



2007 Final Report
to
Montana Board of Research and Commercialization Technology

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Title: Biomimetic floating islands that maximize plant and microbial synergistic relationships to revitalize degraded fisheries, wildlife habitats, and human water resources.

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Funding for Year 2: \$165,535

F l o a t i n g I s l a n d I n t e r n a t i o n a l



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Project Summary

The purpose of this project was to produce and test biomimetic, self-sustaining floating treatment wetlands (“floating islands”) that are designed to remove excess nutrients and other contaminants from lakes, streams, and wastewater lagoons. The goal of the research was to produce a family of new products with proven efficacy which are cost effective and environmentally friendly compared to other commercial products that are currently available to treat water and wastewater.

The research focused on the design, construction, testing and optimization of floating islands for removal of selected contaminants that are common problems in municipal wastewater, urban stormwater, and agricultural runoff. The primary contaminants tested in this project include ammonium, nitrate, phosphate, organic carbon, and suspended solids. The research involved initial laboratory-scale experiments followed by outdoor test-pond experiments. Since market research (conducted with cash-match funds) during the project indicated that key potential markets are likely to include municipal and agricultural sewage treatment, the majority of the experiments were run with relatively high-level concentrations of contaminants in order to simulate municipal and livestock wastewaters.

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Major Research Results

- The islands demonstrated rapid removal of ammonium, nitrate, phosphate, organic carbon and suspended solids, compared to controls and to previous data by other researchers. Removals were calculated on a unit basis (milligrams of nutrient removed per day per square foot of island surface). The best removal rates obtained by BioHaven® floating islands in outdoor test ponds during this project were as follows: ammonium 759 mg d⁻¹ ft⁻²; nitrate 759 mg d⁻¹ ft⁻²; phosphate 106 mg d⁻¹ ft⁻²; BOD 547 mg d⁻¹ ft⁻². The best removal rates obtained by BioHaven® floating islands in test tanks under laboratory conditions during this project were as follows: ammonium 338 mg d⁻¹ ft⁻²; nitrate 10,600 mg d⁻¹ ft⁻²; phosphate 428 mg d⁻¹ ft⁻².
- The BioHaven® floating islands achieved simultaneous aerobic and anoxic removal of ammonium, nitrate, phosphate, and organic carbon within a single island in a single impoundment.

- The BioHaven® floating islands removed phosphate via bacterial processes at approximately the same rate as suspended algae removed phosphate via plant growth. After the phosphate had been removed, water in ponds with BioHaven® floating islands was much clearer than algae-choked water in ponds without BioHaven® floating islands. Turbidity values were 26 NTUs versus 388 NTUs for the island pond and the control, respectively.
- The performance of BioHaven® floating islands can be optimized by providing proper conditions for the bacterial processes. These conditions are dependent upon the nutrient of concern: for ammonium removal, alkalinity and aeration control are critical; for nitrate removal, adequate organic carbon is required. In order to maximize the efficacy of the islands, critical parameters must be measured prior to and during the treatment process; auxiliary aeration, alkalinity and carbon should be supplied if necessary.

Achievement of Objectives

The originally proposed objectives were met: Nutrients concentrations were reduced to target levels; long-term efficacy was demonstrated; commercial and naturally occurring microbes were compared, required micronutrients and other auxiliary requirements were identified, scale-up criteria were developed; wildlife habitat benefits were documented; products were successfully introduced into the marketplace.

Assessment of Commercial Potential

The measurable results from this research have been presented to public and private entities throughout Montana, across the U.S. and worldwide. The strongest and most immediate commercial potential comes in the form of licensing to a Montana firm for a new U.S. production facility in Montana. That facility would create new jobs, enhance many existing related businesses, and positively impact economic development in Montana. Additional strong prospects include the specialized production and placement of islands in California for treatment of the Salton Sea, in Singapore to remediate the Lower Seletar Reservoir, and in New Zealand to treat millions of acres of degraded waterways throughout the country.

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A . O b j e c t i v e s , W o r k , & R e s u l t s

Objective I: Reduction to target levels of phosphorus, nitrogen, algae and other suspended particles in water

Over the course of the project, we conducted approximately 35 experimental runs to measure nutrient removal rates by bacteria and plants. During the first phase of the project, we conducted 30 tank-scale tests under controlled laboratory conditions with various combinations of nutrient concentrations, aeration, and water temperature. In general, we obtained progressively better removal rates as we learned how to optimize growing conditions for the various types of aerobic and anoxic bacteria that remove the studied nutrients (phosphorus, ammonium, and nitrate). We documented the conditions that produced the best laboratory results, then conducted four outdoor experiments in test ponds in which we duplicated the conditions that produced the best laboratory results.

Our experiments demonstrated that the BioHaven® floating islands can reduce nutrient, organic carbon and suspended solids concentrations to target levels for both stormwater and wastewater applications. Our results indicate that the laboratory-scale and test-pond scale BioHaven® floating islands remove nutrients significantly faster than floating planters or constructed wetlands that have been studied by others. Table 1 is a comparison table of those results.

Significantly, we also demonstrated that BioHaven® floating islands can remove all of the constituents of concern (ammonium, nitrate, phosphorus, organic carbon and suspended solids) within a single island body. This finding has important ramifications for the treatment of wastewaters, in which simultaneous removal of these constituents can result in lower construction and operating costs.

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Table 1 - Representative Nutrient Removal Rates (updated 9/22/07)

| Nutrient | Removal Rate mg d ⁻¹ ft ⁻² | Source | Notes |
|--------------------|---|--|--|
| NO ₃ -N | 10,600 | Floating Island Intl - tank test Run 23 | microbes only - carbon source added |
| NO ₃ -N | 1880 | Floating Island Intl - test pond Run 33 | September 2007 |
| NO ₃ -N | 520 | U.S. BoR - tank test | macrophytes, microbes, and algae |
| NO ₃ -N | 56 | Floating Island Intl - tank test | macrophytes only - early results |
| TN-N (see note 1) | 540 | motel septic effluent - Hart (Australia) | Vetiver grass on floating platforms (microbes and macrophytes) |
| TN-N | 270 | Tanner 1995 | total removal (plants, microbes, absorption); tank scale; wastewater |
| TN-N | 255 | U.S. Ag Research Service- tank test | macrophytes only; wastewater |
| TN-N | 68 | Swine effluent - constructed wetland | macrophytes, microbes, and algae |
| NH ₄ -N | 759 | Floating Island Intl - test pond Run 34 | microbes only |
| NH ₄ -N | 338 | Floating Island Intl - tank test Run 16 | microbes only |
| PO ₄ -P | 428 | Floating Island Intl - tank test Run 27 | microbes only - controlled ORP conditions |
| PO ₄ -P | 106 | Floating Island Intl - test pond Run 34 | microbes only |
| PO ₄ -P | 52 | motel septic effluent - Hart (Australia) | Vetiver grass on floating platforms (microbes and macrophytes) |
| PO ₄ -P | 40 | Tanner 1995 | total removal (plants, microbes, absorption); tank scale wastewater |
| PO ₄ -P | 38 | U.S. Ag Research Service- tank test | macrophyte uptake only - assumes 180-day annual growth period |
| PO ₄ -P | 28 | Floating Island Intl - test pond Run 33 | September 2007 |
| PO ₄ -P | 12 | Floating Island Intl - tank test | macrophytes only - early results |

Notes:

1) total nitrogen (TN) in wastewater is typically composed primarily of ammonium



Objectives, Work, & Results *cont.*

We conducted literature reviews to determine typical nutrient influent concentrations and target effluent levels in stormwater detention ponds, municipal sewage, and concentrated animal feedlot operation (CAFO) lagoons; then we performed chemical analyses at selected wastewater sites to confirm nutrient concentrations in untreated lagoons. Starting nutrient concentrations for the experiments were based on the influent data we obtained. We established nutrient removal rates in the experiments by measuring the time required for approximately 90% removal of each nutrient. We compared turbidity and total suspended solids (TSS) levels in island ponds to control ponds to determine the effectiveness of islands for reducing algae and other suspended solids. The experiments showed that the islands could produce target-level concentrations of nutrients, organic carbon, and total suspended solids. A large percentage of the project effort involved optimizing the rates of nutrient removal by floating islands, then comparing the removal rates of the island to the removal rates produced by algae and bacteria in the control ponds.

In order to test the effect of floating islands on improving water clarity, turbidity was monitored in two test pond experiments (Run 33 and 34), and TSS was monitored in one. In these tests, water clarity in the island pond was about 16 times better than the controls; TSS was below detection level in the island pond, but was significant in the non-island ponds. These results indicate that the floating islands provide significant water clarification benefits.

Details of the individual runs are presented in the eight quarterly reports that were produced during the project. A summary of selected experiments that yielded the most significant results is presented below.

