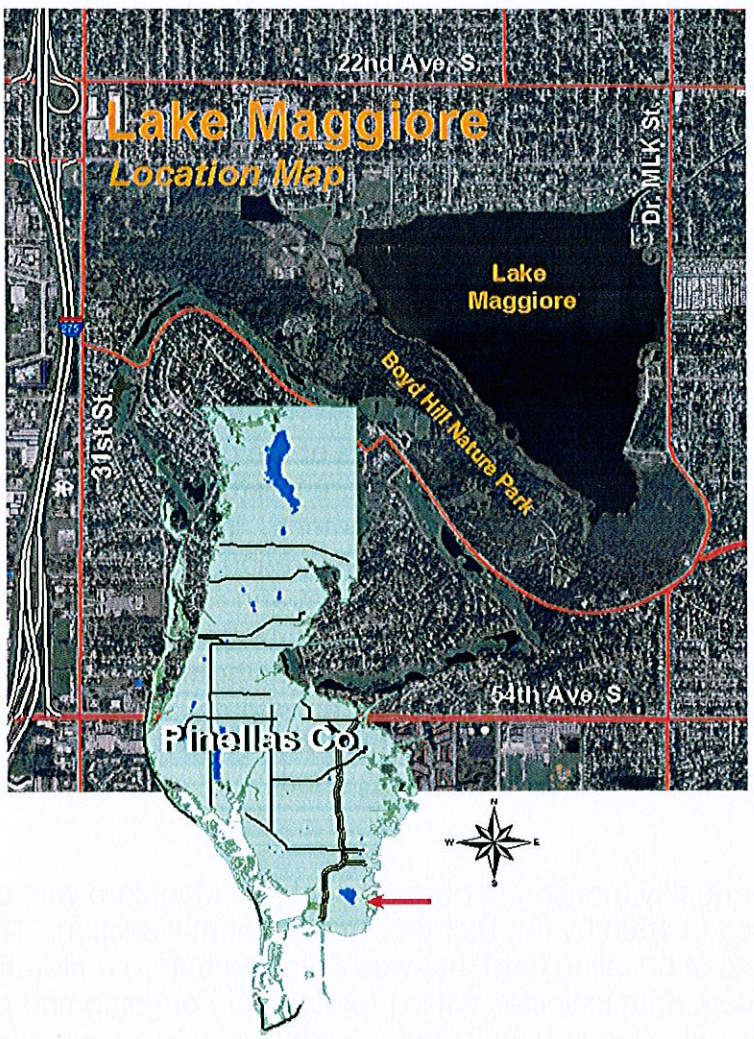
Lake Maggiore Water Quality Monitoring Summary

DRAFT

October 2007



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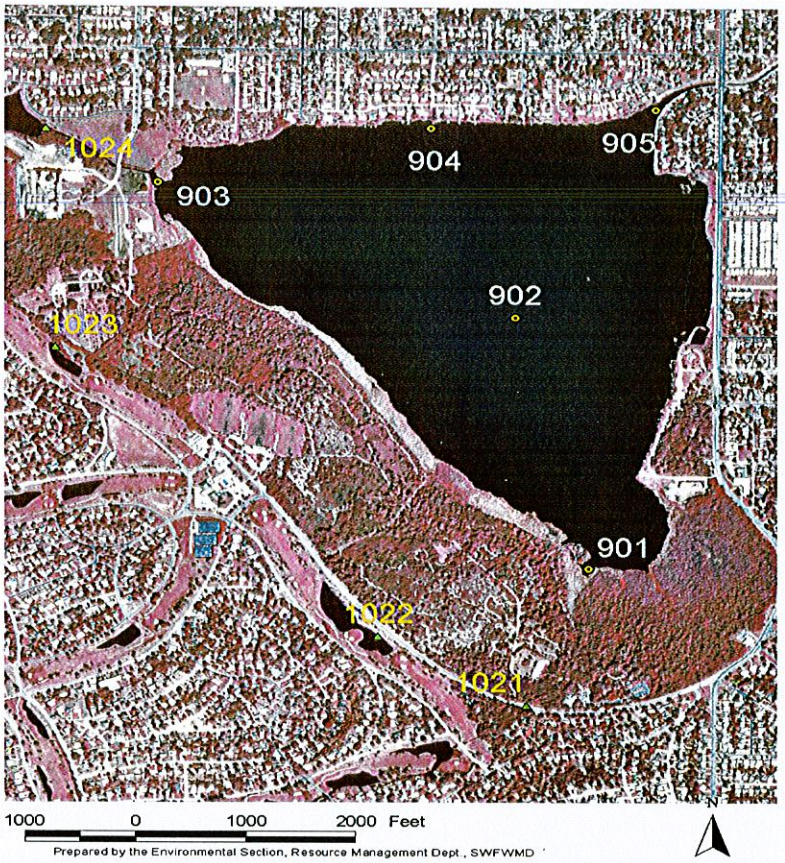


Figure 1. Location of current and historical sampling sites located on Lake Maggiore.

The WQMP SOP was created in accordance with procedures described in the Florida Department of Environmental Protection (FDEP) Standard Operating Procedures (F.A.C. 62-160). The field parameters include: dissolved oxygen, temperature, pH, conductivity, and salinity. Field data are collected in situ using a YSI mulitsonde 600 XLM that is calibrated before and after sampling. Water clarity measurements are also collected in the field using a secchi disk to measure disappear and reappear depths. Water quality samples for the Lake Maggiore project are analyzed by the Southwest Florida Water Management District's (SWFWMD) Chemistry Laboratory (Brooksville, Florida). All samples are analyzed in compliance with the laboratory's Comprehensive Quality Assurance Plan. The normal suite of water quality parameters analyzed is listed in Table 1. Due to the alum treatment facilities, dissolved aluminum was added to the normal suite of parameters tested. Qualified field and laboratory data are currently stored in the laboratory's LIMS database. These data have been exported into Excel format for analyses. All laboratory data are scheduled to be uploaded into the FDEP STORET database.

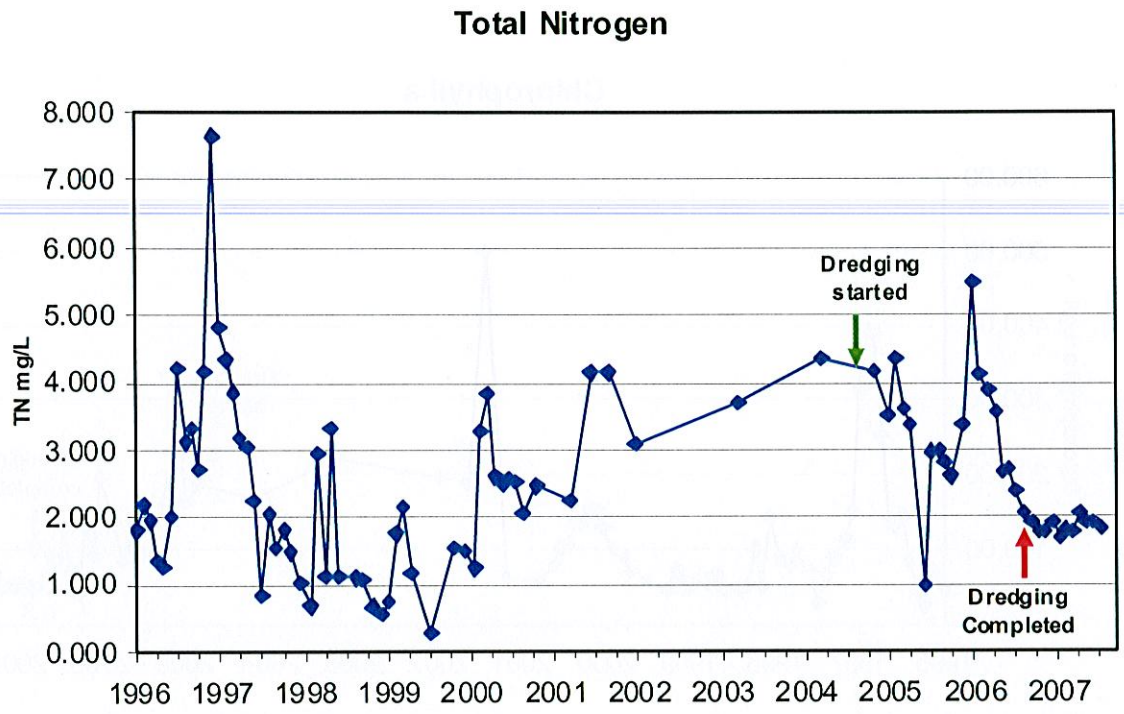


Figure 2. Graph of the average Total Nitrogen concentrations at the five monitoring stations.

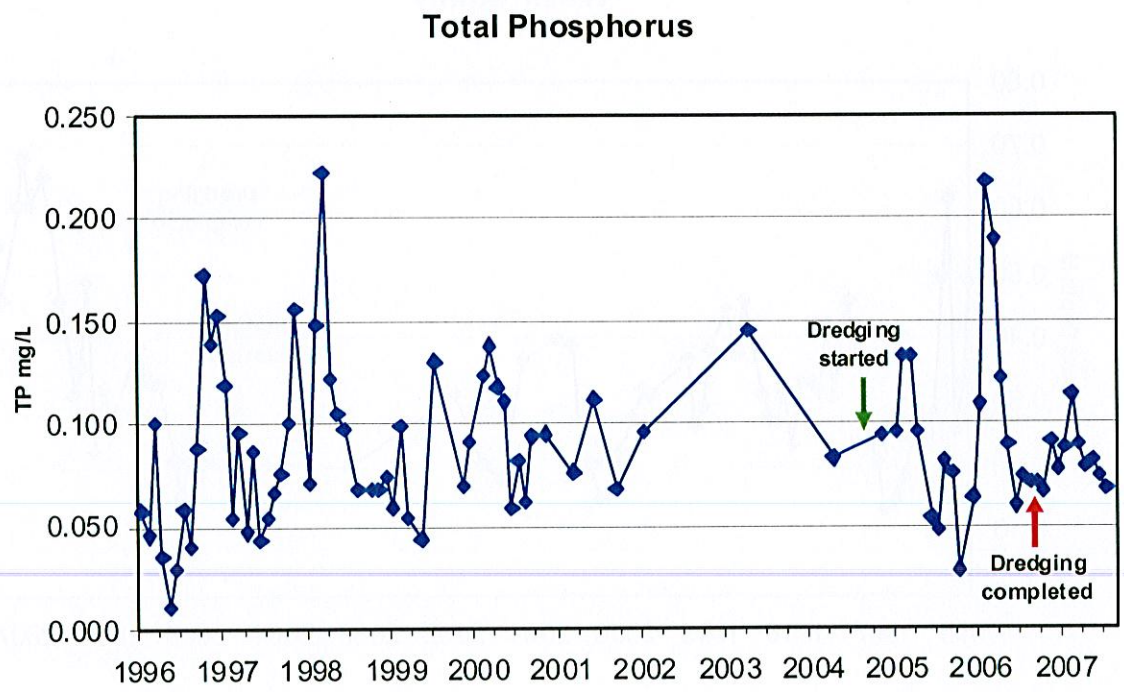


Figure 3. Graph of the average Total Phosphorus concentrations at the five monitoring stations.

