the Lake Association, individual residents have reported the successful use of muck pellets for maintaining their shoreline swimming areas. Residents can be encouraged to use them to improve their personal property’s recreational value.

Aquatic Herbicides

Without regard to public sentiment, on an ongoing basis, limited chemical weed treatments will be needed to eradicate invasive weed species, i.e. Eurasian water milfoil (EWM) and Curly-leaf pondweed (CLP) treatments. If further chemical treatments are needed to enhance the overall and present recreational value of the lake, so-be-it. Above this, continuous weed harvesting and targeted dredging should be employed to remove nutrient rich biomass, silt and muck.

Killing weeds adds to muck accumulation. The nutrients in the muck will promote future plant growth. Plant tissue decomposition consumes oxygen. Oxygen depletion zones on the lake bottom promote noxious anaerobic plant algae growth. Algae and lake water turbidity (cloudy or opaque due to sediments in suspension) can result from excess water nutrification (without plant life consuming those nutrients.)

If the Lake Board deems it unnecessary or uneconomical to use continuous or even periodic weed harvesting to clear boat navigation lanes, chemical weed treatments should continue - - to maintain the present recreational value of Silver Springs Lake.

Aeration
Although aeration will not slow the lake-aging process, it would be indicated to improve overall lake health if/when other activities create oxygen depletion zones, i.e., after dredging, DAHD, herbicide treatments or muck pellet programs are conducted.

Cultural Eutrophication – Each Resdient's Role in Lake Management
The bigger Lake Association and Lake Management Programs will address the non-shoreline Weed Harvesting, Dredging and Inlet Water Sedimentation issues.

The Lake Board and its various Committee Members are not the only ones who will be involved in a Lake Management Program. One of the issues addressed through a comprehensive Lake Management Program is the management of "Cultural Eutrophication" - - which is man's contributions to water nutrification, and to the larger lake maturation process.

Mother nature contributes to the lake aging process through soil erosion and deposition of pollen, dust and leaves. Above this, we humans are responsible for contributions from farm feedlot runoff, fertilized crop field and lawn runoff, leaking septic systems, and improper grass cutting and raked leaf disposal. (Note: The lake water inlet sediments and nutrients were discussed above.)

This 'Cultural Eutrophication' can be minimized through education (best practice information), resource sharing, and continuous encouragement. Residential septic systems and drainage fields must be properly installed and maintained. Lawns close to the lakeshore should not be treated with high phosphorus or high nitrogen fertilizers. Runoff areas should have "buffer zones" where nutrients can be consumed by plants or absorbed by other artificial means before they reach the lake or the lake-water inlet.

To achieve the highest recreational value, homeowners desiring sandy beach and swimming areas should be encouraged to cut and remove aquatic weeds, rake muck and silt below the water surface, and use muck pellets to digest thicker muck deposits. Lawn clippings and leaves should never be placed in the lake or on the lakeshore.

Investing time, money, and effort will have the greatest impact on the recreational value of residential shoreline properties. The Lake Association can provide reference materials for every tool and technique that residents might choose to employ.

Fact-based Decision Making and Interim Steps:
There are multiple programs to be considered and tested by lake managers - - to verify the cost-benefits, funding requirements, timing, and the ease of management for each.

To aid the Lake Board's decision-making process going forward, Biologists and the Aeration Committee members recommend the initiation of a regular water sampling, testing and data collection program. Records should be maintained to document the locations, details and effectiveness of ongoing aquatic herbicide treatments; Additional observations such as water clarity, temperatures, weed species and algae growth in each bay and the inlet area; Seasonal weather conditions should also be noted to record what happens to our lake during periods of rainfall, drought, cool, and warm weather.

Near-term Lake Board decisions will be needed in regard to expanding and fortifying the Association's boat launch ramp and boat dock. We must consider reconfiguration, construction design and location, for launching and docking (one or more 'resident') large, heavy commercial dredges, barges, DASH boats, and/or continuous weed harvesters.

Conclusions:

The Aeration Committee recommends maintaining the deep hole aerators. Deep water circulation is always a good thing. Aerator use would absolutely be indicated if/when the percentage of dissolved oxygen drops to levels deemed dangerous for fish survival (measured) during the winter months.

The Aeration Committee does not support adding additional aerators to Silver Springs Lake at this time, because the lake is already well oxygenated. Measured oxygen levels are near the maximum saturation points. Further, additional aeration does not provide immediate recreational value improvements, nor would it provide a measurable contribution to extending our lake's geologic lifespan. In fact, the current practice of operating the existing deep hole aeration compressors 24/7 is not absolutely necessary.

