



ALGAL TURF SCRUBBER®
SYSTEMS FOR
POLLUTION
CONTROL


HydroMentia
WATER TREATMENT TECHNOLOGIES

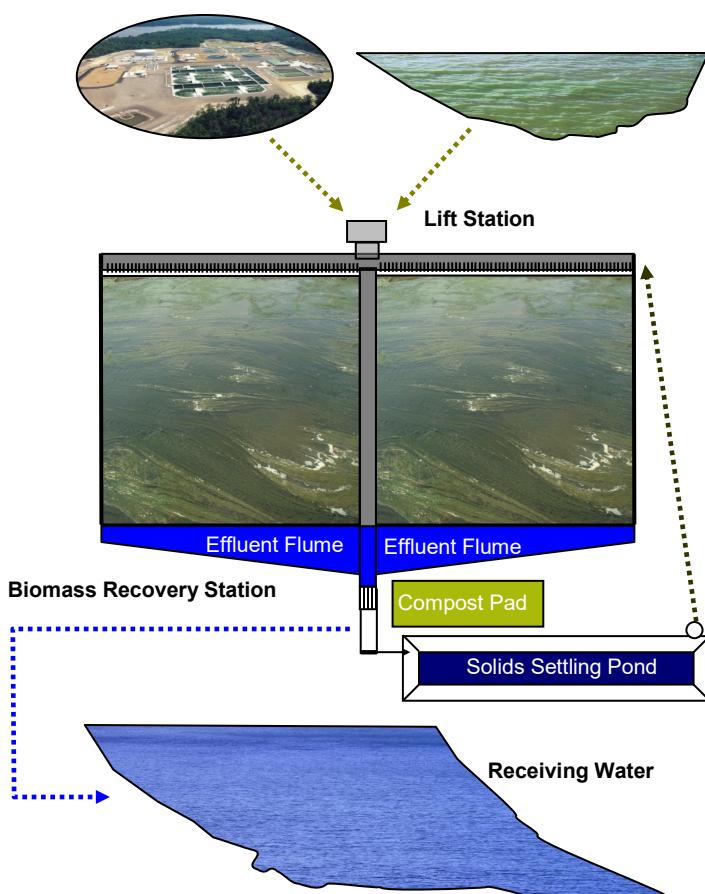
HOW THE ALGAL TURF SCRUBBER® SYSTEM WORKS

ATS™ SURGER AND DISTRIBUTION



ATSTM surger and distribution systems provide flow at linear hydraulic loading rates of 10 to 20 gal lf⁻¹ min⁻¹

TREATMENT OF ADVANCED SECONDARY/AWT EFFLUENT OR IMPAIRED SURFACE WATERS



The ATSTM consists of a suitably sloped substrate overbank with an attachment grid, upon which pollutant-laden waters are discharged and an algal turf is cultured.

Wave surge motion is incorporated into the headwaters of the ATSTM to enhance the exchange of nutrients between algal cells and the water medium. Pulsed flow is provided via a self-siphoning surger.

The algal turf consists of dense mats of small anatomically simple algae less than several centimeters in height.

As water travels down the ATSTM, pollutants are recovered

through both biological and physical processes.

Carbon dioxide, nitrogen, phosphorus and other elements necessary for growth are rapidly consumed by the algae. Removal of these compounds results in water quality changes within the ATSTM

Employing a patented precipitation process, ATSTM systems also offer the benefit of low-cost chemical precipitation of phosphorus.

Through control of operating parameters such as flow rates, micro and macro nutrient concentrations and biomass recovery rates, pollutants such as phosphorus are precipitated onto the algal cell walls, then recovered along with harvested biomass, enhancing phosphorus treatment capacity and reducing system treatment costs.

Physical removal also occurs on the ATSTM through particulate trapping or filtration within the web of algal filaments.

Critical to performance of the ATSTM system, the algal biomass is routinely harvested. Routine recovery serves to optimize pollutant recovery, creating a sustainable treatment technology and eliminating long-term liabilities associated with storage and disposal of pollutants typical of conventional chemical treatment systems.