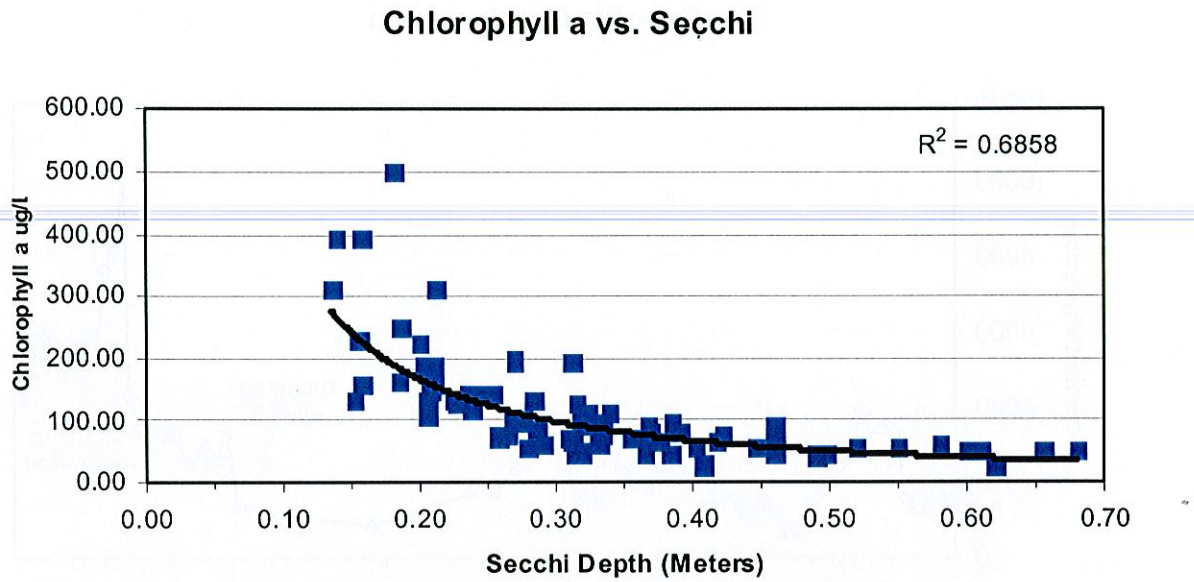


Figure 6. Graph of average Cholophyll a vs. average Secchi at the five monitoring stations.

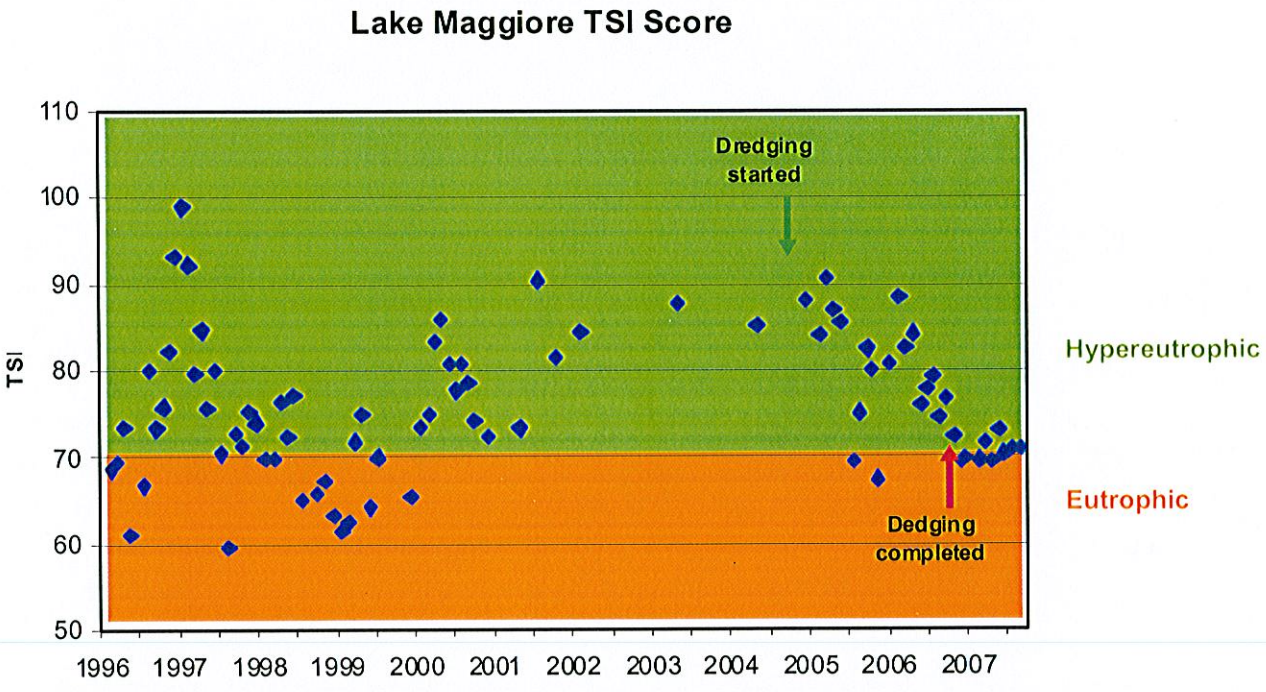


Figure 7. Graph of the average TSI Score at the five monitoring stations.

References

Bromwell & Carrier, Inc., 1995. Lake Maggiore Restoration Dredge Feasibility Study collected for the City of St. Petersburg.

Harper, H.H. (1994). "Lake Maggiore Evaluation of Bottom Sediments." Final Report to the Southwest Florida Water Management District.

Huber, W.C.; P.L. Brezonik; J.P. Heaney; R.D. Dickinson; S.D. Preston; D.S. Dwornik; and M.A.DeMaio. (1982). "A Classification of Florida Lakes." Publication No. 72. Gainesville, FL: Universityof Florida, Water Resources and Research Center.

EXHIBIT "A"
LAKE MAGGIORE RESTORATION
CONCEPTUAL MANAGEMENT PLAN

The City of St. Petersburg and the Southwest Florida Water Management District, through the Pinellas-Anclote River Basin Board, have engaged in a joint effort to restore Lake Maggiore. The City is committed to restoring the environmental assets of Lake Maggiore and, in fact, has identified the lake as the number one project in the City's Drainage Capital Improvement Program which includes five million dollars ($5,000,000) for restoration over the next six years. Similarly, the Pinellas-Anclote River Basin Board has also committed five million dollars ($5,000,000) toward the restoration of the lake over the next five years. Total funding for implementation of this Plan is ten million dollars ($10,000,000).

A conceptual management plan to restore the lake has been jointly developed by City and District staff. This conceptual management plan consists of both short and long-term objectives designed to obtain long-term improvement in water quality as well as improving aesthetic values of the lake. These objectives were generated from the Lake Maggiore Environmental Assessment conducted by the City and CH2M Hill which was completed in May 1991. The elements of this Plan are as follows:

SHORT-TERM RESTORATION INITIATIVES (PROJECTS)

1) **Cattail removal and littoral zone reconstruction.** Unchecked cattail growth in the shallow littoral areas has contributed to the environmental and aesthetic problems Lake Maggiore is experiencing. Environmental problems within the lake are exacerbated by these large cattail stands since their rapid growth and subsequent decay lead to excessive sedimentation within the lake. Additionally, the large stands of cattails, particularly on the east and north side of the lake, create aesthetic problems since local residents and others who wish to use the lake recreationally find it difficult to view the lake, let alone gain access to it. This problem also exists to an even greater extent on the western shoreline adjacent to the Boyd Hill Park where the most extensive stands of cattails are found. To initially address the cattail problem, reconstruction of the littoral zone along the east bank of the lake in the City's Picnic Park on 9th St. is being pursued. The City's consultant is currently designing the reconstruction and obtaining applicable permits for this work. Construction is expected to begin in May 1993 and will involve the removal of approximately 1,200 linear feet of nuisance vegetation and replanting with species that have the ability to absorb nutrients and stabilize sediments. Not only will this project provide some water quality benefits, but it will

also improve the aesthetics of the lake (i.e. an unobstructed view of the lake from 9th St.). The design and permitting of this project has been completed and as noted above construction will be begin in May 1993. The projected cost for the reconstruction and revegetation is estimated at $85,000. To address the problem of the more extensive cattail stands, particularly in the Boyd Hill Park area, a mechanical weed harvester dedicated for use on Lake Maggiore is a possible solution and will be discussed under long-term initiatives.

2) **Design and construction of new outfall structure to Salt Creek.** As noted above, excessive sedimentation within Lake Maggiore has also been identified as a major environmental problem. This problem has resulted from the discharge of sediments from the watershed during rain events as well as from the large amounts of organic matter that are deposited when aquatic plants in the lake (cattails, Hydrilla, and algae) die and decay. A method of potentially reducing the amount of organic sediments in Lake Maggiore is to draw the water level of the lake down and expose these sediments to sunlight and air thus oxidizing and compacting them. This process would stabilize the remaining sediments and provide a more suitable substrate on which more desirable aquatic plants could establish. To conduct such a drawdown requires the construction of a new outfall structure to Salt Creek since the current structure is in a state of disrepair and does not have the ability to adequately draw the lake down. This project is being conducted with the short-term objective of developing a design for a replacement outfall structure that will allow for better long-term lake level fluctuation and for the partial drawdown necessary to improve sediment conditions in the lake. The design and permitting for this project will be completed in May 1993 with construction to begin soon after. The cost of design is approximately $20,000. The projected cost of the replacement structure is $80,000.