Project Report

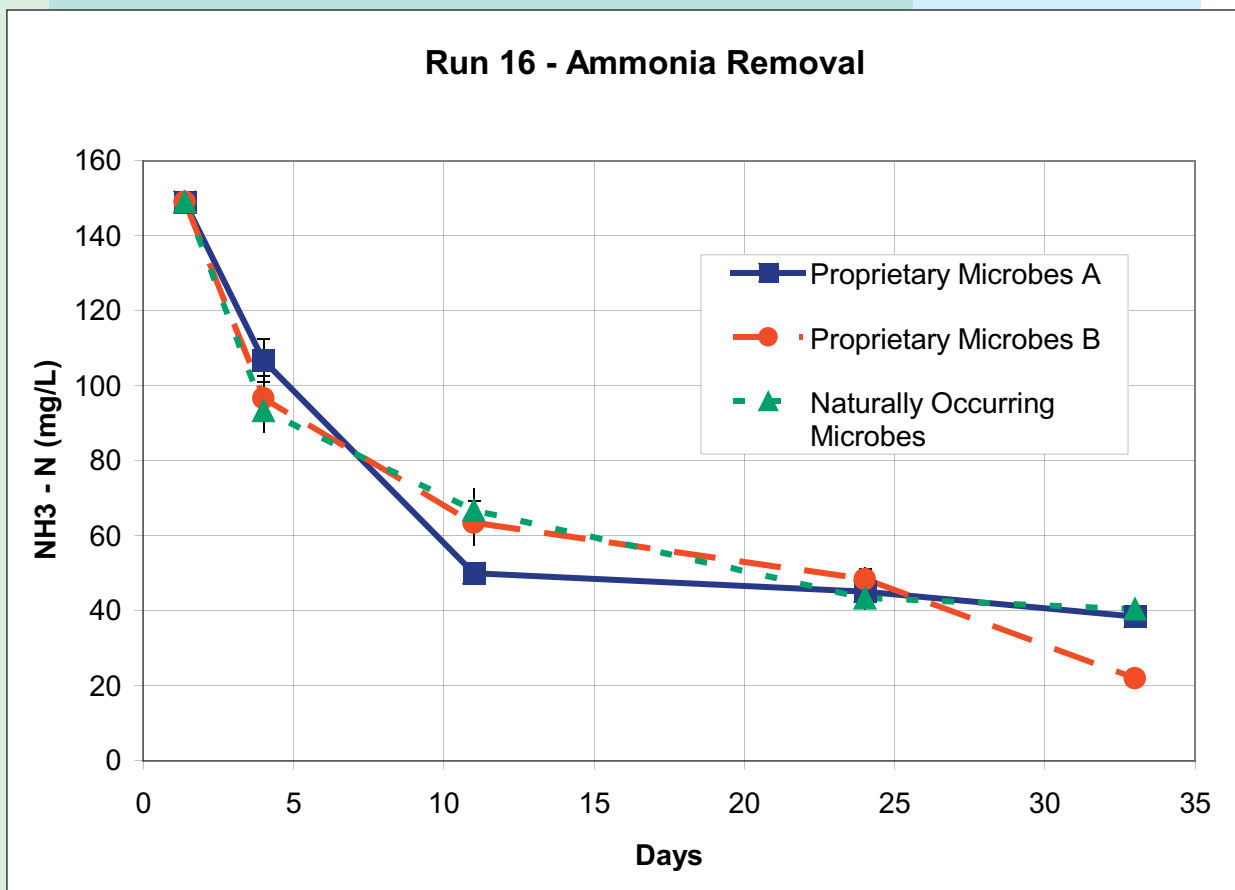
Run 16 – best ammonium removal in a test tank

| | | |
|---------------------------------|--------------|---|
| Experiment I.D. | | Run 16 |
| run dates | | 6/27/06 – 7/29/06 |
| island surface area | | 2.0 square feet |
| island thickness | | 8 inches |
| | | |
| Results | value | units |
| ammonium removal | 338 | mg d ⁻¹ ft ⁻² |
| | | |
| Test conditions | | |
| ammonium starting concentration | 149 | mg/l |
| unit aeration rate | >0.5 | (cfm air / sf of island) |
| unit water circulation rate | none | no circulation pump, but bubbler provided circulation |
| water temperature | 20.0 | degrees Celsius |

Notes: This run demonstrated that naturally occurring bacteria were as effective as commercially purchased bacteria when proper growth conditions were met.



Objectives, Work, & Results *cont.*



Project Report

Run 23 – best nitrate removal in a test tank

| | | |
|--------------------------------|--------------|--|
| Experiment I.D. | | Run 23 |
| run dates | | 1/09/07 – 1/10/07 |
| island surface area | | 2.0 square feet |
| island thickness | | 8 inches |
| | | |
| Results | value | units |
| nitrate removal | 10,600 | mg d ⁻¹ ft ⁻² |
| | | |
| Test conditions | | |
| nitrate starting concentration | 236 | mg/l |
| unit aeration rate | 0 | no aeration |
| unit water circulation rate | 0.4 | gal min ⁻¹ ft ⁻² |
| water temperature | 26 | degrees Celsius |

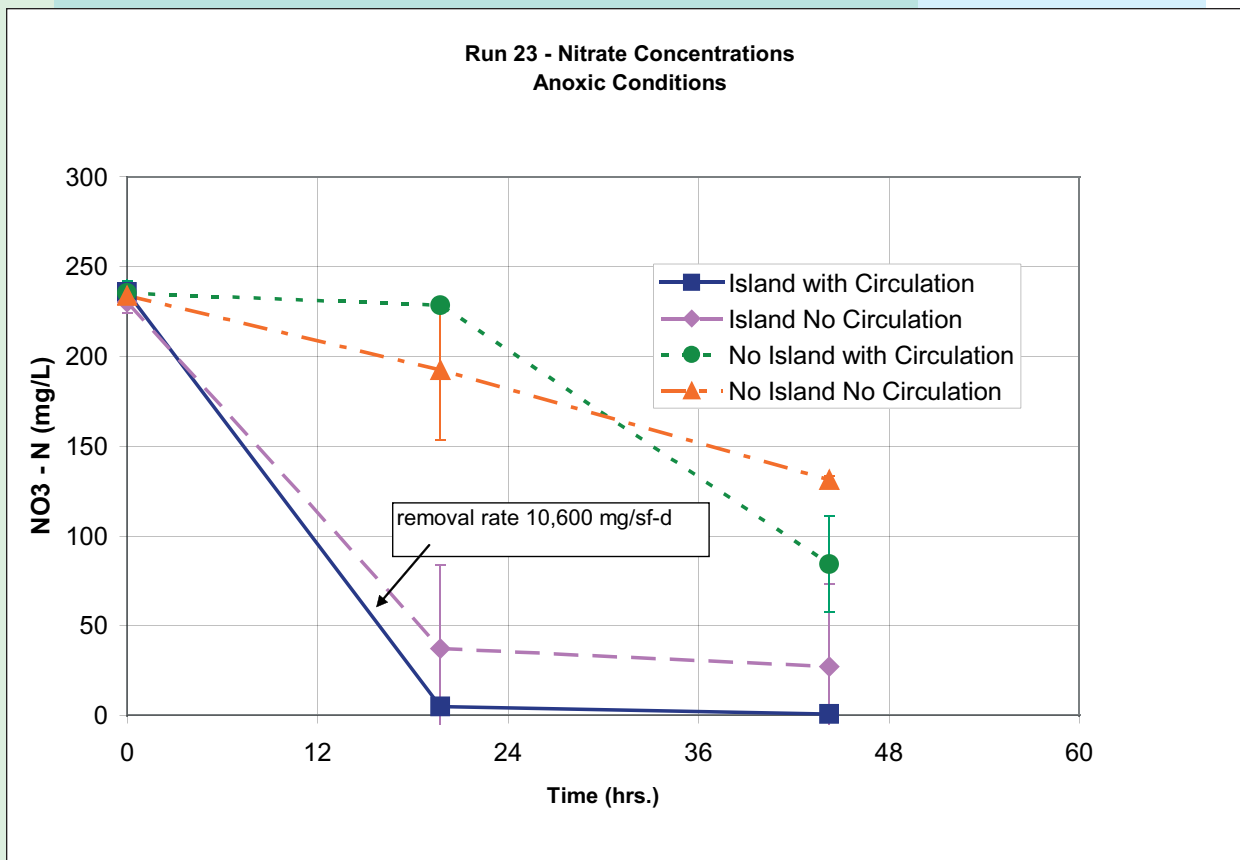
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Notes:

- 1) 1.6 g/l molasses added at start of experiment as organic carbon source for denitrification.
- 2) nitrate 100% removed by second sample – actual nitrate removal rate may be greater than calculated rate