BENEFITS OF THE ALGAL TURF SCRUBBER® SYSTEM

LOW TREATMENT COSTS

HydroMentia's Algal Turf Scrubber® (ATSTM) technology was developed by Dr. Walter Adey, Director of Marine Laboratories at the Smithsonian Institution. Dr. Adey developed the ATSTM while researching low nutrient ecological systems at the Smithsonian.

Optimized for nutrient uptake and pollutant precipitation, the ATSTM can reduce nitrogen and phosphorus concentrations and loads while requiring 90% to 99% less land than comparable treatment wetland systems.

Due to its small footprint and simple and cost-effective construction, the ATSTM offers a lower-cost alternative for nutrient pollution control than either treatment wetlands or chemical treatment.

In addition to recovery of excess nitrogen and phosphorus, ATSTM systems offer treatment for a wide variety of toxic

compounds including metals and chlorinated compounds.

HydroMentia's proprietary biomass management techniques allow cost-effective and efficient recovery and management of the algal biomass. Recovered biomass can be readily processed into high quality compost, organic fertilizer or livestock feed, and in the future biofuel.

Through recovery and management of the biomass, the ATSTM eliminates potential long-term liabilities commonly associated with systems that store captured pollutants.

With over two decades of research and commercial application, the ATSTM offers proven and sustainable treatment performance.

REDUCED LAND REQUIREMENTS

PROVEN PERFORMANCE

REDUCED LONG-TERM LIABILITIES

MARKETABLE END PRODUCTS

A 4.5 acre ATSTM can provide nutrient control for over 10 million gallons per day.



ALGAL TURF SCRUBBER® PHOSPHORUS CONTROL

FLEXIBLE DESIGN

The Algal Turf Scrubber® can be designed and constructed to meet a wide range of phosphorus control objectives.

ATST™ units have been applied to surface water runoff, agricultural and municipal effluents with total phosphorus concentrations ranging from 80 to 8000 parts per billion (ppb).

Whether your treatment objective is reducing total phosphorus loads or achieving a specific outflow phosphorus concentration, the ATST™ system can be optimized to meet your needs.