3) **Feasibility of using lake water for golf course irrigation.** A third project to improve water quality is one to determine the feasibility of using water from Lake Maggiore, rather than reclaimed water, to irrigate the adjacent Lakewood Country Club Golf Course. The Environmental Assessment performed by CH2M Hill indicated that the discharge of this reclaimed water to the lake through ground water seepage or, directly through several ponds to a creek entering the lake, contributes excessive nutrients, thus further degrading water quality. By using lake water instead of reclaimed water for irrigation of the golf course, nutrient loads to the lake could ultimately be reduced and water quality improved. The feasibility study should be completed by April 1993 and, if the concept is determined to be feasible,

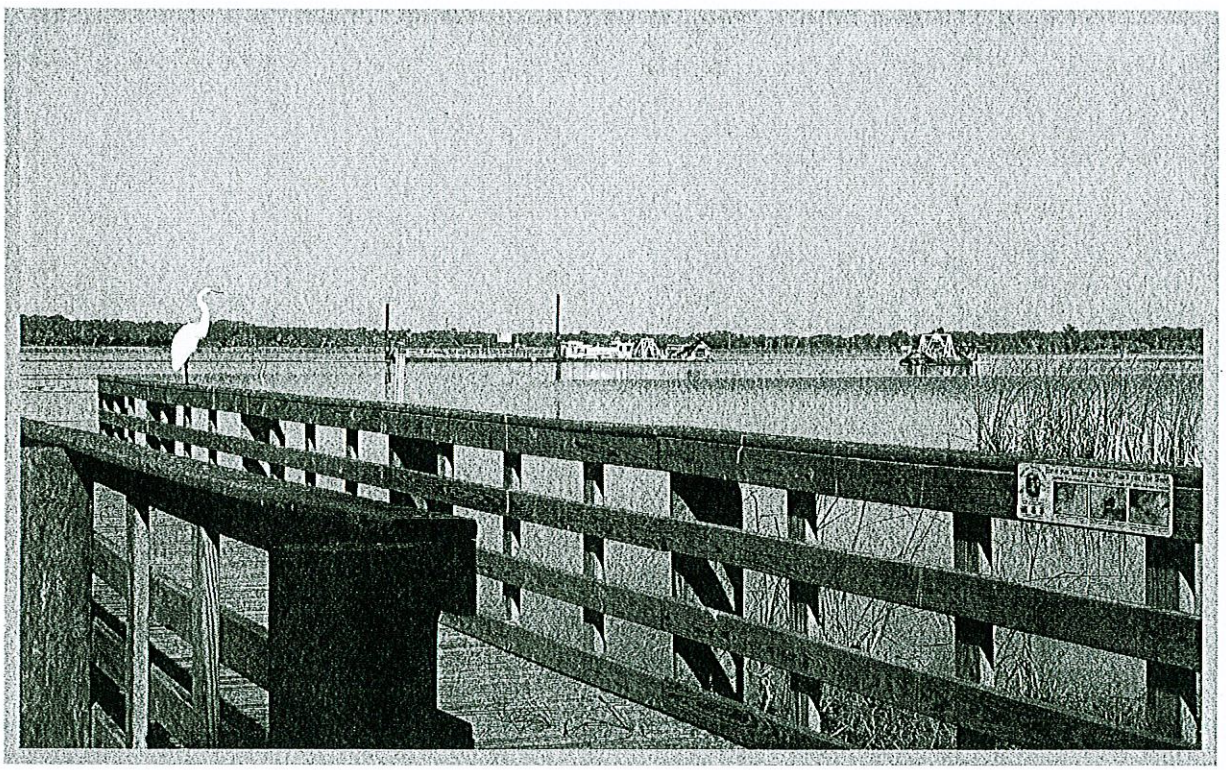
procurement of Federal permits are expected to dovetail with those previously identified short-term objectives, thereby allowing major advances to commence with cleaning up the lake. To initiate the long-term stormwater enhancement program it is proposed that demonstration treatment systems be designed, permitted and constructed and their effectiveness evaluated before commencing construction on the remaining sites. The demonstration sites proposed by City and District staff will be in areas overgrown with Brazilian pepper trees. Thus, the sites offer an opportunity to concurrently test stormwater treatment technology and eradicate several large stands of nuisance vegetation. Implementation of stormwater treatment systems on City park land is contingent on compliance with the Citys' "Change of Park Use" Ordinance.

2) **Mechanical weed harvester.** The Pinellas-Anclote River Basin Board funded the purchase of a mechanical harvester that will be dedicated for use on Lake Maggiore and operated by City personnel. This piece of equipment will be a great asset to the City for improving the aesthetics of Lake Maggiore while removing nuisance aquatic vegetation, particularly cattails, that eventually die, decay and contribute to the lake's water quality and sediment accumulation problems. Estimates to purchase a suitable mechanical harvester range from $90,000 to $110,000. Operation and maintenance costs will be the City's responsibility.

3) **Dredging lake bottom sediments.** As noted earlier, the accumulation of organic, flocculent sediments in the lake from stormwater discharges and the decay of large quantities of aquatic plants has contributed to persistent water quality problems. Additional stormwater treatment, as well as harvesting of aquatic plants, will help prevent further sediment accumulation within the lake. However, existing sediment problems must be addressed before long-term water quality (i.e. nutrient reduction) and habitat improvements can be realized. To accomplish this goal hydraulic dredging of the lake bottom will be necessary. The dredged sediments would be deposited on an upland site, de-watered then transported to a disposal site. An alternative method of sediment disposal might be the creation of spoil islands within the lake itself. The project would take several years and is estimated to cost over $6,000,000.

LAKE MAGGIORE RESTORATION

Dredging and Dewatering of Organic Lake Bottom Sediments in an Urban Setting



City of St. Petersburg, Florida, Engineeent

Thomas B. Gibson, P.E., Director

February 2008

LAKE MAGGIORE RESTORATION AND MANAGEMENT PLAN

Lake Maggiore is a 380 acre natural lake within an urbanized 2200 acre watershed in St. Petersburg, located in southern Pinellas County. The lake is surrounded by public parks and environmental preserve lands, and discharges directly to Tampa Bay via Salt Creek. The lake had reached a hyper eutropic state, due to the effects of nutrient loaded storm water inflows over many years, from the surrounding watershed. Discharges from the lake to Tampa Bay contributed to water quality problems within the Tampa Bay estuary.

The City of St. Petersburg (City) and the Pinellas-Anclote Basin Board of the Southwest Florida Water Management District (SWFWMD) recognized the need to address the decline of the lake, and began lake restoration efforts at Lake Maggiore in 1989 with a cooperatively funded Diagnostic/Feasibility Study. The results of that study became the basis for the development of a Lake Maggiore Restoration and Management Plan implemented through a "Master Agreement" signed by the SWFWMD and the City of St. Petersburg. The Master Agreement included the Lake Maggiore Restoration and Management Plan which outlined a series of short-term and long-term projects focused on the improvement of the lake's water quality, habitats, recreational use and aesthetics. The early diagnostic work completed for Lake Maggiore indicated that untreated stormwater and the large quantity of organic much were contributing to the excessive nutrient (phosphorus and nitrogen) enrichment of the lake. Subsequent restoration efforts focused on treating and improving the quality of Stormwater runoff, and in sediment removal to reduce the store house of nutrients within the lake.

The goals of the Lake Maggiore Restoration and Management Plan were to be met through several capital improvement projects, including short-term and long-term projects. Short-term

restoration activities were completed including: 1) cattail removal and littoral zone reconstruction; 2) a feasibility study using lake water for golf course irrigation; 3) a stormwater treatment study including facility siting; 4) implementation of aquatic weed removal through the use of a mechanical harvester; 5) the design and construction of an outfall structure to Salt Creek; and 6) a stormwater master drainage plan.

SWFWMD has maintained the Master Agreement with the City to implement two long-term lake restoration projects including: stormwater retrofit and sediment removal (dredging) projects. Per the Master Agreement, the stormwater conveyance system has been successfully retrofitted, and five alum injection systems were constructed. The City obtained easements from the St. Petersburg Country Club, a private golf club, to allow construction of alum injection stations on private property and the use of private lakes for stormwater treatment. Together, these systems treat runoff from approximately 2,200 acres of residential and light commercial areas in the lake's watershed. This project substantially reduced the volume of nutrients and other contaminants entering Lake Maggiore.

The dredging, dewatering and disposal of lake bottom sediments was the last of the long-term restoration projects included in the Master Agreement for Lake Maggiore. The removal of lake sediment was a critical element in the overall lake and watershed management plan that would assist in attaining a trophic state index of 60 within Lake Maggiore.

The trophic state index, or TSI, is a general description of the nutritional status of a lake, i.e. an approximation of a lake's overall health. The TSI of Lake Maggiore has historically remained

above 80 which describes a highly productive and eutrophic lake. A TSI/nutrient balance analysis had been completed and concluded that complete removal of the sediment within Lake Maggiore would result in a TSI reduction of approximately 13 units yielding a lake TSI of about 70. Sediment removal coupled with other remediative measures such as alum treatment of runoff and baseflow from priority sub-basins, and assuming that these additional nutrient source controls achieved similar nutrient load reductions, it appeared that achieving a TSI goal of 60 was feasible. Following some initial permit modifications and legal challenges to the permit, the lake dredge and dewatering plant became fully operational in October 2004, with Jahna Dredging, Inc., as the contractor. With approval from SWFWMD, the City undertook the hauling and disposal of dredged sediments utilizing City forces, which allowed for enhanced control of disposal operations, and avoidance of potential cost claims that could arise if the hauling was contracted work. Dredging, dewatering and disposal operations were completed in October 2006, with over 1.3 million cubic yards of organic sediments removed.

Following is a detailed description of the final long-term project, Dredging of Lake Bottom Sediments.

DREDGING LAKE BOTTOM SEDIMENTS

Project Description

Dredging lake bottom sediments from a hyper-eutrophic 380-acre freshwater lake which serves a 2,200-acre urbanized watershed in St. Petersburg, and discharges directly into Tampa Bay via Salt Creek. The center of Lake Maggiore was originally eight to eleven feet deep; however, an accumulation of organic sediments had reduced the depth to four to five feet deep. The organic sediments resulted from years of cattail and other aquatic plant growth which accumulate on the lake bottom where they die. This organic muck is nutrient-rich and adversely affects water clarity, water quality, and further contributes to additional aquatic plant growth due to the excess nutrients (nitrogen and phosphorus) which remain in the lake. Removal of an estimated 1.5 million cubic yards of highly organic lake bottom sediments would reduce the nutrient loading in the lake, improve water quality and clarity, and effectively extend the service life of a hyper-eutrophic lake system. Dewatering the lake to remove sediments was not feasible due to the negative impacts to the surrounding wildlife and park users. Hydraulic dredging of sediments was determined to be the most efficient method of removal, and involved pumping a 95% water slurry over a mile to shore, where the sediments would need to be dewatered for removal from the site.