Aeration does not kill weeds, nor prevent weed growth. Incremental improvements (adding diffusers) would have highly localized (10-20 yard) effect on muck and a minimal effect on nutrient reduction. Most of the muck (and all of the nutrients) would simply be relocated upon entering the water column, eventually settling elsewhere.

Aeration compressors are noisy. Aeration lines might also 'get in the way of' (impede) alternative weed harvesting and dredging program operations.

Aerators might be required as an adjunct to chemical weed treatments, dredging, hydraulic suction, or muck pellet treatment programs - - if/when pockets of oxygen-depletion are detected.

To immediately improve the lake's recreational value and to reverse the water nutrification processes long-term, we need to physically remove biomass/nutrients.

The aging process for Silver Springs Lake can be slowed and potentially reversed with a comprehensive Lake Management Program. Combining (aggressive) targeted

dredging and continuous weed harvesting programs (in the general vicinity of navigation lanes) will improve the lake's recreational value and slow its maturation rate.

This Aeration Committee is proud to have made this small contribution to our residents and to the Lake Board. As active members of the Clean Water Committee, we look forward to 'working' several of these lake preservation strategies forward within the next 12 months. Our goal is to assist the Lake Association Board, to improve the lake's recreational value and to preserve our long-term property values.

Exhibit A:

New Hampshire Department of Environmental Services: Lake Eutrophication
https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/bb-3.pdf