Objectives, Work, & Results *cont.*



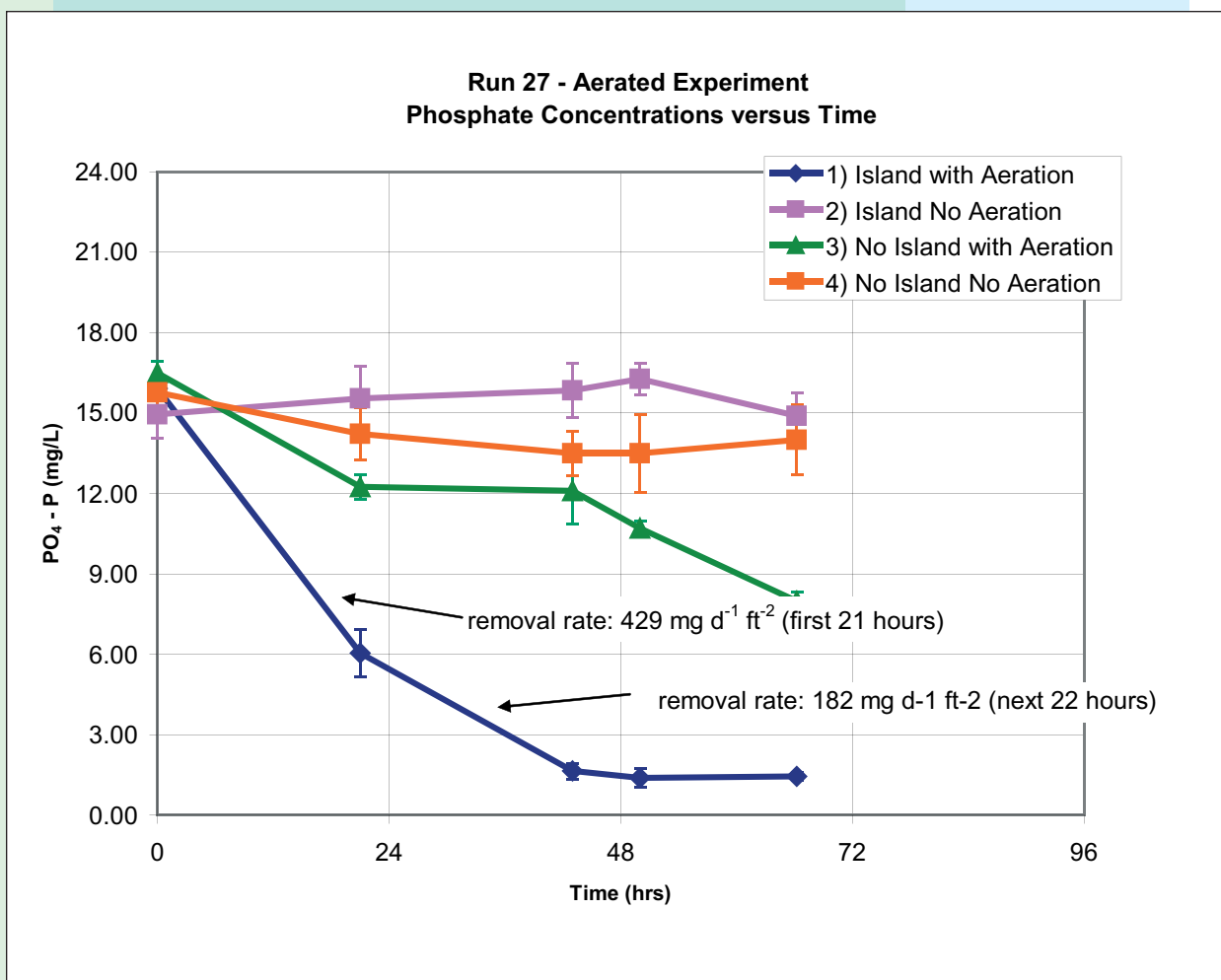
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Run 27 – best phosphate removal in a test tank

| | | |
|----------------------------------|--------------|---------------------------------------|
| Experiment I.D. | | Run 27 |
| run dates | | 4/10/07 – 4/11/07 |
| island surface area | | 2.0 square feet |
| island thickness | | 8 inches |
| | | |
| Results | value | units |
| phosphate removal | 428 | mg d ⁻¹ ft ² |
| | | |
| Test conditions | | |
| phosphate starting concentration | 15.9 | mg/l |
| unit aeration rate | 0.05 | cfm air /square foot island |
| unit water circulation rate | 0.4 | gal min ⁻¹ ft ² |
| water temperature | 26 | degrees Celsius |



Objectives, Work, & Results *cont.*



Project Report

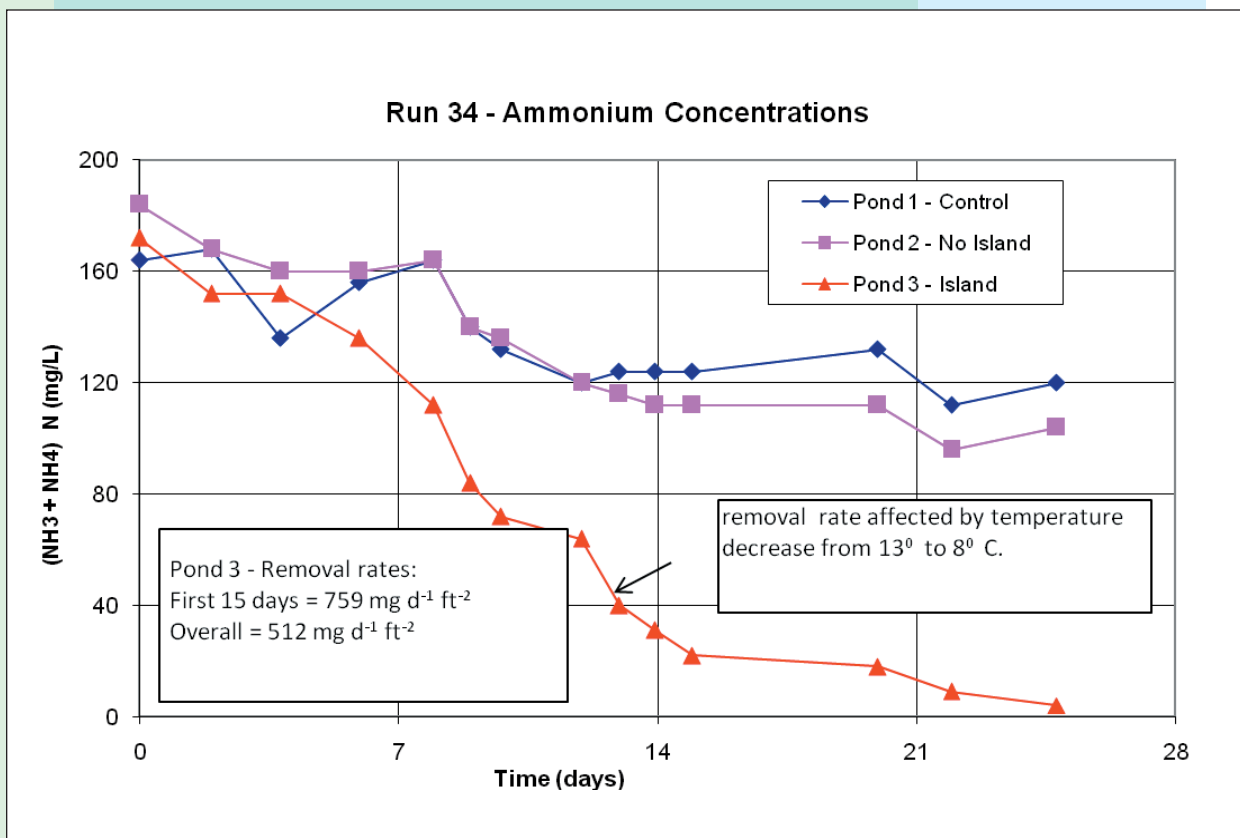
Run 34 – best removal of ammonium, nitrate, phosphate, turbidity, and suspended solids in a test pond

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| | | |
|--|--------------|--|
| Experiment I.D. | | Run 34 |
| run dates | | 9/26/07 – 10/24/07 |
| island surface area | | 250 square feet |
| island thickness | | 8 inches |
| | | |
| Results | value | units |
| ammonium removal | 759 | mg d ⁻¹ ft ⁻² |
| phosphate removal | 106 | mg d ⁻¹ ft ⁻² |
| nitrate removal | 759 | mg d ⁻¹ ft ⁻² |
| turbidity ratio | 0.06 | (NTU island / NTU control) |
| DOC removal | 1177 | mg d ⁻¹ ft ⁻² |
| BOD removal | 547 | mg d ⁻¹ ft ⁻² |
| CaCO ₃ required | 3.6 | kg CaCO ₃ required per kg NH ₄ removed |
| Organic carbon required | 10 | liters molasses required per kg NO ₃ removed |
| | | |
| Test conditions | | |
| ammonium starting concentration | 172 | mg/l |
| phosphate starting concentration | 13.6 | mg/l |
| unit aeration rate | 0.03 | (cfm air / sf of island) for half of island aerated |
| unit water circulation rate | 0.12 | gal min ⁻¹ ft ⁻² |
| water turnover time (volume pond / flowrate) | 167 | (gal / (gal/min)) = minutes |
| water temperature range | 8.5 – 15.0 | degrees Celsius |
| percent of pond surface covered by island | 55 | % |