Unique Problems

Due to the parks, preserve lands, and residential neighborhoods surrounding the lake, large areas to construct evaporation/drying ponds for sediment dewatering did not exist. Unlike inorganic materials such as sand, organic sediments remain suspended in water when dredged and pumped

to shore. These sediments would require processing to increase the solids content to a minimum of 25% for hauling.

The problem of dewatering suspended organic material with limited available land was accomplished within a 3-acre area which had been the City's former nursery yard, located in a wilderness preserve area at the northwest corner of the lake. Dredging was accomplished by a 400-hp centrifugal pump-driven cutter head dredge mounted on a spud barge with sophisticated GPS hydrographic survey capability. Dredge materials were pumped to shore via a mile-long, 16-inch diameter HDPE pipe. The project dredging and dewatering contractor constructed a temporary dewatering plant for the project consisting of two hydrocyclone separators to remove sand, a 120-foot diameter, 1.6 million gallon clarifier tank where dredge materials are mixed with a polymer for thickening, and eight belt presses for dewatering to a minimum of 25% solids. The dewatered organic cake was then conveyed by belt conveyor to a storage area capable of holding one day's production, loaded onto trucks and transported to a disposal site.

Due to the limited area to store dewatered cake at the site, City forces performed continuous trucking to an offsite disposal site during the 27 months of dredging. Trucking was required 16 hours a day, for five to six days a week, using 11 City trucks and another 8 private haulers when required to maintain production. Two thousand cubic yards of dewatered cake per day were disposed of on one of four privately owned sites outside of the city limits, requiring a one-way haul distance of 12 to 25 miles. City forces performed the loading, trucking, unloading and placed the materials onsite in accordance with the property owners' directives and regulatory permits. The largest disposal site used was a 200-acre former citrus grove in Manatee County

which had been stripped of trees due to citrus canker infestation. The organic materials were spread over the native sandy soils and tilled into the soil using a farm plow, in accordance with the property owner's directions.

Unique and difficult conditions were overcome by the project team, including:

- Environmental permitting objections for the dewatering plant construction from local environmental community, due to perceived impacts to the preserve. After a year-long delay and an Administrative Hearing, a permit modification for dewatering plant construction was approved.
- Design, construction and permitting of a 0.5-mile temporary haul road through preserve lands to allow haul trucks to bypass the residential neighborhoods north of the dewatering site.
- The project site was located in an environmental preserve which contained a nesting eagle, endangered fox squirrels, and numerous large alligators. Special animal crossings were constructed beneath the haul road to provide for wildlife safety. The eagle was monitoring during the nesting season, and all project personnel were trained to protect and report on wildlife in accordance with environmental permits.
- The dredging operations began in July 2004 and ended in October 2006. During this period, the region experienced numerous storm events including Hurricanes Dennis, Charley, Frances, Ivan and Jeane in 2004, and Hurricanes Katrina and Rita in 2005. Although the St. Petersburg area was fortunate not to receive a direct hit from these named storm events, the conditions at the disposal sites were nearly impossible for long periods of time due to wet conditions. Extensive temporary berms and haul roads were

constructed in order to contain the organics at disposal sites and maintain access and disposal operations.

- Obtaining regulatory approvals for disposal sites, and maintaining working relationships with the property owners who agreed to accept the dredge material. The sediments required months of dry weather to dry out, firm up, and shrink in volume. The process of spreading organic muck consisting of 75% water content across hundreds of acres of land required detailed environmental permit submittals, surveys, and extensive coordination and cooperation with private land owners who agreed to accept the materials as a soil amendment.

Schedule

The project commenced in 2004 with dewatering plant start-up in July of that year. In October 2004, regulatory approval was received for full operations. Continuous dredging, dewatering, hauling and disposal operations lasted 27 months, with the final loads placed in December 2006. Restoration of the temporary haul road and dewatering site was completed in June 2007.

Project Partners and Budget

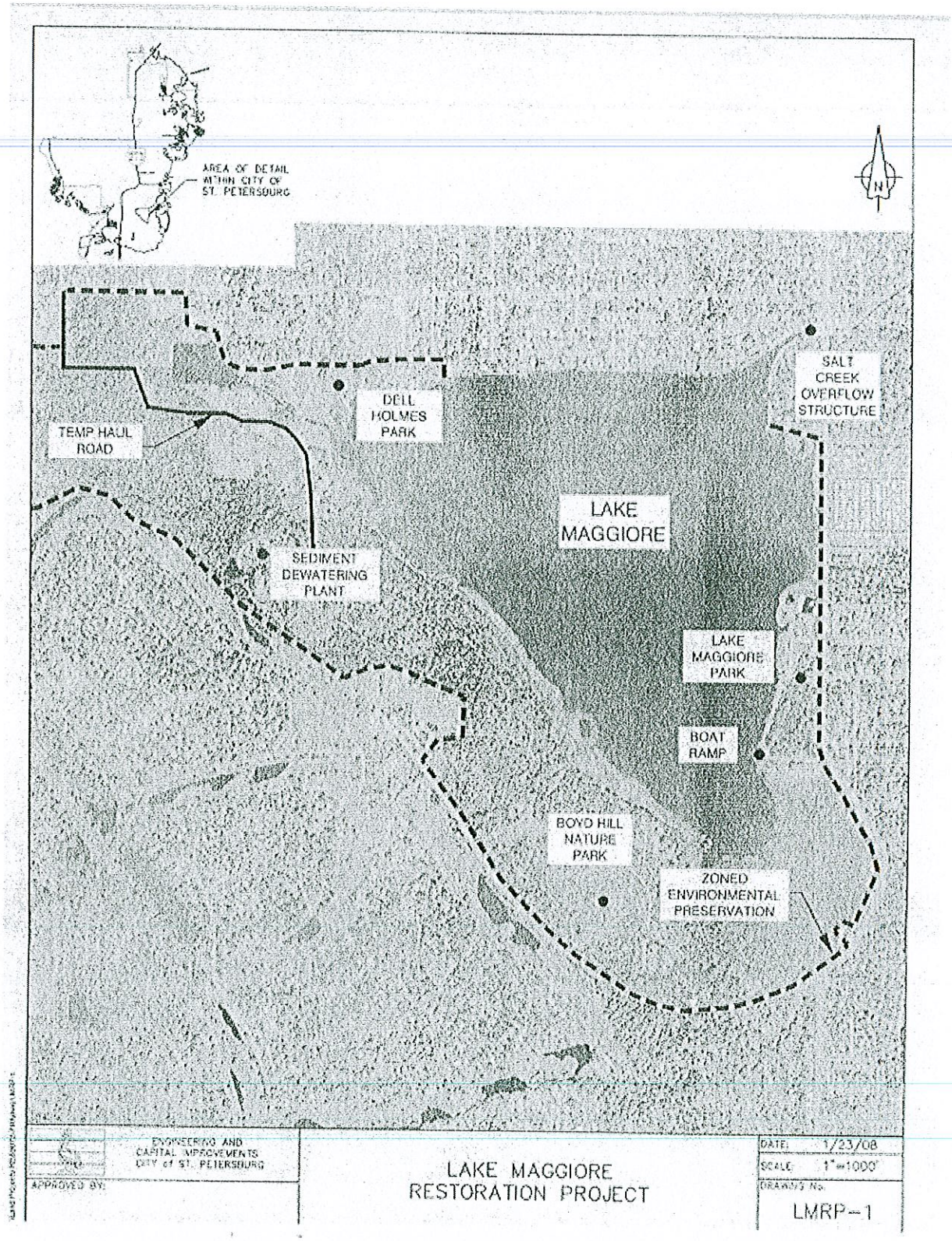
The City received 50% cooperative funding from the Southwest Florida Water Management District (SWFWMD) for the project. The total project cost was $15.5 million dollars, including hydrographic survey, design, permitting, dredging, dewatering, hauling, construction and removal of a .5 mile temporary haul road at the west side of the lake, and temporary haul roads and berms at four disposal sites. The dredging and dewatering was performed by Jahna Dredging, Inc. of Lake Wales. The hauling of the dewatered sediments was performed by City

Stormwater Operations staff. Project management was provided by the Engineering Department staff. City forces safely transported over 80,000 loads of organic sediment to remote, undeveloped sites while protecting wildlife, and minimizing delays to the dredging contractor.