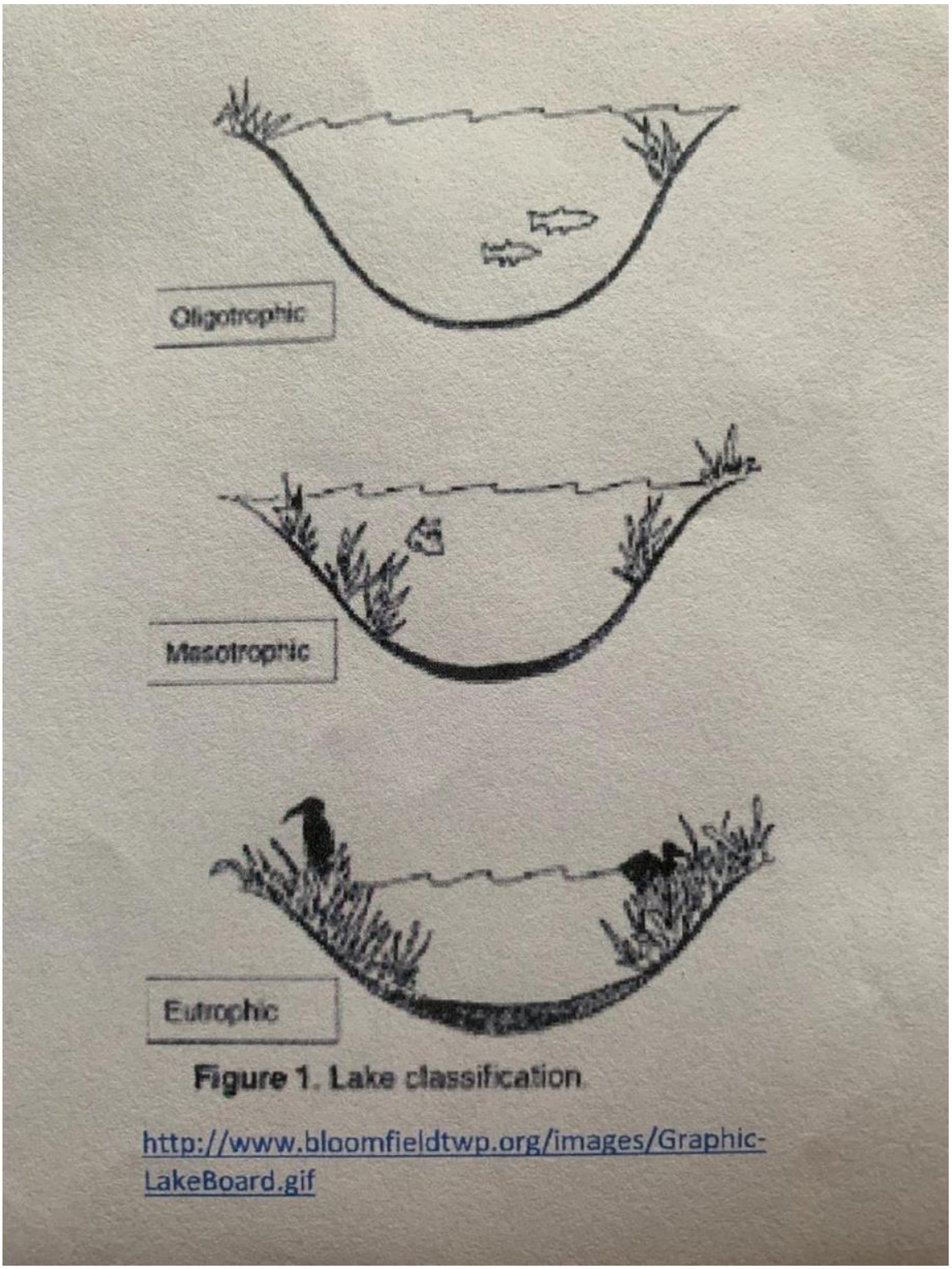


Figure 1. Lake classification

http://www.bloomfieldtwp.org/images/Graphic-LakeBoard.gif

Exhibit B:

Wisconsin DOT: Sedimentation Traps and Basins
https://wisconsindot.gov/rdwy/fdm/fd-10-10.pdf