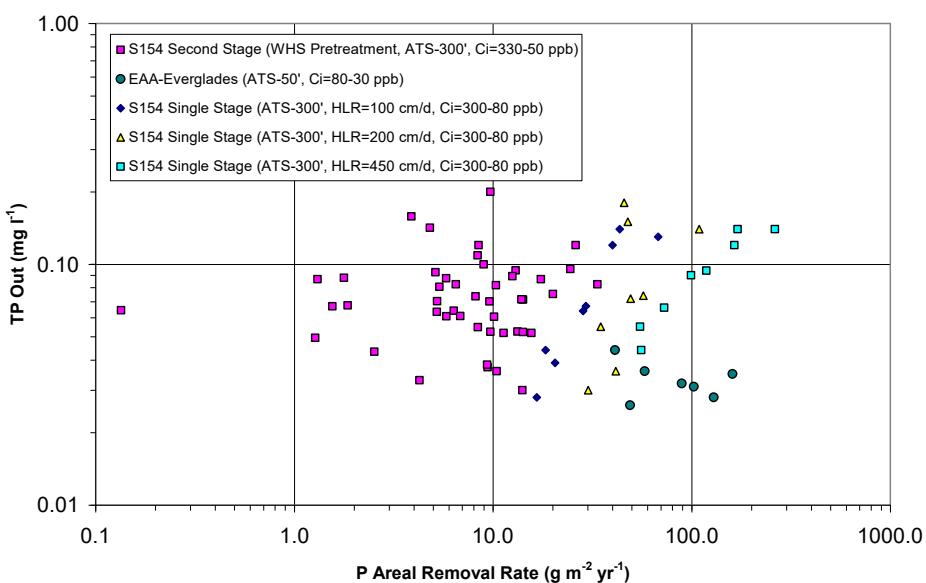
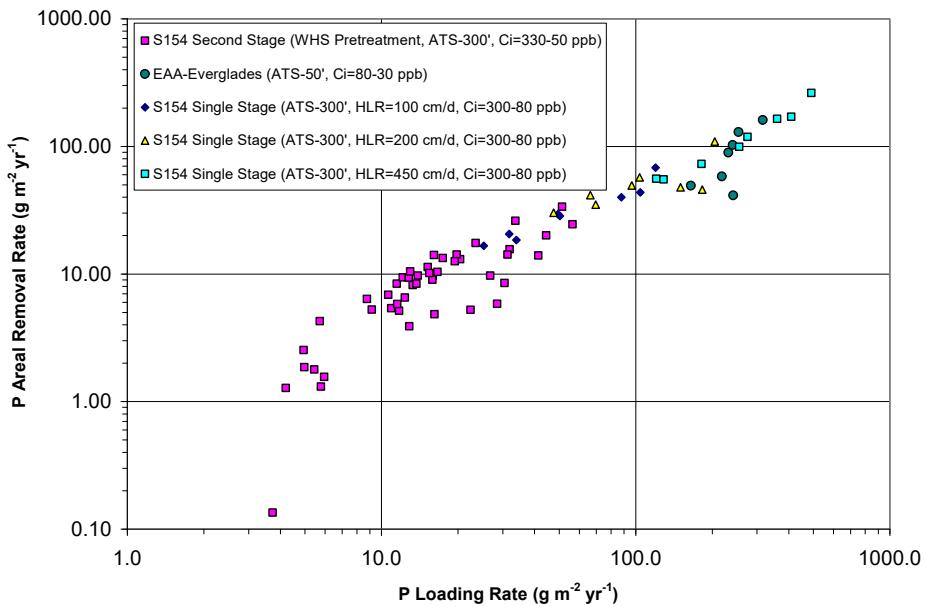
Capable of consistently and reliably reducing phosphorus concentrations to below the most stringent TMDL objectives, the ATST™ is the ideal surface water treatment technology.

Recent advancements have resulted in significant increases in

DESIGN ADVANCEMENTS

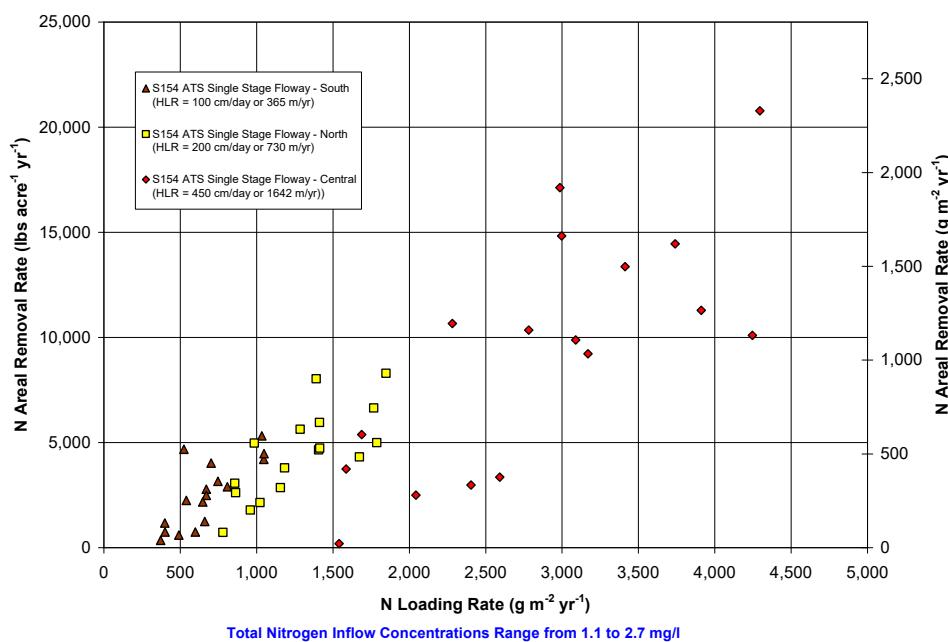
areal removal rates even at relatively low inflow phosphorus concentrations. Capable of recovering phosphorus at rates greater than 1,000 lbs/acre-ATST™/yr, these advancements allow for significant reductions in the treatment facility footprint. The net results are both lower capital and operating costs for the ATST™.