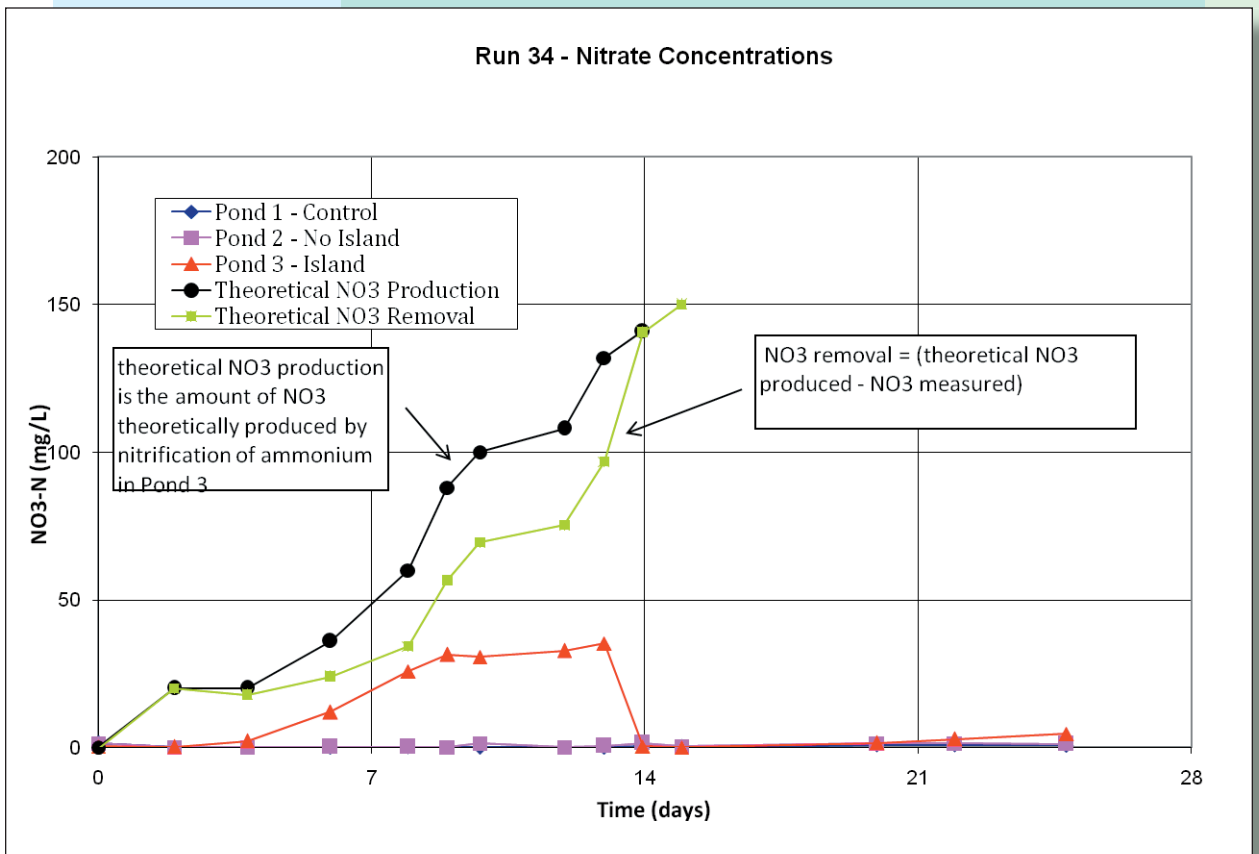


Objectives, Work, & Results *cont.*



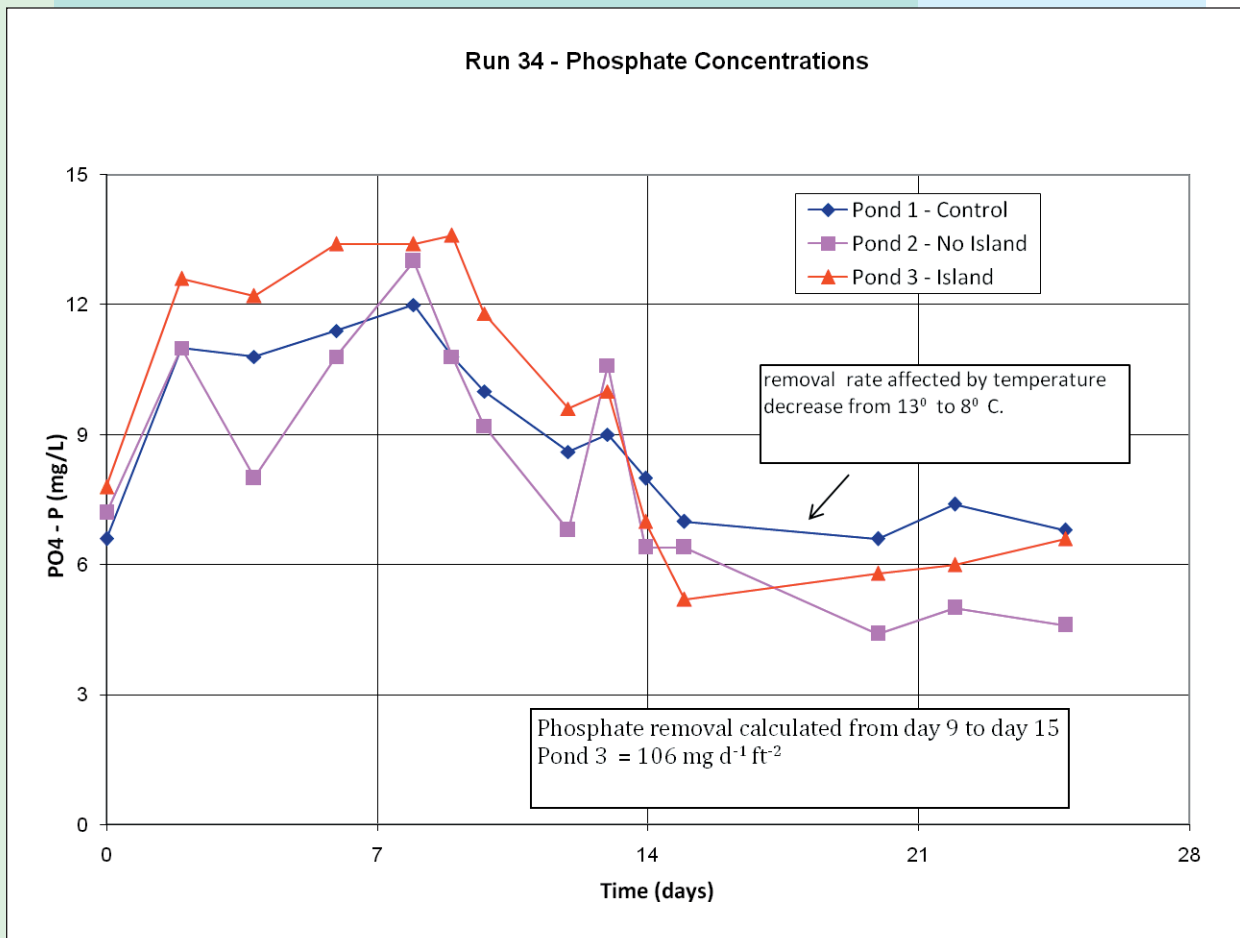
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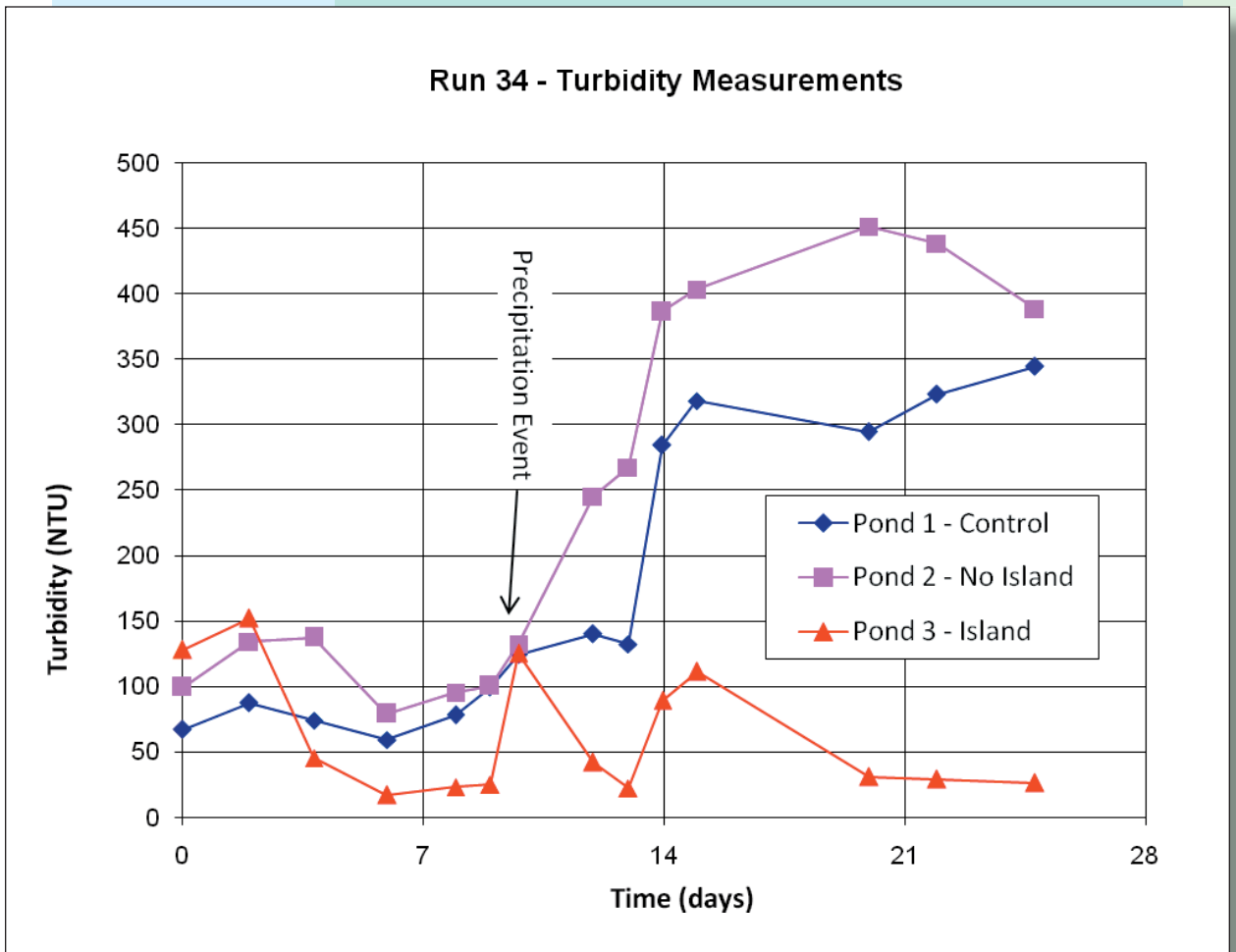