Results

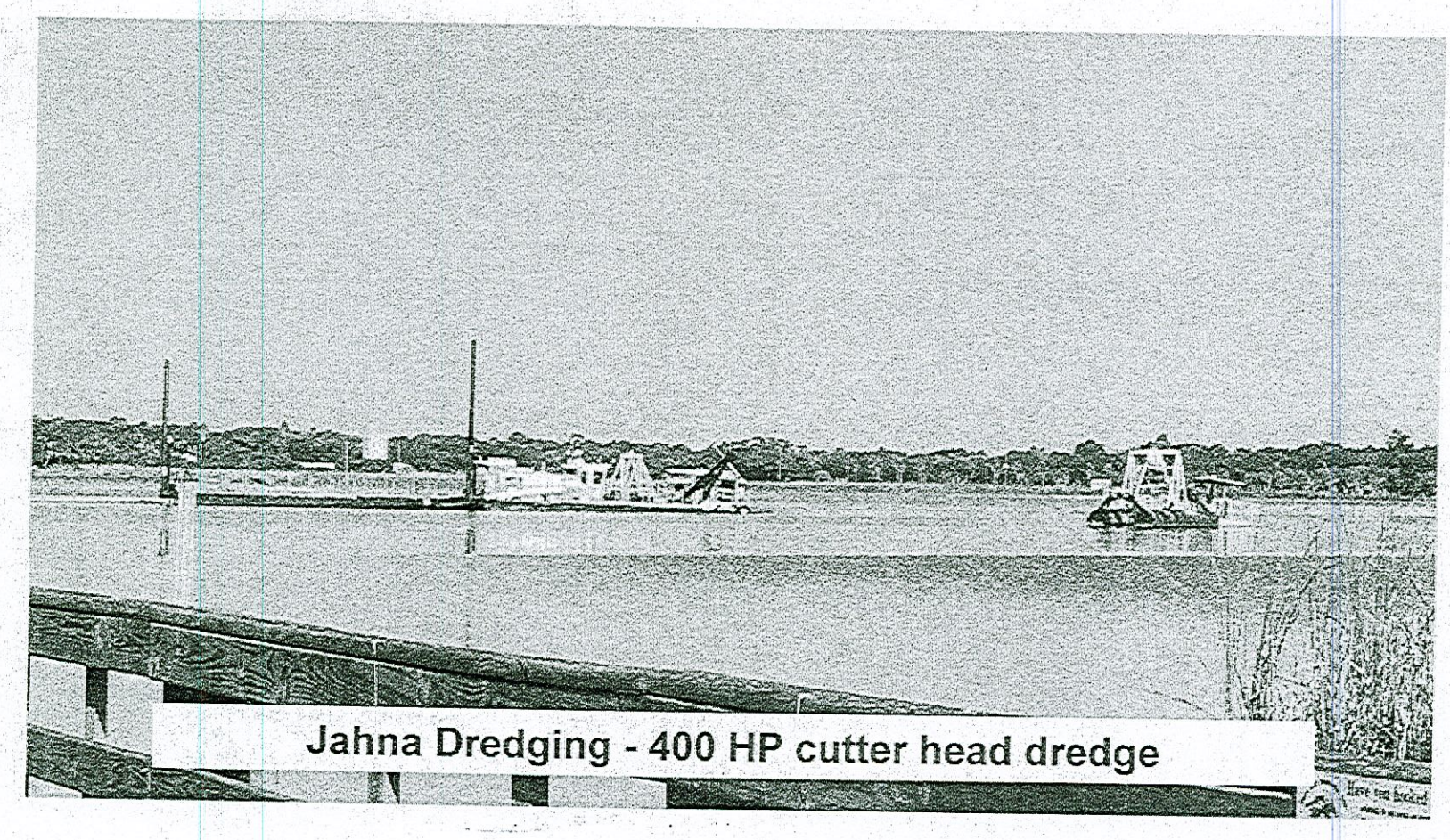
A total of 1,340,718 cubic yards of highly organic lake bottom sediments were dredged, dewatered, and hauled to one of four privately-owned disposal sites, during a 27-month period of dredging, dewatering, and disposal. The restored lake has a depth of eight to nine feet, providing improved recreational opportunities, improved water quality, and improved fishery and wildlife habitat.

Residents and visitors to St. Petersburg will enjoy the benefits of this lake restoration for many years to come, in the form of enhanced recreational opportunities at the lake and surrounding parks, improved wildlife habitat, and improved property values in the surrounding neighborhoods, by a reduction in nutrient loading and improved water quality in the lake and receiving waters of Tampa Bay.



Lake Maggiore Restoration Project – Site Aerial

Appendix – Photo #1

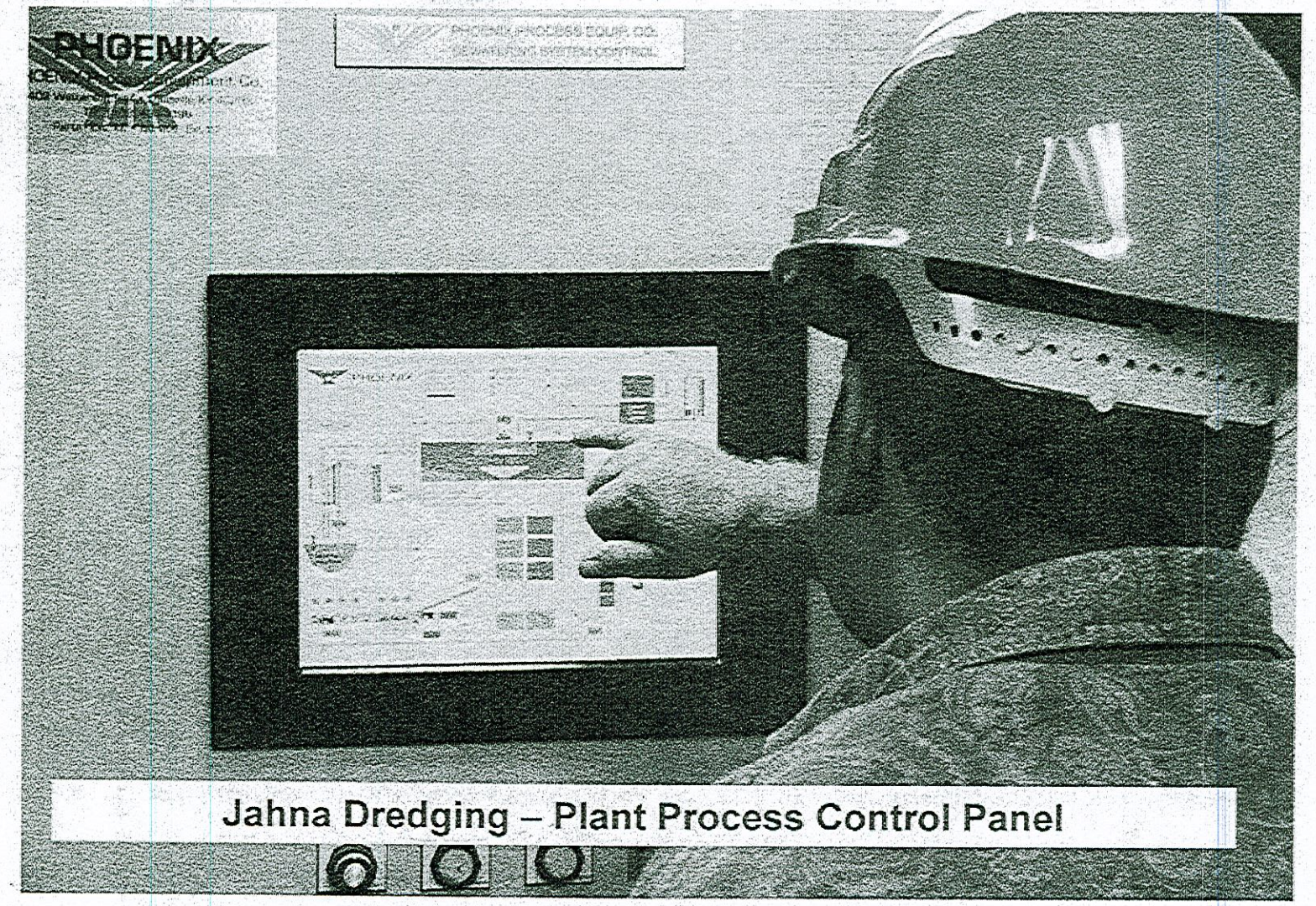


Jahna Dredging - 400 HP cutter head dredge

Appendix – Photo #2

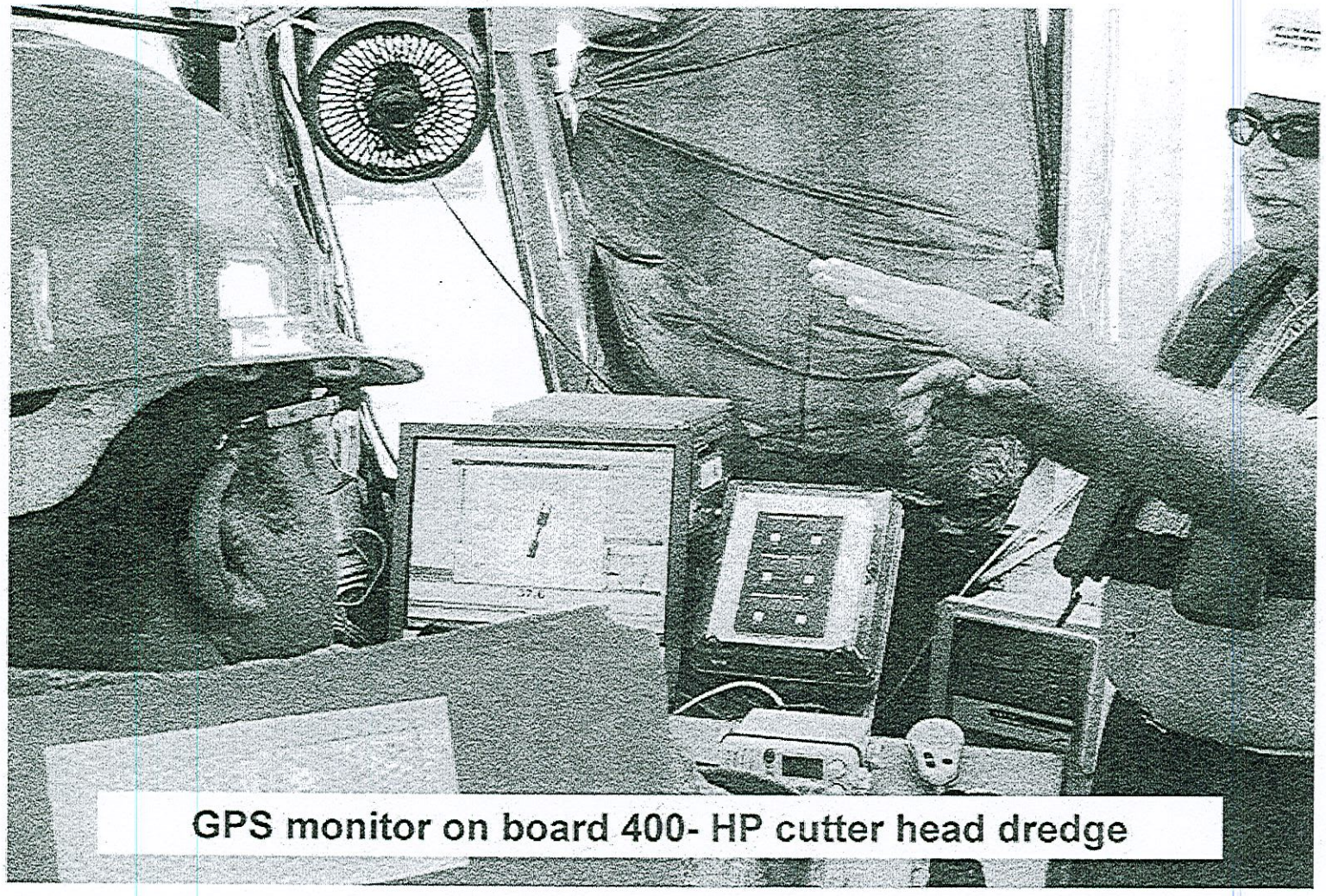
Lake Sample – Untreated Organic Sediment