With these advancements, ATST™ offers the lowest cost alternative for phosphorus control.



ALGAL TURF SCRUBBER® NITROGEN CONTROL

LOAD VERSUS CONCENTRATION



As with phosphorus, the Algal Turf Scrubber® can be designed and constructed to meet a wide range of nitrogen control objectives.

ATS™ units have been applied to surface water runoff, agricultural and municipal effluents with total nitrogen concentrations ranging from 1 to 18 parts per million (ppm).

Whether your treatment objective is to reduce your AWT effluent to allow discharges to local source waters or load reduction to meet the new TMDL requirements, the ATS™ system can be optimized to meet your needs.

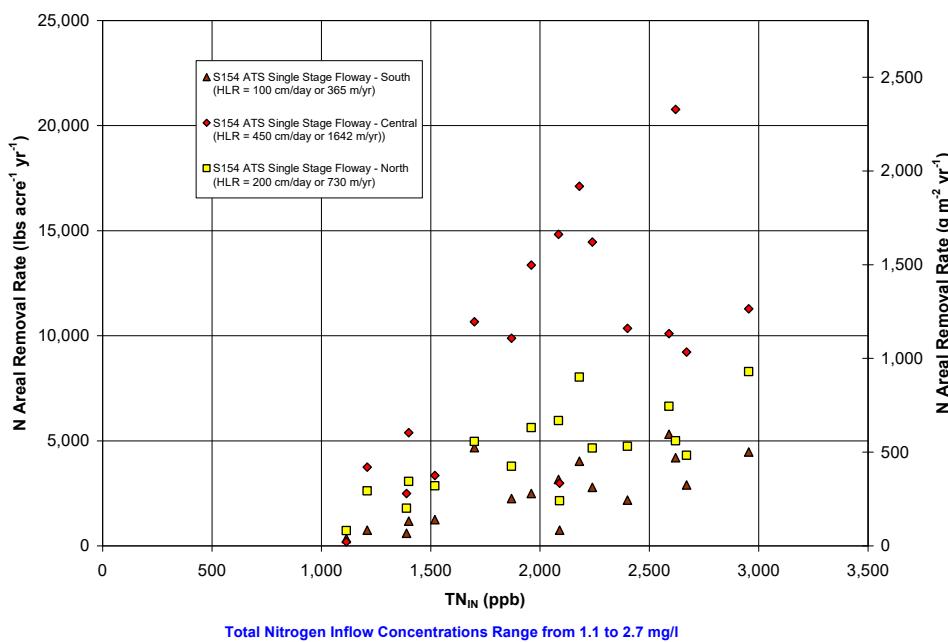
ATS™ systems are capable of

LOW-LEVEL TREATMENT

providing consistent, cost-effective nitrogen reduction, even with the lower nitrogen concentrations often present in surface water runoff.