Objectives, Work, & Results *cont.*



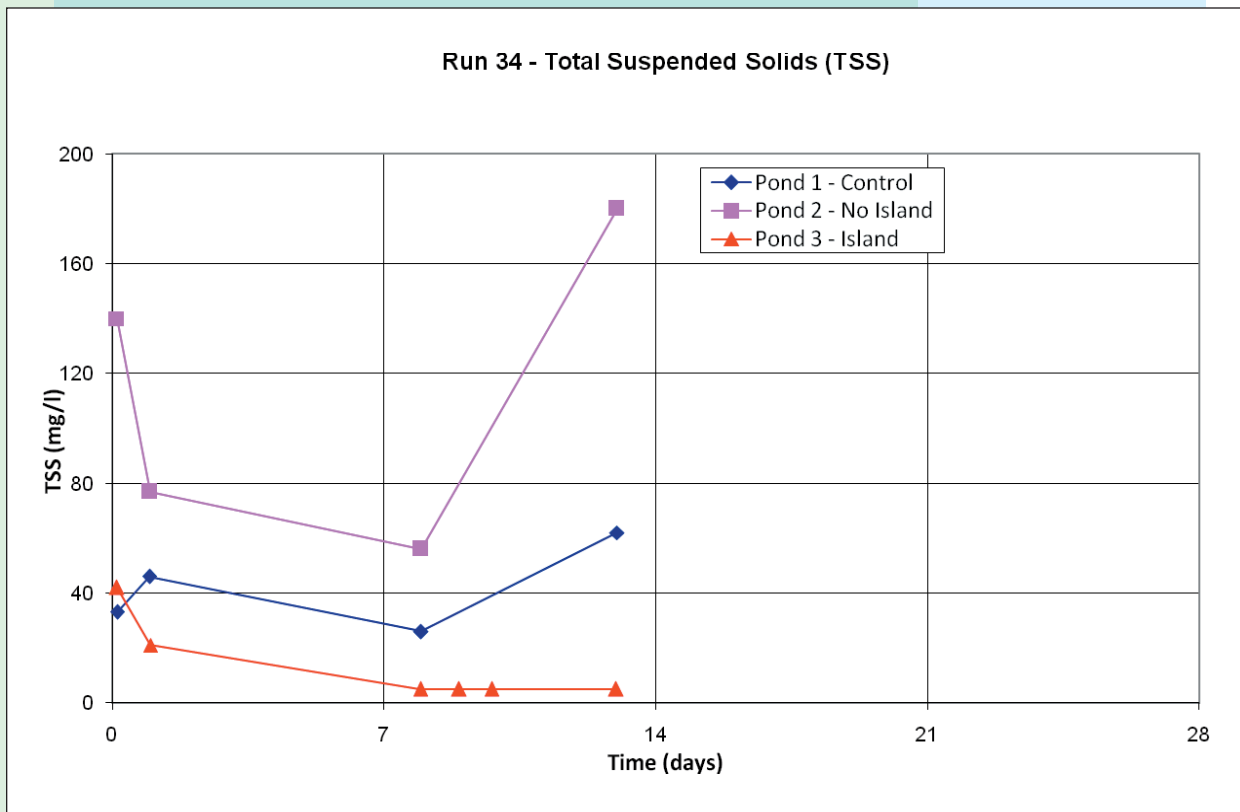
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Objectives, Work, & Results *cont.*



Project Report

Objective II: Data proving that a proprietary blend of nitrogen- and phosphorus-removing microbes with natural root-enhancing additives improve islands' performance in favorable and adverse weather conditions

We compared several commercial formulations of microbes to naturally occurring microbes found in nutrient-rich waters for five experimental runs under various nutrient loading conditions and temperatures, and we found that the naturally occurring microbes that had adapted to the specific local conditions performed as well or better than the relatively expensive commercial microbes. Communications with microbial researchers at MSU-Bozeman confirmed that commercial microbes typically do not outperform native microbes that have adapted to local conditions. Subsequent experiments focused on using natural bacteria, providing them with proper growth conditions, and allowing them to adapt to the particular experimental conditions that were present. (Proper growth conditions varied depending upon the nutrient that was being treated – for example, ammonium-removing bacteria require oxygen and alkalinity, but are inhibited by excess carbon; nitrate-removing bacteria require carbon but are inhibited by oxygen.) We used published literature in the field of biological wastewater treatment for reference guidelines. In general, the performance of the microbes continued to improve when the same islands were reused in follow-up experiments indicating that the ability of an island to remove nutrients will improve as the island microbial colonies mature.

We developed a proprietary plant-growth medium for use in sprouting seeds and starting young plants on the islands. This product is a combination of hydrophilic polymers and organic materials, and may be applied as a top coating on the islands or placed in pockets that are preformed into the island matrix. The material, named BioMix™, provides wicking, moisture retention, and starting nutrients for young plants, and also serves as a colonizing surface



Objectives, Work, & Results *cont.*

for beneficial microbes. Seeds and plants started in BioMix™ exhibit higher survival and faster growth rates than those started on bare island matrix.

In summary, the best combination of microbial and plant performance was achieved by using locally-adapted microbes well established on island matrix, in combination with plants that were grown in proprietary BioMix™.

Defined parameters for microbial dosing frequency

As described in the previous section, we used native microbes that were present in nutrient-rich shallow groundwater to seed the islands, and we found that additional microbial redosing was not required during the experiments. For the ammonium removal experiments, alkalinity was required by the nitrifying bacteria to convert ammonium to nitrate, and we dosed the experiments as required to maintain sufficient alkalinity and to keep pH in a favorable range for the nitrifying bacteria. The water used in the experiments contained a natural starting concentration of about 150 mg/l of carbonate alkalinity and had a pH of about 7.8. The pH was monitored daily throughout the experiments, and powdered calcium carbonate was added as required to maintain the pH between about 6.5 and 8.0. The additional mass of calcium carbonate required for unit removal of ammonium is shown in Run 34 on page 16.

Dissolved organic carbon (DOC) in the form of molasses was added to promote conversion of nitrate to nitrogen gas by denitrifying bacteria. The mass of DOC required for unit removal of nitrate was determined experimentally, as is shown in the Run 34 table on page 16. (Organic carbon is present in most wastewaters, and one of the primary goals of wastewater treatment is to remove this carbon. When excess carbon is added to promote nitrate removal, the additional carbon mass required should be calculated so that the effluent is depleted of both nitrate and carbon.)

Objective III: Data proving that islands work long-term after macrophytes have reached maturity

Nutrient removal in wetlands has been shown to decrease over time as wetland vegetation matures and plant growth rate decreases. We evaluated this potential effect with floating islands in order to determine if floating islands have a longer predicted operational lifetime than conventional treatment wetlands.

Comparing the nutrient removal rates for microbes and plants from data produced during this project and from other researchers (see table on page 8), it has been shown that microbes (when supplied with ideal growth conditions) can remove nutrients 10 to 20 times faster than plants. Based on these data, nutrient uptake associated with plant growth is not a significant source of nutrient removal compared to microbial removal on floating islands; therefore, the bacterial component of floating islands will continue to uptake nutrients at a relatively high rate after the plant component has matured and experienced a slowdown in nutrient uptake. (Submerged plant roots can provide a significant growth area for colonizing bacteria and therefore can be beneficial for nutrient removal; however, in this case mature plants are more beneficial than young plants.)

Although we did not experience significant plugging of the island matrix or sludge buildup in the island ponds or tanks during this project, we do expect an eventual buildup of biomass associated with conversion of phosphate to organic phosphorus. For some applications with high phosphate loading, it may be beneficial to replace the islands periodically in order to remove accumulated phosphorus. In some cases, the old phosphorus-rich islands may be redeployed for other applications such as streambank stabilization.



Objectives, Work, & Results *cont.*

Objective IV: Established ratio of island mass to water volume that is required to reach target levels of phosphorus, nitrogen, and algae in the water

Experimental results were documented in terms of “unit removal rates” (i.e., mass of nutrient removed per day per square foot of island, abbreviated as $\text{mg d}^{-1} \text{ft}^{-2}$); auxiliary parameters found to be of significance (e.g., unit aeration rate, pH control, and through-island water circulation) were also recorded. Using this approach, it is possible to use the experimentally-derived data to predict the performance of a given island system for removal of nutrients in any wastewater having known nutrient concentrations and target effluent levels, if the volume, temperature, alkalinity, and other field parameters of the wastewater can be determined. Examples of the experimental results and operating parameters are shown in the data tables beginning on page 8.

Objective V: Creation of habitat for native species of fish and wildlife—documenting for commercialization that combined benefits of water quality improvement and wildlife enhancement add market value

The objective in the proposal stated that we would select and track wildlife progress on five islands within the state of Montana. During the course of the Grant timeline, we expanded our tracking to include islands installed at several sites in other states and countries. These projects were funded by a combination of commercial sales and cash-match funding. Selected projects are summarized below. All of these projects are providing data and photographs that are documenting the combined benefits of BioHaven® floating islands.