Appendix – Photo #3



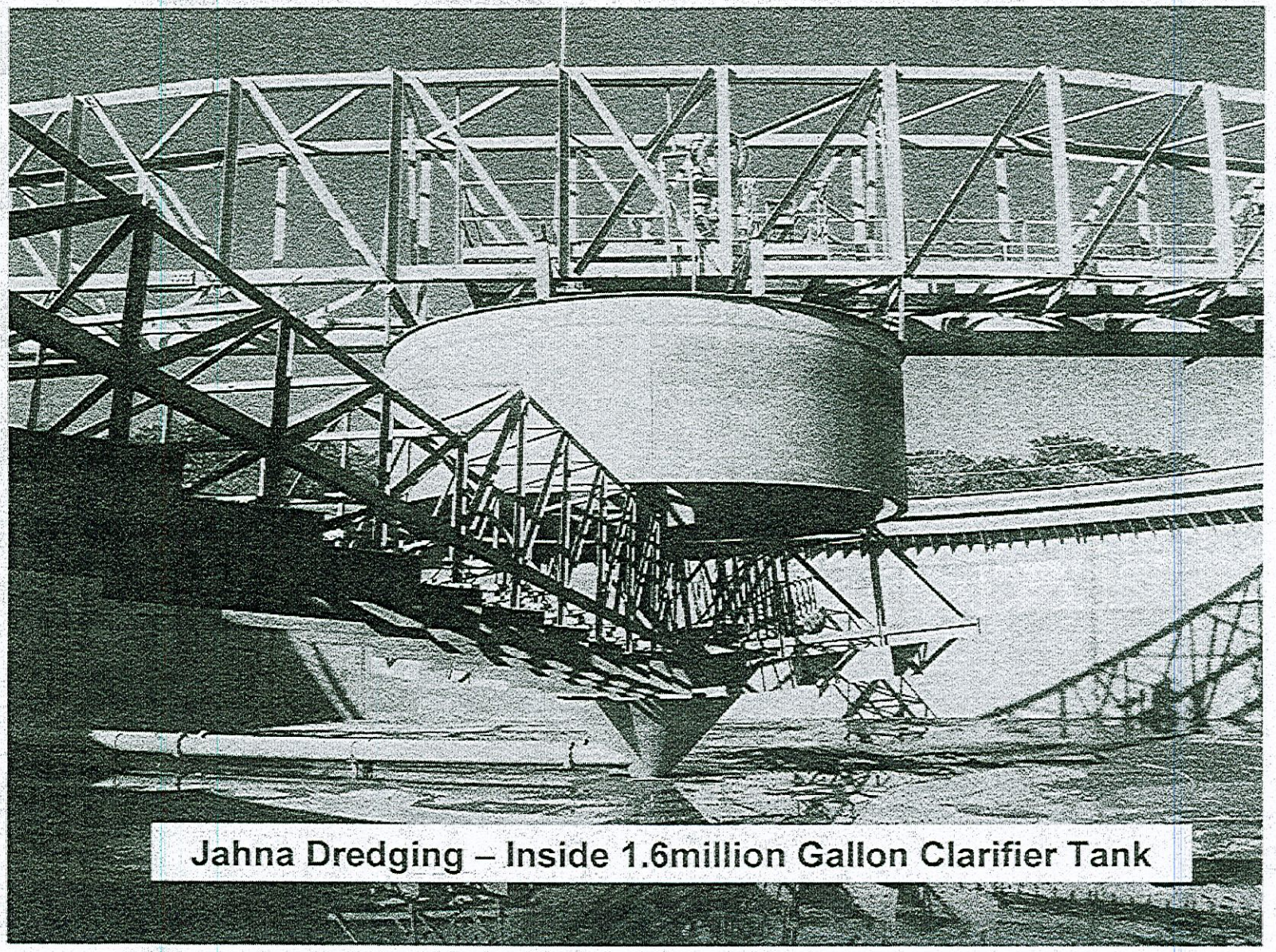
Jahna Dredging – Plant Process Control Panel

Appendix – Photo #4



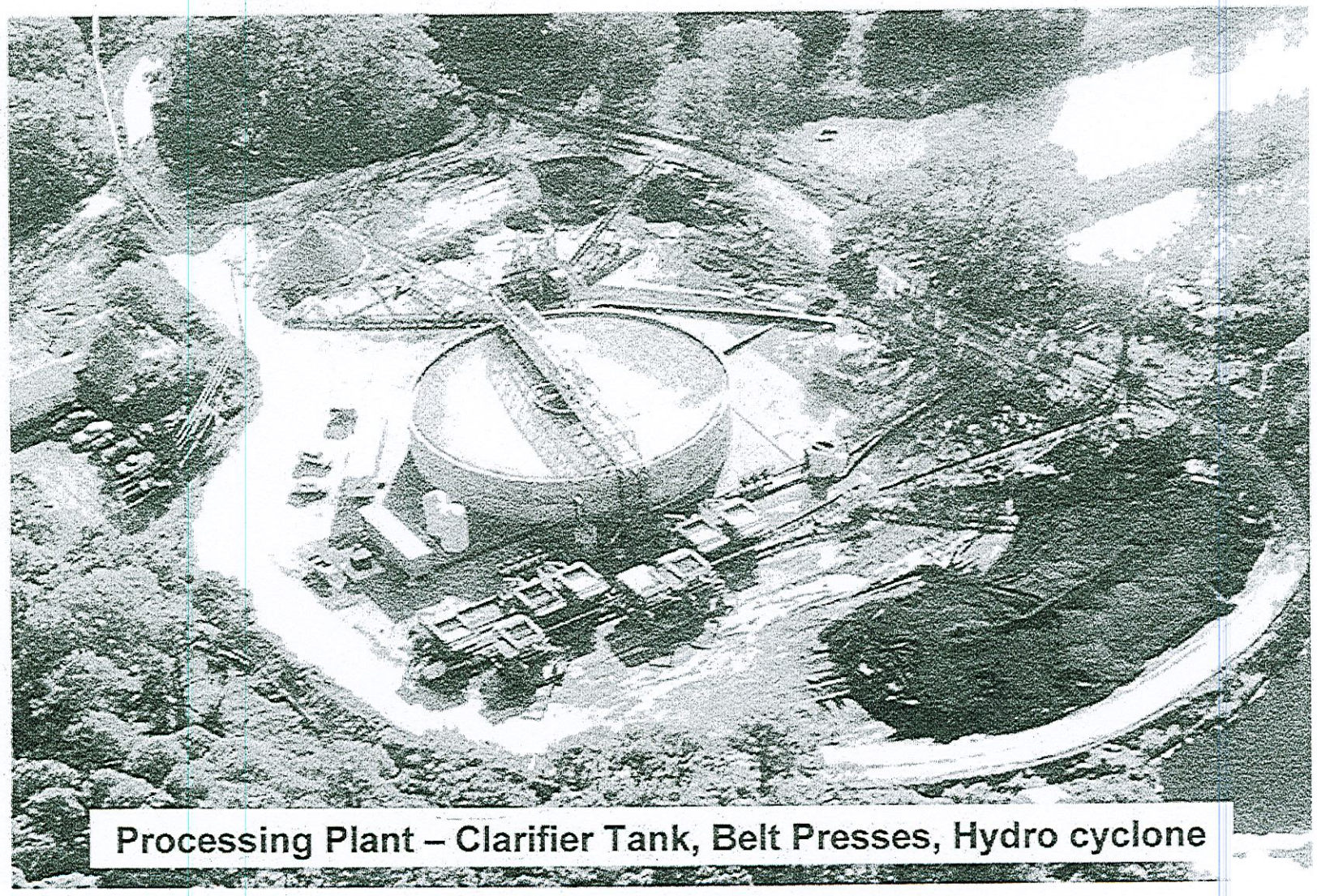
GPS monitor on board 400- HP cutter head dredge

Appendix – Photo #5



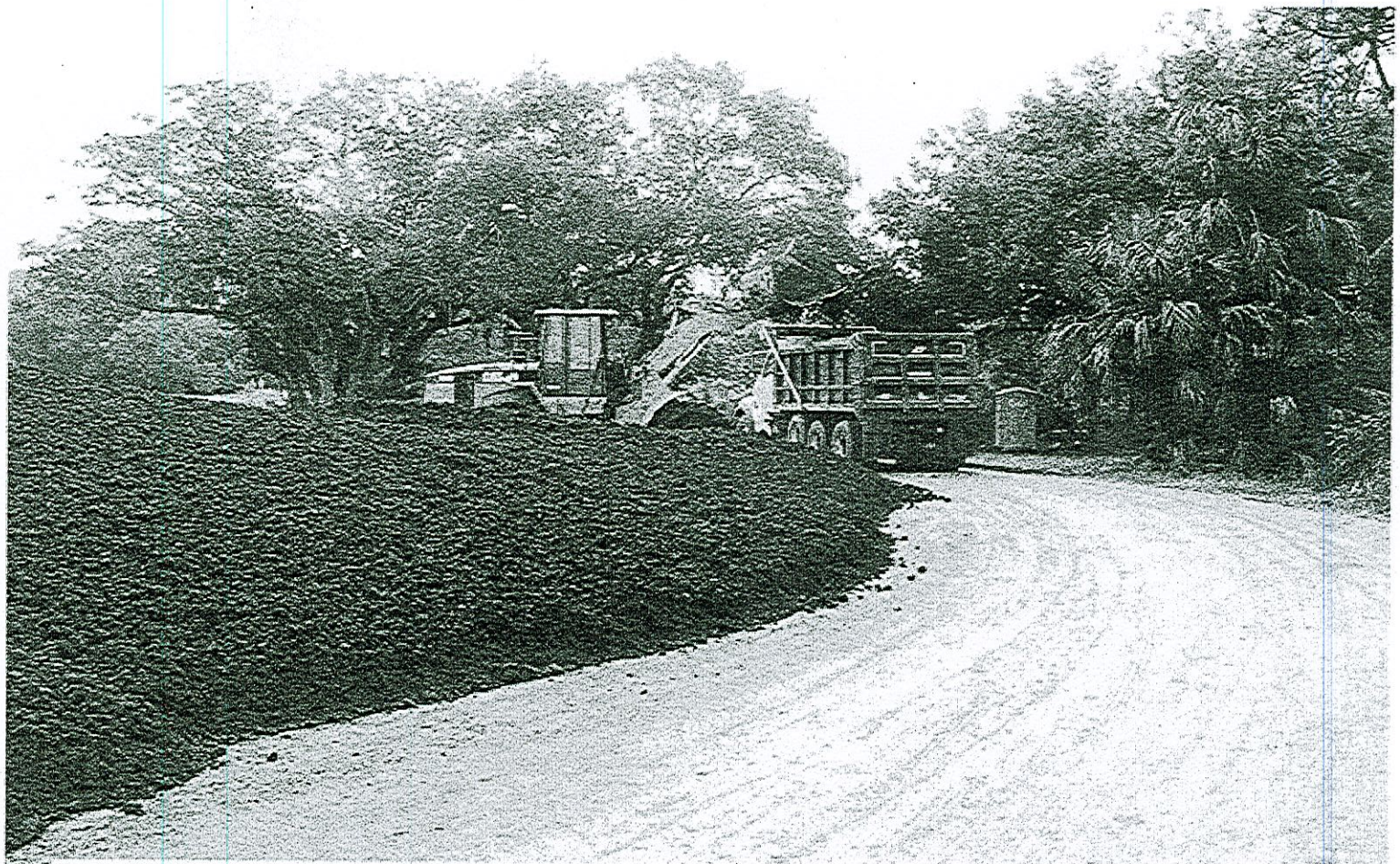
Jahna Dredging – Inside 1.6million Gallon Clarifier Tank