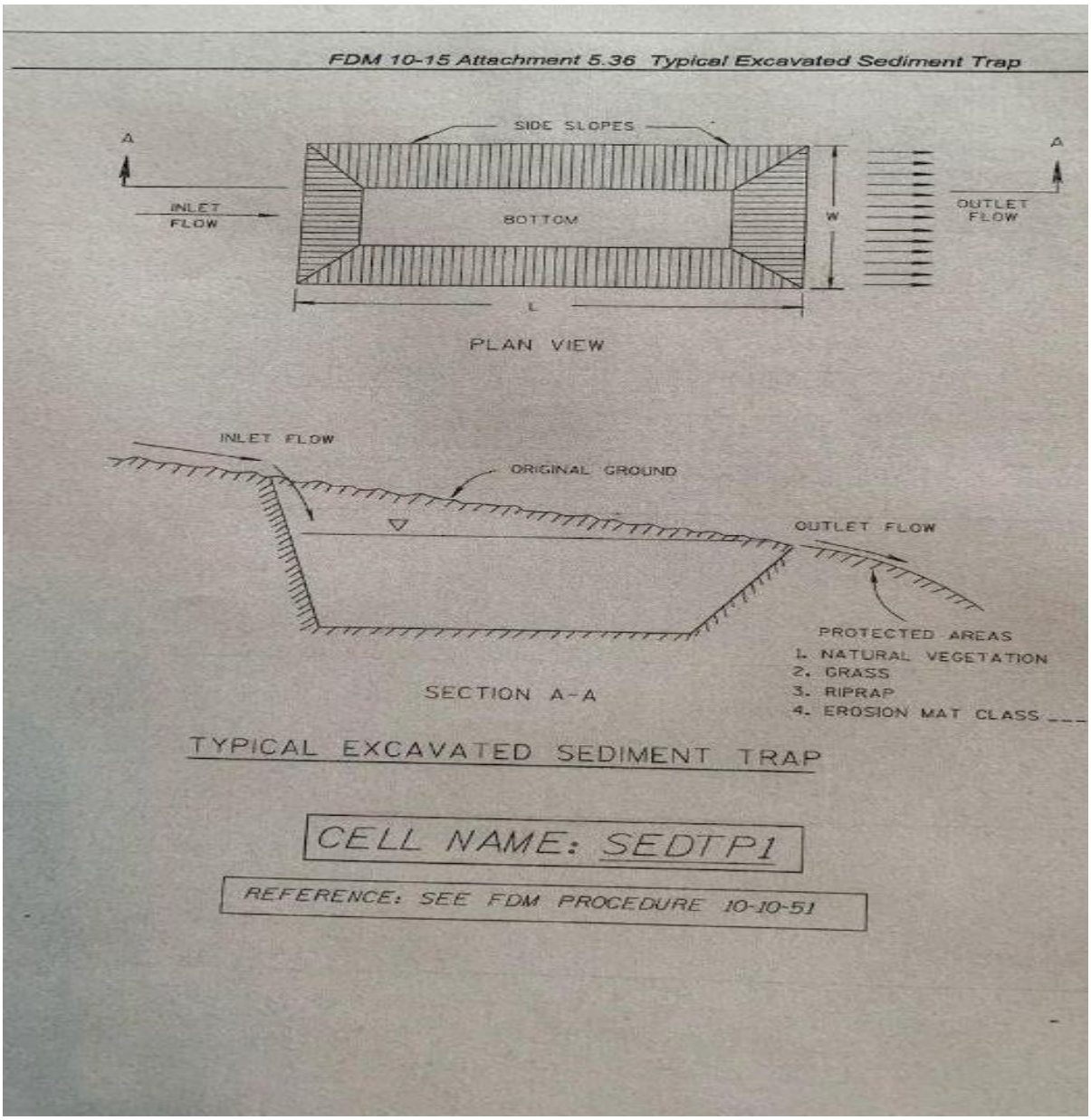
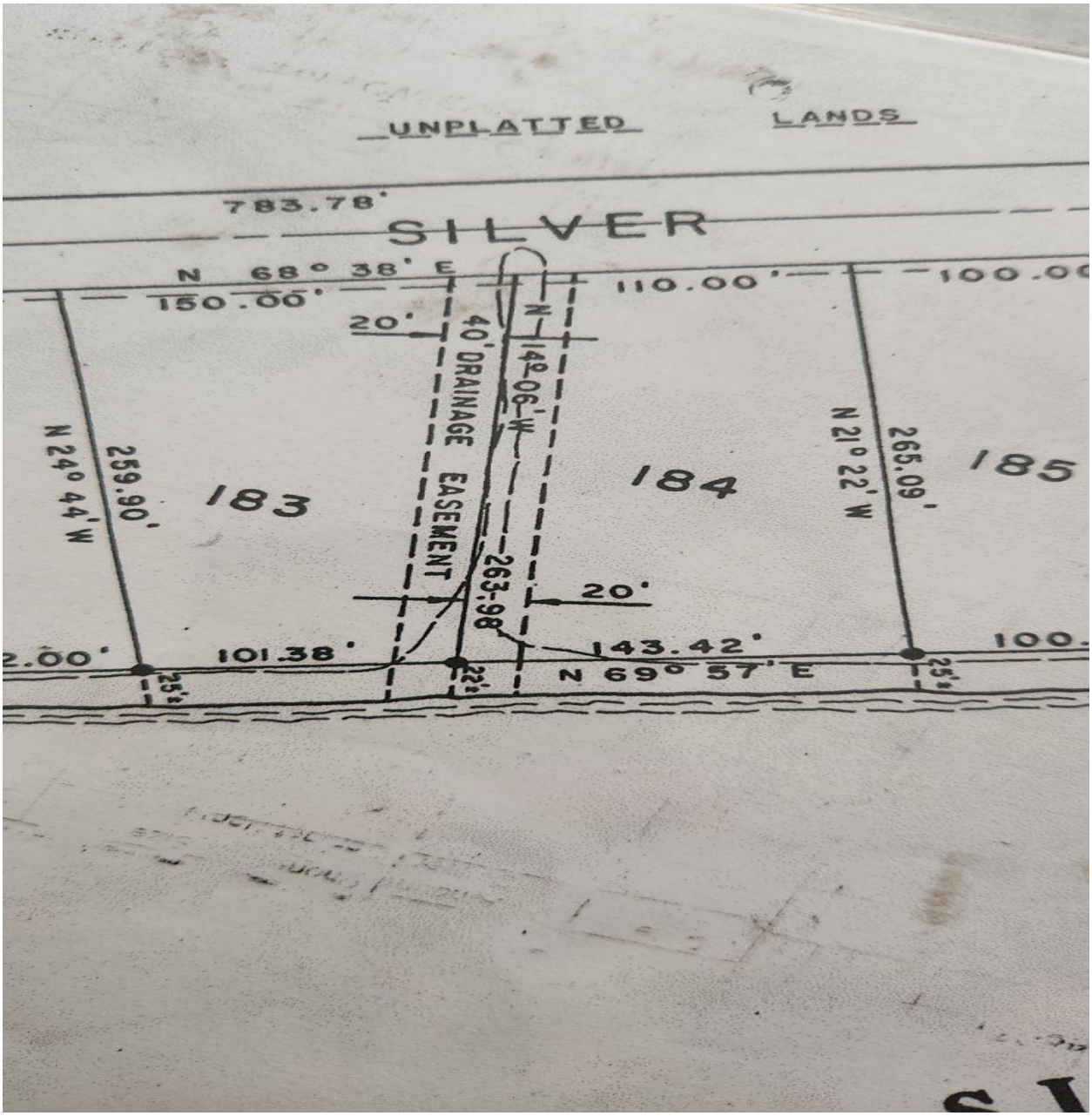


Exhibit C
Silver Springs Lake Inlet Easement Map


UNPLATTED LANDS
783.78'
SILVER
N 68° 38' E
150.00'
110.00'
100.00
20'
40' DRAINAGE EASEMENT
N 14° 06' W
N 24° 44' W
259.90'
183
184
N 21° 22' W
265.09'
185
263.98'
20'
2.00'
101.38'
143.42'
N 69° 57' E
100.
25'
25'
22'