- Delta Waterfowl Duck Nesting Project – We provided islands for duck nesting projects in South Dakota for the 2005 and 2006 nesting

P r o j e c t R e p o r t

seasons. Brush covered islands provided successful nesting habitat; sod-covered islands provided loafing and grazing habitat.

- Michigan Loon Nesting Project – FII provided four nesting islands for a test in U.P. Michigan that was conducted by White Water Associates. Two of the islands were used in the first season, and three of the islands were used in the second season.
- Chicago River Project – FII installed 22 floating islands in the Chicago River in the city of Chicago during July 2006. The purpose of the project was to provide aesthetic enhancement, wildlife habitat, and water quality improvement. The islands have been heavily used by wildlife and may require modification to protect plants from excessive grazing by waterfowl.
- Citizens for Conservation Project – A series of islands were installed by a volunteer group in Barrington, IL, for the purpose of wetland restoration. Plant growth and wildlife use are being photographed.
- Singapore – A group of islands was launched during 2007 in a brackish water lagoon in Singapore as part of the city’s “ABC” program for water (Active, Beautiful, Clean).
- ZooMontana – Floating islands have been installed in several locations in the Billings zoo, including the otter habitat. The underwater viewing window in this display allows monitoring and photography of root growth and the use of the underwater portions of the island by captive wildlife as well as wild birds with access to the site. Islands at other sites within the zoo are being used for aesthetic value, water quality improvement and wildlife habitat.



Objectives, Work, & Results *cont.*

- Shepherd Research Facility – Numerous floating islands in various sizes and configurations have been launched in wetlands and ponds at FII’s Montana site. The oldest island is currently six years old. This island has been monitored and photographed to track its use by frogs, garter snakes, shore birds, waterfowl, fish and other wildlife. Plant species succession has also been photographed and documented. An underwater viewing chamber has been constructed in a 20-foot deep pond to allow monitoring and photography of underwater island use by fish, insects, and other forms of wildlife. Root palatability of various plant species by native fish has been investigated to either encourage or discourage fish grazing depending on the intended use of the island. There are currently about 200 islands under study at the site, ranging in size from 1 square foot to over 1700 square feet. These islands grow trees, flowers and vegetables as well as native wetland plants.

Objective VI: Application and expansion of current commercialization efforts—building and capitalizing on brand recognition—to connect successfully with target markets in the areas of water quality improvement

- Launch introductory product—aquarium-size island—into the commercial market Aquarium-scale islands were manufactured in Shepherd and test marketed through a retail store in Bozeman during 2006-2007. At this time, an existing license-holder is considering picking up the license for the aquarium-size market. The Shepherd facility is currently taking telephone orders and manufacturing custom and stock islands in a wide range of sizes. These products are being sold nationally and internationally.

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- Conduct market research to identify specific targets in mine reclamation, municipal and private water treatment, feedlot waste management, dairy operation, manufacturing, water treatment and stormwater management, and fisheries; and expand current marketing plan to these markets Over the period of the Grant, FII has conducted extensive market research in the fields of mine waste remediation, wastewater treatment, livestock effluent management and stormwater management. We have done limited market research in the areas of manufacturing process treatment and aquaculture.

We have made wastewater presentations to representatives from the city of Helena, the Montana DEQ, the MSU Water Center, and several other authorities. We presented to Montana Department of Environmental Quality (MDEQ) on behalf of the Hebgen Lake Subdivision Water and Sewer Board. The Board is interested in using FII technology in wastewater lagoons that receive sewage from approximately 50 homes. Project team members from FII are continuing to work with engineering consultants and subdivision water and sewer board member to win a pilot project. We also presented to the City of Kalispell, Montana, and to the developer of a new subdivision to incorporate FII technology into stormwater management wetlands. The presentation received a very favorable response which resulted in the developer requesting a proposal for FII technology. In addition, we have conducted seminars on various topics including water quality remediation and waterfowl nesting habitat.

FII is currently in negotiations with a national marketing firm to promote brand recognition. In addition, we are working with the Montana university system to run annual conferences, beginning in 2008, that will bring together water quality professionals (researchers,



government agencies, foundations, and other public and private entities) together in dialog to inform, educate, and problem-solve, as well as to promote floating islands as a bio-remediation tool.

- Expand photographic and videographic materials Over the period of the Grant, we have assembled a portfolio of over one thousand photographs that show a diverse range of island-based subjects, including plant growth, wildlife use, test setups, and launching techniques. FII has produced a DVD of a general concepts presentation by Mark Osterlund that is coordinated with a promotional PowerPoint. Another DVD is in the works that demonstrates how to launch a floating island.
- Prepare marketing materials, media buys, website updates, tradeshow attendance/presentations We have used data and photographs collected during the Grant to produce several marketing documents that are being distributed to potential customers, and we have also distributed copies of the quarterly reports to numerous potential partners and customers.

We have developed and keep current an extensive website www.floatingislandinternational.com with the latest results of research, product development, and new locations of island deployment. In addition, we are compiling a list of tradeshows and working with our growing international network to recommend and attend key shows on our behalf.

- Success will be measured by tracking return on investments—cost-benefit analysis FII is tracking expenditures, incomes and profit margins as part of our normal business operation.





B . P e r f o r m a n c e B e n c h m a r k s

1. Secure greenhouse facility, equipment, and supplies for *Stage 1*. Target Date August 2005

Benchmark accomplished. Greenhouse space was rented from Aquatic Design and Construction (ADC) in Livingston, Montana, starting July 2005. Analytic instruments were purchased, including a Hach 890 Colorimeter (used for measuring ammonium, nitrate, phosphorus, and other parameters); a pH meter, an alkalinity meter, and a conductivity meter. Tanks, aerator pumps, circulation pumps, chemical supplies, nursery plants, etc., were purchased during August 2005.

2. Construct controlled testing facilities, run tests to establish baseline statistics. Target Date Sept 2005.

Benchmark accomplished. A bank of 24 aerated tanks was installed; 2 technicians (employed by ADC) were trained to operate the measuring instruments and other equipment; baseline tests (screening runs) were conducted using reference standards to confirm proficiency for measuring concentrations of phosphate, nitrate, ammonium, dissolved oxygen, pH and temperature.

3. Start *Stage 1* cool weather laboratory experiments. Target date Oct 2005.

Benchmark accomplished. Experimental Runs 1, 2, and 3 were started. Run 2 was completed; Runs 1 and 3 were continued into Q2.

4. Submit first Quarterly Progress Report. Target date Oct 2005.

Benchmark accomplished. The Q1 report was submitted on time and accepted by the MBRCT.

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5. Submit second Quarterly Progress Report. Target date Jan 2006.

Benchmark accomplished. The Q2 report was submitted on time and accepted by the MBRCT. By the end of Q2, we had completed six experimental runs, including tests with plants and microbes.

6. Secure equipment and supplies for *Stage 2*. Target date March 2006.

Benchmark accomplished. Tanks, plants, and expendable supplies were obtained for the outdoor tank experiments at the Livingston facility.

7. Complete *Stage 1* cool weather laboratory experiments. Target date March 2006.

Benchmark accomplished. Twelve laboratory runs were completed during the first six months of the project.

8. Start *Stage 2* warm weather laboratory experiments. Target date April 2006

Benchmark accomplished. Run 13 (first warm weather plant experiment) was started April 25, 2006.

9. Submit third Quarterly Progress Report. Target date April 2006.

Benchmark accomplished. The Q3 report was submitted on time and accepted by the MBRCT.

10. Summarize Bruce Kania's international research trip(s) for Year 1. Target date July 2006.



Performance Benchmarks *cont.*

Benchmark accomplished. This information was originally presented in the Q4 report as follows:

“Research and Commercialization Trips by Bruce Kania and other Floating Island International Associates (cash match funding)”

Jan 2006

- Bruce Kania and Anne Lamont-Low (International Liaison) – Visit to Americo (Acworth, GA), the manufacturers of the matrix used in island fabrication. Met with Richard Rones (President) and Kris Panattiere (Sales Manager); viewed the production lines; discussed product development to meet current and projected needs; discussed investment potential.
- Bruce Kania – Meeting with D2 Corporation (Indianapolis, IN) to advance distributorship possibilities.
- Bruce Kania – Held talks with patent attorneys (Columbus, OH), which have subsequently resulted in an arrangement to secure patent enforcement representation.

February 2006

- Bruce Kania and Anne Lamont-Low – Visited two companies in Germany and one in Switzerland to begin market development in Europe; crossed to UK and held talks with five companies: one importer, a consulting engineer specializing in erosion control, and retailers; in addition, met with the Duke of Buccleugh’s estate manager and prepared the ground for a license deal in Scotland. We are holding ongoing talks with the importer.

P r o j e c t R e p o r t

May 2006

- Bruce Kania – Trip to Raleigh, NC, to visit Nomaco (part of the multi-billion dollar Noel Group) to present FII as a license/investment prospect.

July 2006

- Bruce Kania and Anne Lamont-Low – Drove to Chicago to install 22 floating islands for the city on the Chicago River in downtown Chicago. The islands will be monitored carefully with respect to plant species / growth success rates, tolerance by (and to) waterfowl and overall improvement in the river health and aesthetics.