Appendix – Photo #6



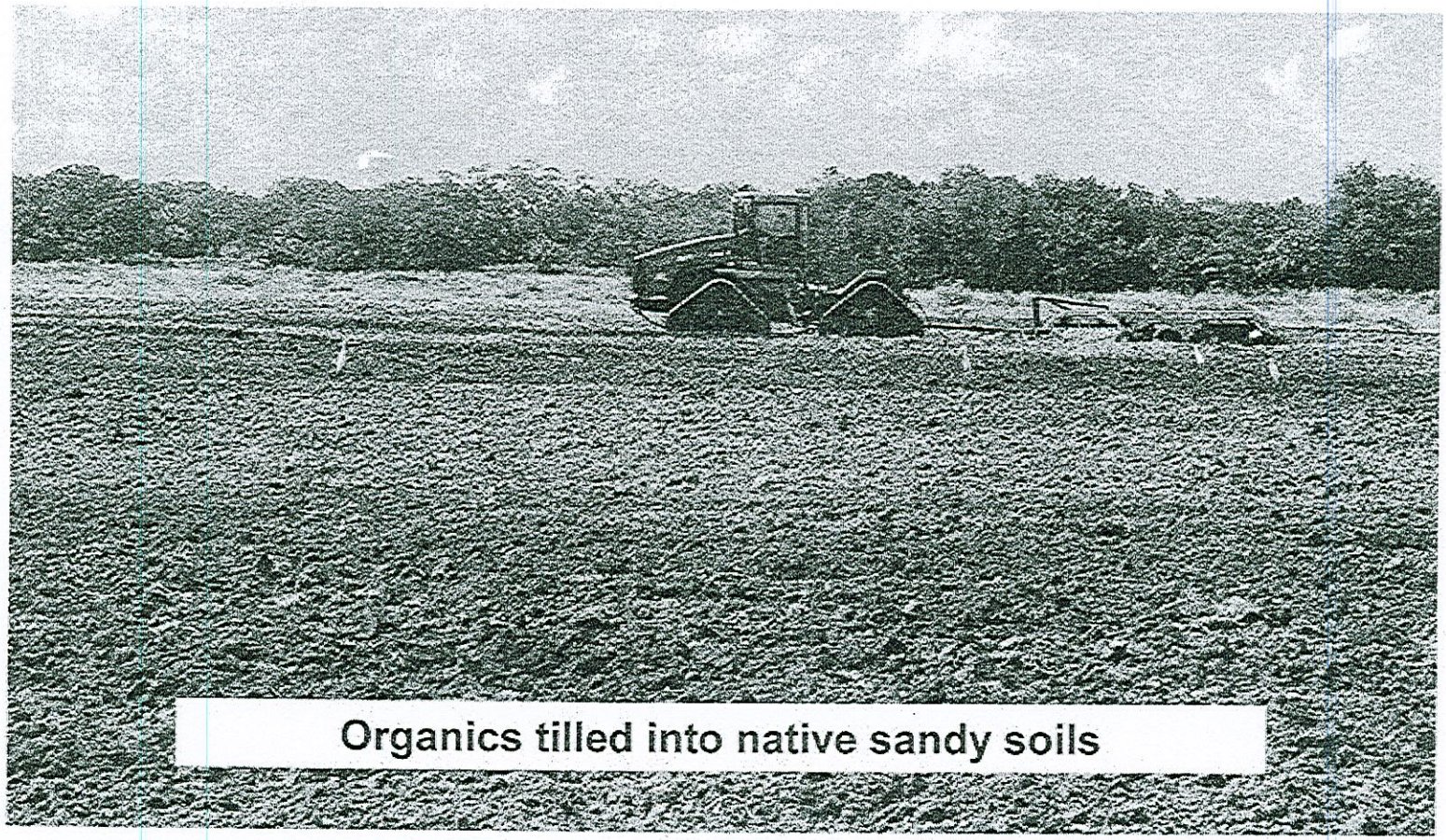
Processing Plant – Clarifier Tank, Belt Presses, Hydro cyclone