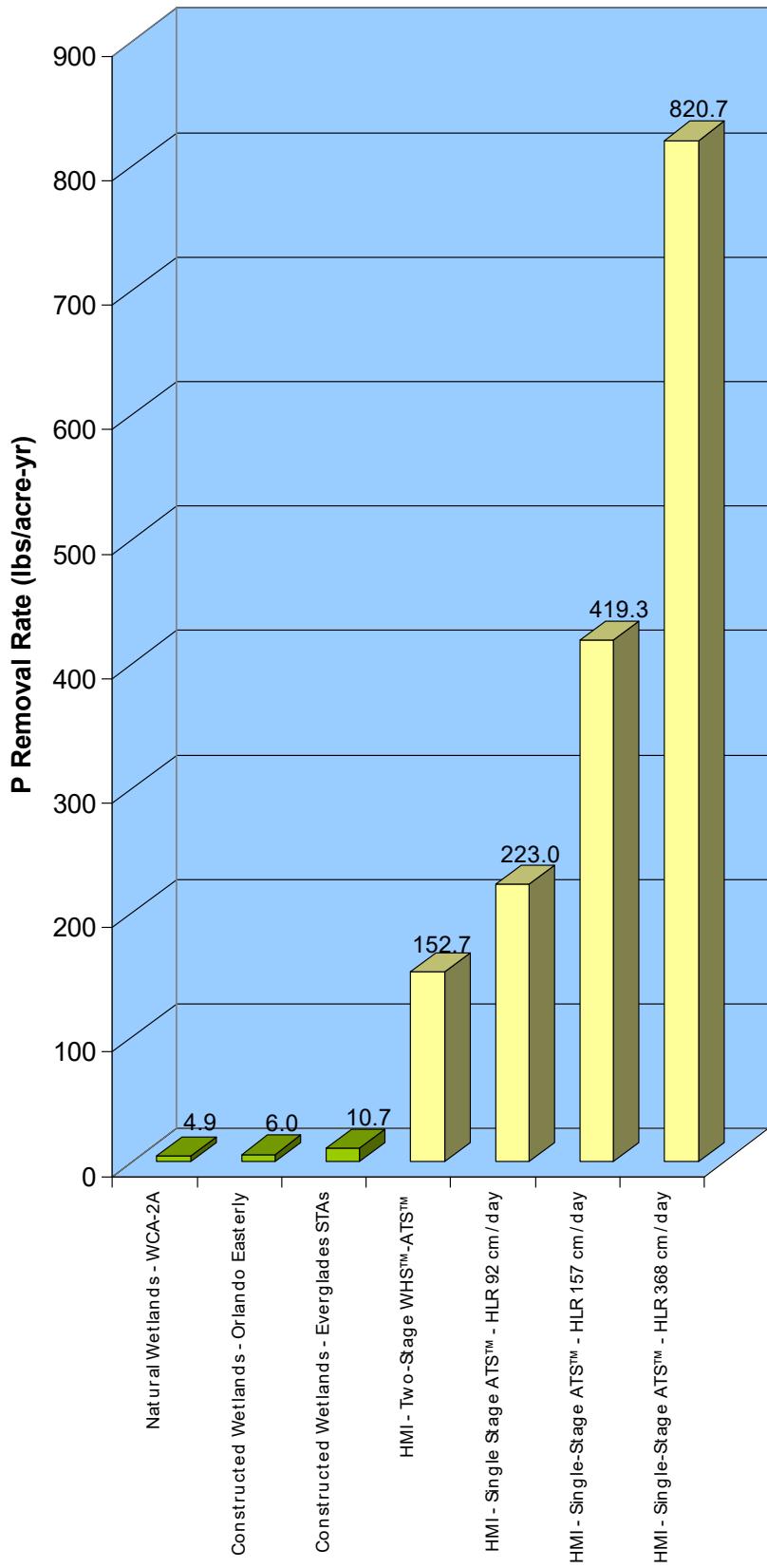
Designed to operate at high Linear Hydraulic Loading Rates (LHLR), high nitrogen areal removal rates can be achieved for a wide range of point and nonpoint source applications, including lake restoration projects.

The result is that the ATS™ offers the lowest cost treatment technology for nitrogen control.



TREATMENT FACILITY LAND REQUIREMENTS

POLLUTANT AREAL REMOVAL RATES



Biological treatment systems including treatment wetlands and Managed Aquatic Plant Systems (MAPS) have been repeatedly shown to offer the lowest cost alternatives for nonpoint source pollution control. However, with these systems, land requirements become a critical selection factor, both in terms of overall costs and land availability. For many of today's applications, sufficient land simply is not available for construction of a treatment wetland system.

It is here that ATS™ system benefits provide a distinct advantage over treatment wetland systems. Operated at significantly higher hydraulic loading rates, ATS™ systems offer equivalent treatment performance while requiring a fraction of the land area.