11. Submit fourth Quarterly Progress Report. Target date July 2006.

Benchmark accomplished. The Q4 report was submitted on time and accepted by the MBRCT.

12. Complete *Stage 2* warm weather laboratory experiments. Target date Sept 2006.

Benchmark accomplished. Final runs for this stage were Run 14B and Run 20 comprised of both microbes and macrophytes. Details were presented in the Q5 report.

13. Submit fifth Quarterly Progress Report. Final report for Stages 1 and 2 will be completed. Target date Oct 2006.

Benchmark accomplished. The Q5 report was submitted on time and accepted by the MBRCT.



Performance Benchmarks *cont.*

14. Technical Articles for Year 1 results will be generated and submitted to a minimum of 3 major technical/commercial publications. Target date Nov 2006.

Benchmark accomplished. The following documents were published or submitted for publication during year 1.

- a. “Implementation of an Effective Floating Island and Water Quality Treatment Technology,” presented to the National Association of Lake Management Society, 26th International Symposium, November 8-10, 2006, Indianapolis, IN. (printed copies available for distribution)
- b. “Island Life,” *Watershapes Magazine*, Volume 7, Number 4, April 2005.
- c. “Treasure Islands,” *Billings Gazette*, June 17, 2006. Front page article with color photographs of islands, picked up by AP and reprinted nationally in numerous newspapers.
- d. “Floating Islands as an Alternative to Constructed Wetlands for Treatment of Excess Nutrients from Agricultural and Municipal Wastes – Results of Laboratory-Scale Tests,” *Land Contamination and Reclamation Magazine*, submitted for peer-reviewed publication, January 2007. Accepted with major revisions required 2/16/07. Revised article submitted 7/16/07. Accepted by editor 7/23/07. Accepted by publisher with minor revisions required 9/13/07. Expected submittal date for revised version is end of November, 2007.

P r o j e c t R e p o r t

15. Submit sixth Quarterly Progress Report. Target date Jan 2007.

Benchmark accomplished. The Q6 report was submitted on time and accepted by the MBRCT.

16. Secure facilities, equipment, and supplies for *Stage 3*. Target date March 2007.

Benchmark accomplished. A site for construction of the test ponds was selected at the Shepherd Research Facility. Pond liner, piping, valves, and other required parts were purchased.

17. Build full scale islands, design and build outdoor test facility. Target date April 2007.

Benchmark accomplished. The *Stage 3* facilities comprised three identical 5000-gallon test ponds with grid power, solar power, and wind power options for aeration and water circulation. The ponds could be filled either by gravity flow from a connected irrigation ditch or from an existing pond by pumping. Dry and liquid nutrients were purchased for the purpose of dosing the ponds with simulated wastewater containing ammonium, phosphate and organic carbon. Powdered calcium carbonate was purchased to provide alkalinity dosing for the nitrifying bacterial process. The three ponds were set up as follows: Pond 1 – no aeration or circulation (to simulate a stagnant wastewater lagoon); Pond 2 – aeration and water circulation supplied, but no floating island; Pond 3 – one 250-square foot floating island equipped with both aeration and water circulation. Initial screening runs were conducted to develop efficient methods for mixing chemicals, distributing the circulated water, collecting samples, etc.



Performance Benchmarks *cont.*

18. Submit seventh Quarterly Progress Report. Target date April 2007.

Benchmark accomplished. The Q6 report was submitted on time and accepted by the MBRCT.

19. Start *Stage 3* - Full Scale verification tests. Target date May 2007.

Benchmark accomplished. We started and completed screening Run 30 in the outdoor test ponds, then modified the equipment setup as required. We started Run 31 which tested the uptake of high concentrations of ammonium by a 250-sf floating island and compared the island performance against two different control conditions.

20. Summarize Bruce Kania's international research trips for Year 2. Target date July 2007.

Benchmark accomplished. The U.S. and international research trips taken by FII personnel were originally presented in the Q8 Report as follows:

January 2007

- Presented to NACO – National Association of County Commissioners – ag caucus (Bozeman).

- Licensing Visit to Arizona and California – Bruce Kania and Anne Lamont-Low (27 Jan – 11 Feb 2007)
 - a. Meeting with Dr. Bruce Rittmann ASU and Andrew Wooten AZTE – Presented FII and learned about BR's hydrogen membrane technology for nutrient and selenium removal; assessed the potential fit between the two technologies as high:

P r o j e c t R e p o r t

compatibility excellent and moving toward a potential FII technology license deal with Andrew's company.

- b. Jerry Miller, Coyote Wash Golf Course and condominiums, Wellton, AZ – Jerry owns two old-style floating islands which have developed buoyancy problems. We left him with two new islands and need to work with him further to review how they're doing and replace them with larger ones. Jerry's family owns a construction company and is involved in major property development. He could be an ideal license candidate for FII.
- c. Polycoat Plastics, Santa Fe Springs – Met with Ashish and Mike Volesky, reviewed their operation and presented FII technology; came away with greater understanding of their coatings and how they can be used by FII. Good relationship-building exercise, especially with Mike, with whom we have already had excellent dealings.
- d. Meeting with senior members of the Departments of Conservation and Water Resources in Sacramento – Presented FII technology to senior members of the California state government - Karen Scarborough, Undersecretary, Dept. of Resources; Bridgett Luther, Head, Dept. of Conservation, and Dale Hoffman-Floerke, head of the Salton Sea office. The use of recycled plastics is a prime concern in CA, and the use of floating islands in the remediation of the Salton Sea was explored. Our presentation was very well received. It was considered more practical to treat the tributaries flowing into the Sea, especially the New and Alamo Rivers. Concerns still expressed by the Salton Sea office about floating islands' ability to withstand the environment's harsh conditions.



Performance Benchmarks *cont.*

- e. Meeting with Zenny Yagen, Division Head, Dept. of Recycling – We were talked through the grants available for keeping recycled plastics in California and shown sample successful applications. Enthusiasm was strong for our potential application.
- f. Meeting with Water Resources Board (California EPA) – Tom Howard, acting Director; Charlie Hoppin and others. Presented to a more technical, scientific audience who were supportive of permitting floating islands in TMDL and stormwater applications. They were more conservative about waste-water applications.
- g. Travelled South to meet with Bruce Milne and George Aguilar – Were taken to visit Pinnacle Plastics and Jacobsen Plastics, but there did not seem to be much prospect of a license deal or partnership with either company.
- h. Introduced to the management team of the new company George and Bruce have set up, Bio Remedial Services – Were presented with their business plan. This company is very serious about moving forward with a license covering the State of California, and plans to send Arn Lahde, CEO, to Shepherd the week of February 18, and conclude the license deal on March 8–10.
- i. Visited Inca Plastics – Met with Bill Odell, the owner, who has been ear-marked as the production manager for Bio Remedial Services.
- j. Lake Elsinore – Ray and Sandra Stinnett, Pat Kilroy, Jeff and Rick (from SAWPA). Visited the Lake and discussed the implications of using floating islands in a pilot project in two one-acre areas.

P r o j e c t R e p o r t

Presented the benefits of floating islands to Pat and the two SAWPA engineers. Their main concerns centered around how to measure these benefits (Frank Stewart has already been in touch to offer assistance). Pat indicated there were no funds yet allocated for this project. Ray and Sandra Stinnett are very enthusiastic supporters of FII and are shaping up as dealers.

- k. Back in Sacramento – Breakfasted with George Tchobanoglous and made him aware of the benefits of floating island technology. George offered to set up a meeting between FII and the city manager(s) of San Francisco.

Saturday, March 24

- Pond Boss Conf. & Expo. Texas – Break-out session with Dr. Richard Anderson
- Left Texas for Florida

Monday, March 26

- 1:30 pm – Bruce presented for Peter Seyffert's group in Sarasota, FL
- Met with Wendy Swindell, Biological Research Associates

Wednesday, March 28

- Met with Larry Dyck in Lake Sinclair Business
- Bruce met with reps from Georgia DNR at Lake Sinclair, GA

Friday, March 30

- Breakfast meeting with Ted Martin, Ted Falgout & CC Lockwood in Baton Rouge, LA



Performance Benchmarks *cont.*

Report of International Research Trip April 2007

Bruce Kania, Anne Lamont-Low

New Zealand

- We visited with John Preece of NZ Wetland Nursery, a wetlands plant specialist and wetland construction consultant, and his wife Elspeth, a businesswoman. We presented them with the floating island concept and research data with a view to their participation as a distributor or license holder. John decided to be part of the Delphi system as his current circumstances do not permit a more committed business involvement.
- Anne visited with Ken Johns of Astron Plastics, a possible supplier of recycled plastic “re-grind.” Ken suggested an alternative option would be chopped laminate for filling the low-cost modules. Ken then put us in touch with RDR Foam, a manufacturer of a brand new polyethylene foam. Discussions have commenced. Both manufacturers represent suppliers to whatever entity eventually becomes the NZ manufacturer of floating islands.