Appendix – Photo #7

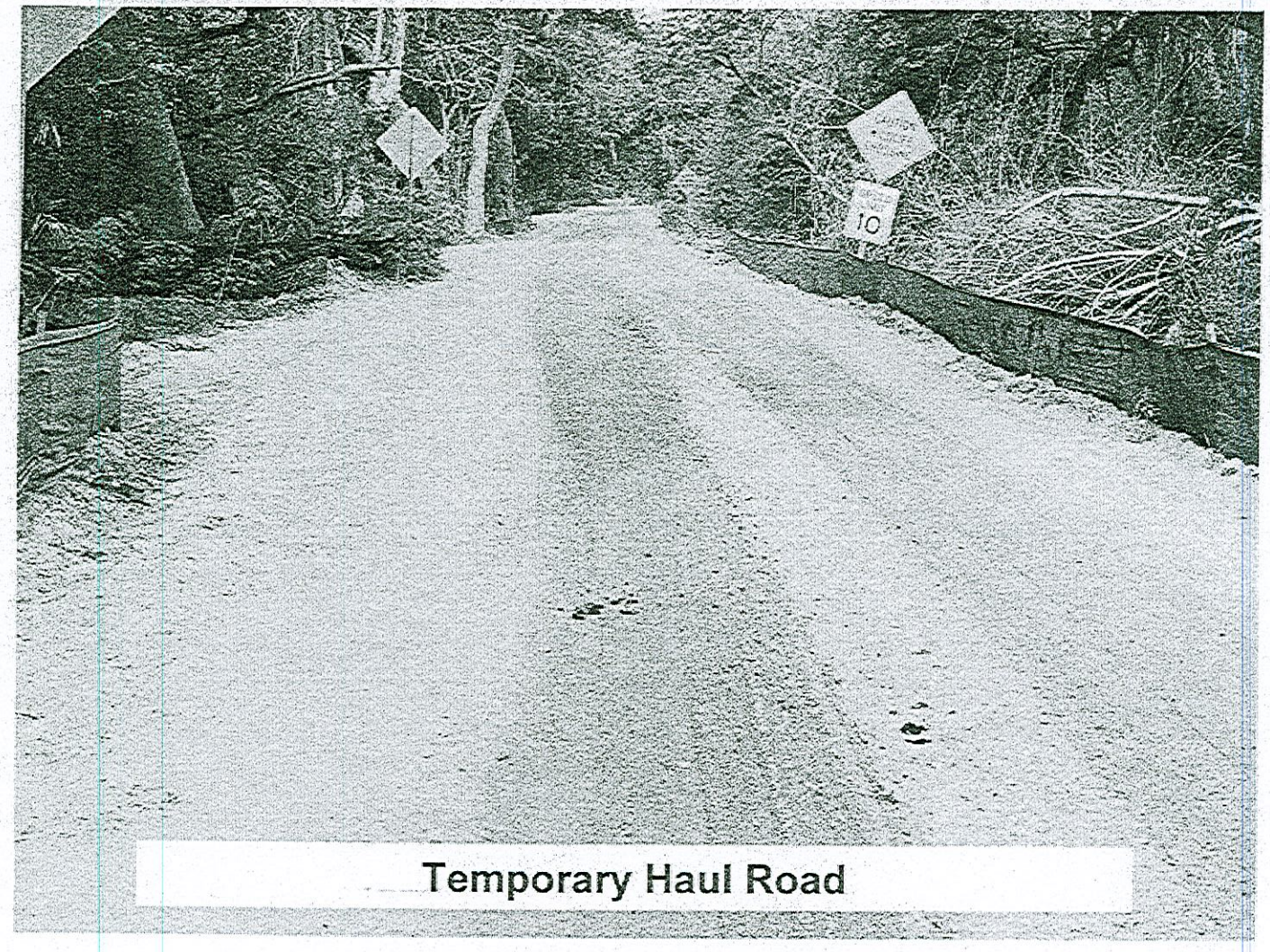


Loading and Truck Hauling – City Forces

Appendix – Photo #8

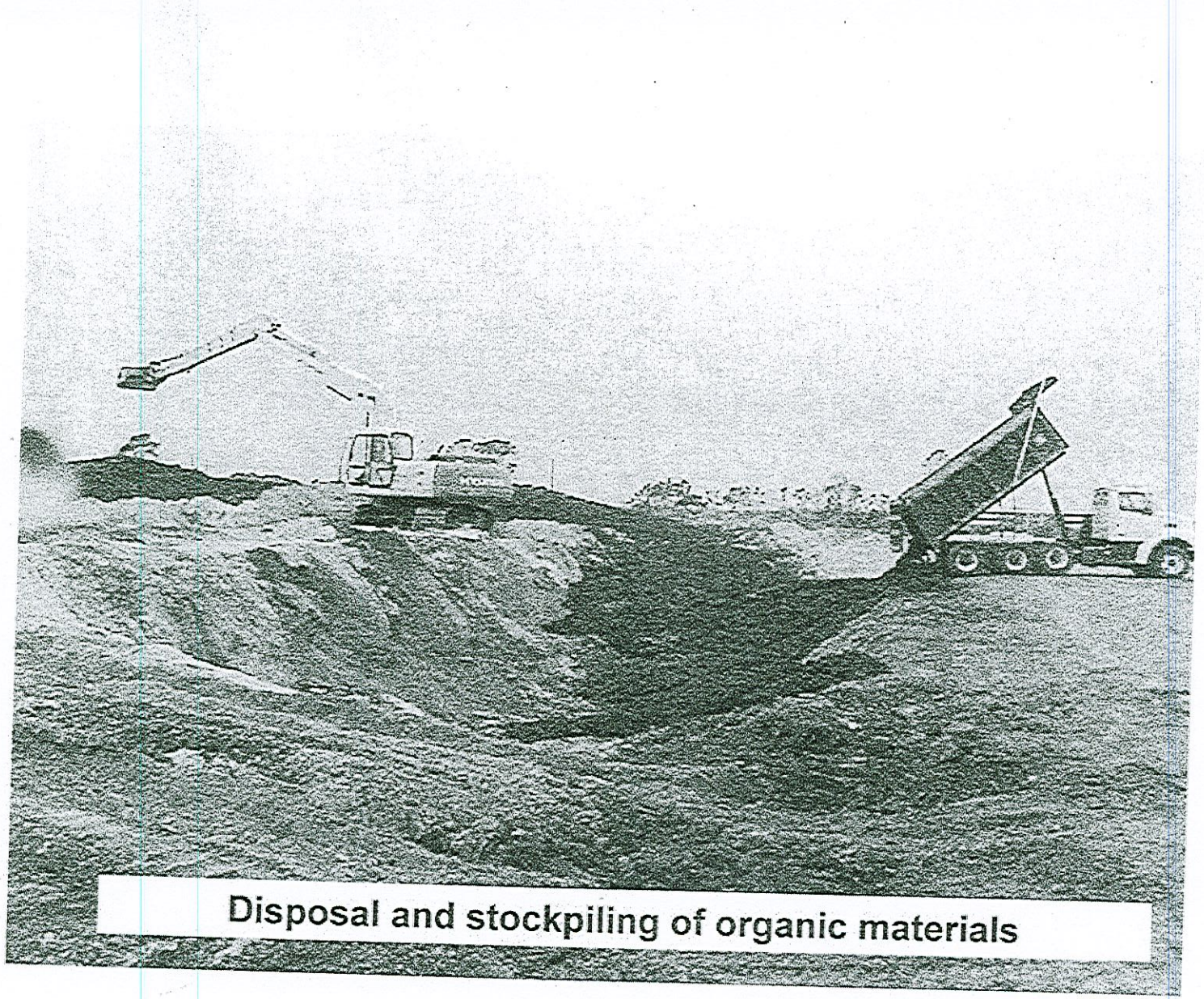


Appendix – Photo #9



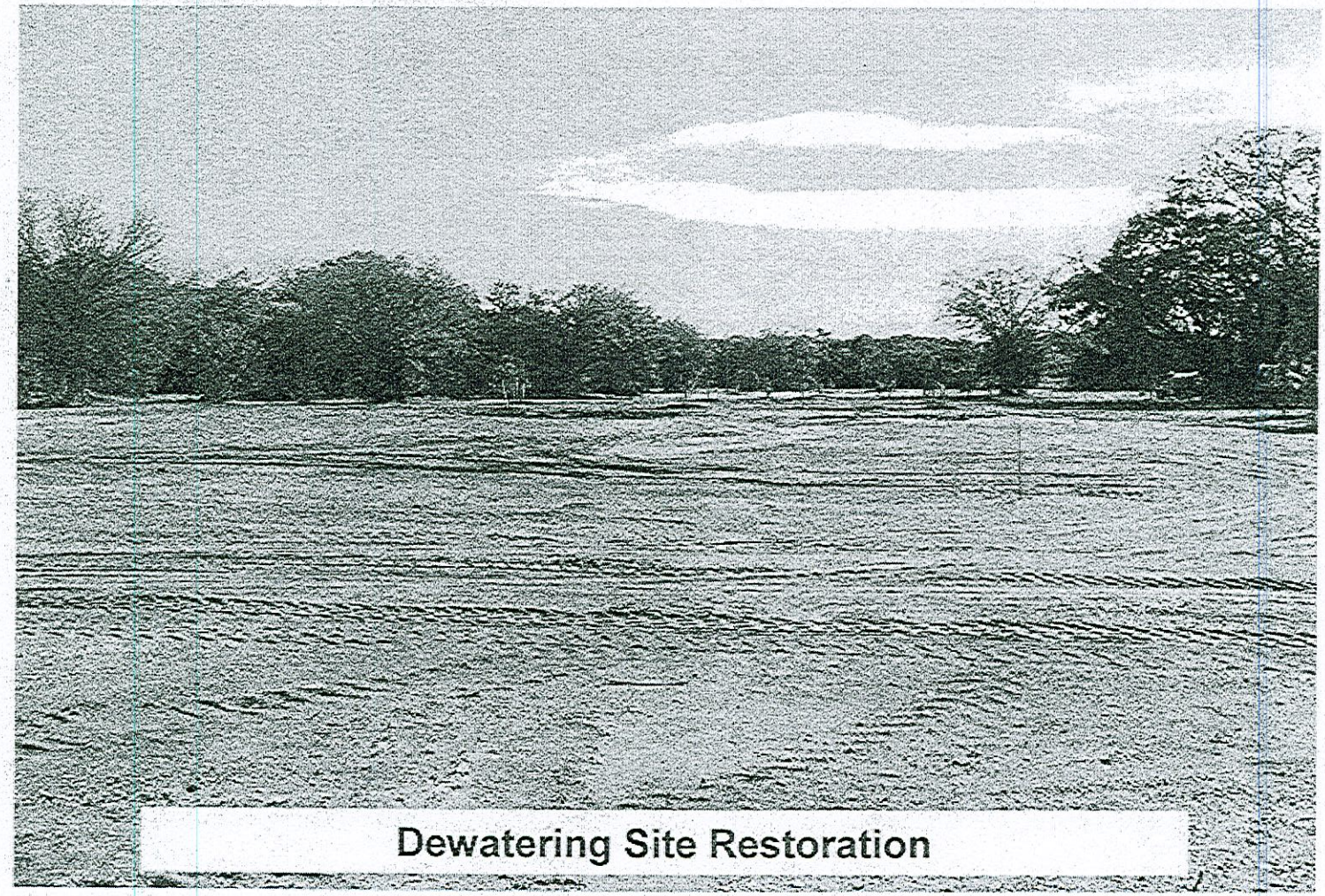
Temporary Haul Road

Appendix – Photo #10



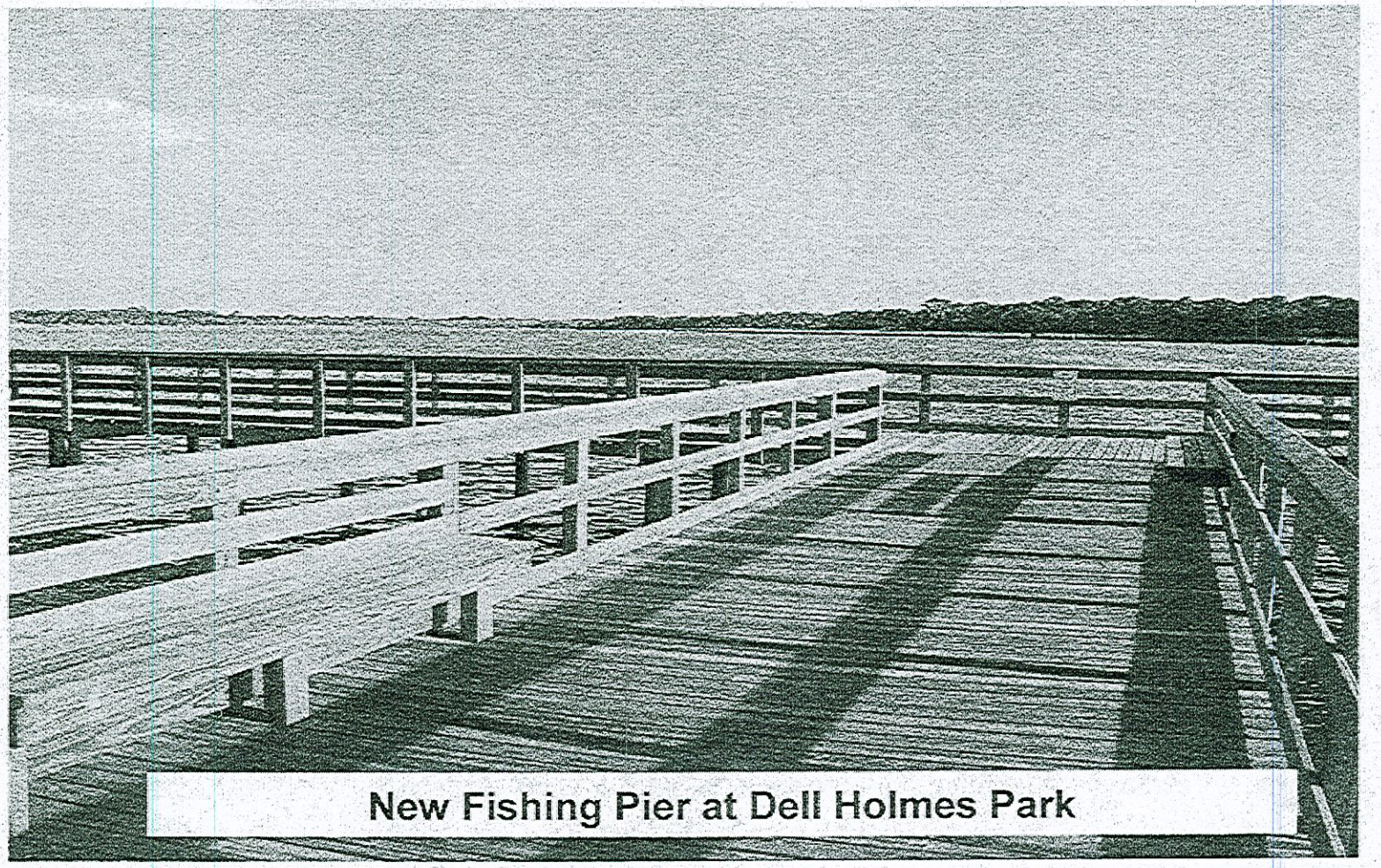
Disposal and stockpiling of organic materials

Appendix – Photo #11



Dewatering Site Restoration

Appendix – Photo #12



New Fishing Pier at Dell Holmes Park

Appendix – Photo #13