Recent advancement have demonstrated the versatility of the

COST-EFFECTIVE POLLUTANT RECOVERY

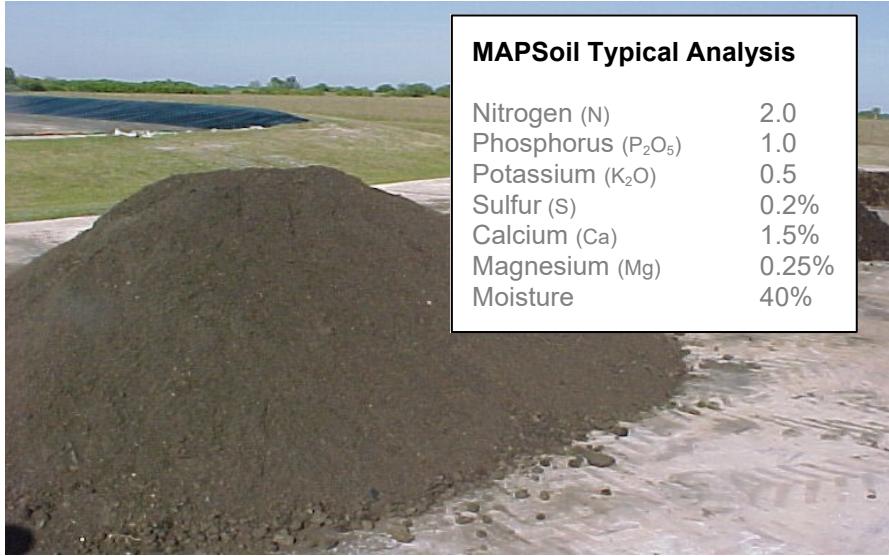
ATS™ system. Operational data have shown that increases in hydraulic loading rates of over 400%, have resulted in minimal loss in percent removal of priority pollutants.

Dependent on project specific objectives, HydroMentia's engineers can design an ATS™ system to optimize pollutant removal while achieving designated outflow pollutant concentrations.

Comparative phosphorus areal removal rates for ATS™ and treatment wetland systems

Biomass Management and Processing

Efficient Biomass Recovery



MAPSoil Typical Analysis

Nitrogen (N)	2.0
Phosphorus (P_2O_5)	1.0
Potassium (K_2O)	0.5
Sulfur (S)	0.2%
Calcium (Ca)	1.5%
Magnesium (Mg)	0.25%
Moisture	40%

End products made from the harvested algae include compost (above), livestock feed and biofuel (below).



To reduce operating costs, HydroMentia developed a proprietary technique for recovering algal biomass in which process water conveys severed biomass to a central harvesting station.

A four-wheel all terrain vehicle or tractor with attached implement is used to sever algal biomass from the growing matrix. The severed material is then conveyed via process water to a receiving flume, where it is recovered by an automatic rake at a centralized harvesting station.

These design efficiencies allow a single operator to recover biomass from approximately one acre of ATS™ in less than one hour. With algal biomass recovery scheduled once every 7 to 14 days, minimal labor is required to maintain the ATS™ at optimal performance.

Recovered material is conveyed to a bunker or transport trailer, where it is

Cost-Effective Processing

available for further processing.

High in nutrient content, algal biomass can be processed into a high-grade organic fertilizer/growing media, livestock feed or biofuel.

Growing media produced within ATS™ systems are suitable for a broad range of horticultural applications. As a livestock feed, processed algae is typically 20 to 30% crude protein, offering a protein-rich high quality feed ingredient for the massive U.S. agricultural market

Currently in development are systems for processing the conversion of algal biomass to energy products, including biodiesel and ethanol.

ALGAL TURF SCRUBBER® SYSTEM PILOT SYSTEMS

ATS™ MOBILE PILOT UNIT

HydroMentia's Algal Turf Scrubber® (ATS™) Mobile Pilot Unit is the ideal system for determining ATS™ design criteria on a case by case basis with its economical and mobile engineering.

The customized unit replicates full-scale ATS™ systems, incorporating surge motion and biomass recovery into the design. ATS™ performance can be assessed on site, aiding in development of full-scale systems to meet individual water quality needs.

Pilot studies for large scale projects can be time consuming and costly. HydroMentia's ready to assemble facility eliminates implementation delays, allowing faster determination of ATS™ success and project execution.

At study completion, the unit is removed, restoring the site to its original condition.

Cost savings are realized immediately through reduced construction and demolition service needs.

HydroMentia's innovative approach to pilot scale studies is as versatile as it is economical.

Available at lengths up to 1500' and widths up to 4', the system can



1200' ATS™ Pilot Unit
Palm Beach County, FL

be operated at virtually any site, no matter how remote or urbanized.

The pilot unit is composed of an aluminum or fiberglass floway and steel supports. The floway is overlain with the same liner and grid that is used in full scale ATS™ systems. Water is conveyed through an automatic surge unit, over the growing matrix. Pilot system outflow is collected and delivered to a receiving water body or holding tank.

HydroMentia recognizes that investigative study needs can be as varied as full-sized projects.

Thus, the Algal Turf Scrubber® Mobile Pilot Unit can be positioned to receive water from any test source.

The ATS™ Mobile Pilot Unit is designed to provide client confidence in the effectiveness of the ATS™ system and HydroMentia's commitment to protecting our most vital resource.

ALGAL TURF SCRUBBER® APPLICATIONS

BROAD RANGE OF APPLICATIONS

ATST™ offers cost savings for a broad range of water treatment applications.

STORMWATER RUNOFF

Nonpoint source applications that involve nutrient pollutants are especially well-suited for the ATST™ with the system's capacity to treat large volumes of water contaminated with relatively low concentrations of pollutants. ATST™ systems can be designed to meet the most stringent of TMDL objectives.

WASTE WATER TREATMENT

ATST™ offers an exciting opportunity for advanced treatment of domestic wastewaters. Since water is a limited resource throughout the country, secondary or tertiary treated wastewater can be polished with an ATST™ unit, making the water clean enough to be discharged to local surface waters. This eliminates the need for disposal via deep well injection and spray irrigation.

AGRICULTURAL

ATST™ serves as an agricultural solution to an agricultural problem—nutrient discharges. As the lowest-cost alternatives for nutrient



Pilot ATST™ Wastewater Facility located in New York City, NY

recovery, ATST™ systems are well suited for agricultural applications.

INDUSTRIAL APPLICATIONS

Due to the rapid rate of algae production and recovery within the ATST™ unit, trace metals present in source waters may be incorporated into recovered biomass. Many of these trace metals serve as necessary and valuable micronutrients for algal growth. Recovered from the treatment system and processed as an organic fertilizer/compost, these trace elements become a beneficial resource.

Applied to industrial wastes, a high-production, high-pH scrubber unit can effectively recover, through algal uptake and precipitation, a wide variety of organic and inorganic compounds.

Serving as an “artificial kidney,” ATST™ units can be designed to recover incoming pollutant loads to meet TMDL mandates while reducing

LAKE RESTORATION

nutrient pollutants stored within lake sediments.

The net result is a reduction of in-lake nutrient concentrations, improved water clarity, and enhanced littoral zone communities and fisheries.

Short start-up periods allow the ATST™ to operate on a seasonal basis for reduced operational costs, or for application in northern climates.

GEOGRAPHIC OPPORTUNITIES

ATST™ APPLICATIONS

Stormwater Treatment

- Phosphorus
- Nitrogen

Tertiary Treatment

- Nutrients

Agricultural

- CAFO
- Runoff

Industrial

- Nutrients
- Metals

Lake Restoration

**ALGAL TURF SCRUBBER®
SYSTEMS FOR
POLLUTION
CONTROL**



HYDROMENTIA TECHNOLOGIES

CORPORATE
PO Box 2164
Ocala, FL 34478
352.433.0771
hydromentia.com

CONTACT:
Mark J. Zivojnovich
President
352.804.5126
mzivo@hydromentia.com