Singapore

- Bruce, Anne, and initially Bernie Masters held extensive meetings over four days with engineering firm CPG Consultants, the Public Utilities Board (PUB) of Singapore, academics representing research projects, and other engineering firms and individuals.
- CPG Consultants have a contract with PUB to construct a floating amenity of approximately 2,000 sq. meters in the Sungei Punggol, a waterway which flows inland from the sea, which is soon going to be blocked off to form, over time, a freshwater reservoir. FII has

P r o j e c t R e p o r t

been approached by CPG to supply islands as part of the overall project solution. We are working with Coco Wang. We needed to demonstrate that floating islands were suitable for the job, and nutrient removal was a significant factor. We were able to draw on the excellent results of Q5 to support our case. We presented to a large number of representatives from CPG and PUB (including the Director of the Catchment and Waterways Department) and were well received. We spent the remainder of our day with CPG helping to modify their design and generating more ideas about how our islands can be used most effectively.

- The credibility that our involvement with the MBRCT grant gave us, along with FII's matching contributions, led to an invitation the following Monday to present to a group of academics and researchers who administer grant funding for water-related projects in Singapore. They seemed very willing to identify suitable projects and assist us to apply for funding.
- Further meetings with CPG led to two demonstration projects being finalized, to be undertaken immediately: on May 13, the Prime Minister of Singapore will open a sports facility on the Lower Seletar reservoir right by the water's edge. FII will air-freight demonstration islands to take advantage of this public occasion. Bernie Masters will be on hand to manage the launch. The second pilot, slated to begin the end of May, will test what vegetation grows best on floating islands in the target waterway, in both freshwater and brackish conditions, in the tropical climate of Singapore.
- There are two other similar projects being undertaken by other engineering firms elsewhere on the island. We met with two



Performance Benchmarks *cont.*

representatives from Black and Veatch to establish our credentials and make initial contact.

- And finally, a private contact – a relative of one of the engineers approached us interested in being involved in FII at some level. He, Isaac, toured us around the islands’ waterways and gave us extensive insight into the water issues and resources that the PUB is seeking to steward. “ABC – Active, Beautiful, Clean” is their slogan, and they are serious about enacting it.

Seoul, South Korea

- Our purpose was to meet with a potential license candidate, Magicone21, a firm involved in zoo construction and live animal importation which has business connections with a relative of Bruce’s. They appeared to be very keen to distribute or license floating islands.
- Over two and a half days, we presented our technology in detail, and indeed the research results were one of the keys to establishing the credibility of FII and the islands themselves. Korea is especially interesting as there is at least one other firm manufacturing and launching a version of a floating island, so Magicone21 were particularly interested in the points of difference. We were able to establish that the efficacy of BioHavens® exceeded the efficacy of the Korean islands by a huge factor, if their figures are accurate (Their figures - P : 1.4mg/square feet per day. N : 21mg/square feet per day. Our figures - N:10,600 mg/sf/day; P 140 (at the time) mg/sf/day). This was very persuasive.
- The outcome was we shook hands on a license agreement, to be worked out in detail and contracts to be signed over the next 45 days.

P r o j e c t R e p o r t

This will give Magicone21 the rights to manufacture and sell floating islands in Korea, and in the short term into any territory not yet covered by a license. In return they will pay a lump sum, and royalties on all sales, to FII.

Report of U.S. Research Trip July 2007

Bruce Kania, Anne Lamont-Low

Harrisburg, PA.

- Brinjac Engineering – Met with Steve Zeller and Dr. Vikram Pattarkine to review wastewater treatment using floating islands, in particular, the pilot project at Wiconsico, which is starting to show preliminary results.
- Presented to section directors at DCNR and Wildlife and Parks.
- Land Science – Bill Achor and Jim Baney. Very strong interest in taking a distributorship or license.

Columbus, OH.

- Met with business development manager and scientists at Battelle with a view to entering into a partnership involving research and/or investment.

Wisconsin

- Various sites in Wisconsin to research natural floating islands. Engaged Charles Sandstrom (Guide on Lake Chippewa Flowage) for diving services.



Performance Benchmarks *cont.*

- Dave Knapp and Lisa Reas – based in Green Lake, WI. Potential distributor / WI licensee. Bank restoration specialists.

21. Submit eighth Quarterly Progress Report. Target date July 2007.

Benchmark accomplished. The Q8 report was submitted on time and accepted by the MBRCT.

22. Complete *Stage 3* - Full Scale Verification Tests. Target date Sept 2007.

Benchmark accomplished. We completed Runs 31 and 33 by the end of September. Based on continued favorable outdoor weather conditions, we made one additional run (Run 34), which was completed October 21, 2007. This final run provided our best nutrient removal rates for the project in an outdoor test pond environment.

23. Complete Final Report for *Stage 3* results. Target date October 2007.

Benchmark accomplished. This report fulfills the requirement for Benchmark 23. The details of the *Stage 3* experiments are presented in our Year 2 Annual Report which will be submitted shortly following this Final Report.

24. Submit technical articles for Year 2 results to a minimum of six major technical/commercial publications. Target date Nov 2007.

Benchmark accomplished. The following articles were published or submitted during Year 2.

- a. “Microbes Rule!” WaterShapes Magazine, May 2007, by Bruce Kania.

P r o j e c t R e p o r t

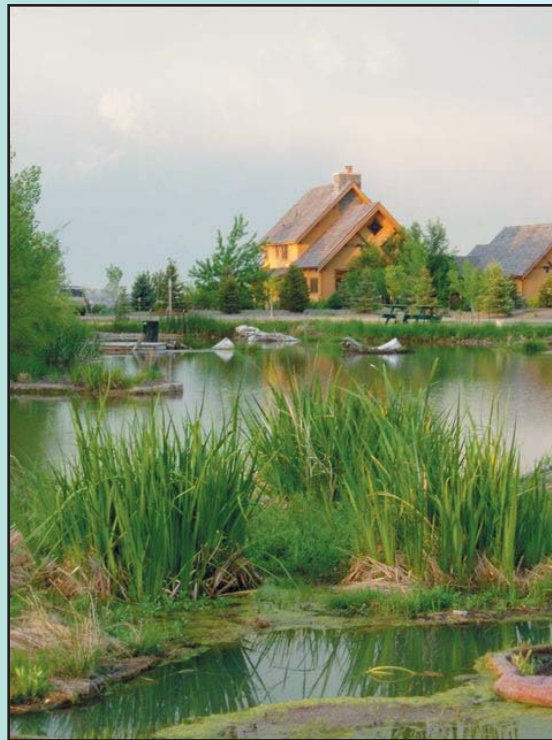
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- b. “Microbes Rule”, Landscape Architecture, July 2007 (P. 92 – 99 Copyright WaterShapes. Reprinted with permission from May 2007 issue)
- c. “Floating Islands – New Dimensions in Pond Management,” cover story, Pond Boss Magazine, Nov/Dec 2006, VXXV, No. 3.
- d. “The Future of the Environment – Mega Engineering Projects – Build Wetlands from Scratch,” Popular Science Magazine, August 2007. An article about BioHaven® Floating Islands, by Rena Marie Pacella with technical support by Bruce Kania and Frank Stewart; May 2007.
- e. “Floating Islands Dress Up Farm Ponds,” Farm Show Magazine, 2007, Vol 31, No. 4.
- f. “Biomimicry...Nature Knows Best - Pathways to Healthier Water,” Pond Boss Magazine, submitted for publication Sept 2007, By Bruce Kania, Frank Stewart & Mark Osterlund
- g. “Floating Wetlands may help sink algae,” “Water and Atmosphere,” Vol. 15, No. 2, July 2007, by Tom Headley, NIWA. An article describing the planting and deployment of a BioHaven® floating island by volunteers in New Zealand.
- h. “Stacking Functions: Floating island technology for water purification, habitat creation, environmental research and community mobilization,” Municipal World Magazine, November 2007. An article about the multiple benefits of BioHaven® floating islands.



Performance Benchmarks *cont.*

- i. “Results of Floating Island Experiments to Improve Water Quality in Test Ponds,” Land Contamination and Reclamation Magazine. by Frank Stewart, Al Cunningham, Tim Mulholland, Mark Osterlund. This article is currently being completed and will be submitted after the report of the first year’s research has been published.



*FII's Shepherd, Montana,
Research Facility*

C . F i n a n c i a l R e p o r t

Montana Board of Research and Commercialization Technology

FINAL FINANCIAL REPORT

Grant Agreement: #06-20 Biomimetic Floating Islands that Maximize Plant and Microbial Synergistic Relationships to Revitalize Degraded Fisheries, Wildlife Habitats, and Human Water Resources

Principal Investigator: Frank Stewart

Phone: 406-586-0790

Email: fstewart@wildblue.net

Date Submitted: November 30, 2007

I. FINANCIAL STATUS

| Budget Item | Original Amount Budgeted – Total Years 1 & 2 | | | | R&C Funds | Matching Funds | Other Funds | Total |
|-------------------------------------|--|----------------------|-----------------|----------------------|----------------------|----------------------|-----------------|----------------------|
| | R&C Funds | Matching Funds | Other Funds | Total | Expended | Expended | Expended | |
| Salaries | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - |
| Payroll Benefits | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - |
| Repair and Maintenance | \$ 8,700.00 | \$ - 0 - | \$ - 0 - | \$ 8,700.00 | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - |
| Travel | \$ 15,600.00 | \$ 14,000.00 | \$ - 0 - | \$ 29,600.00 | \$ 11,627.81 | \$ 15,342.44 | \$ - 0 - | \$ 26,970.25 |
| Communications | \$ 4,000.00 | \$ - 0 - | \$ - 0 - | \$ 4,000.00 | \$ 5,804.21 | \$ - 0 - | \$ - 0 - | \$ 5,804.21 |
| Contracted Services | \$ 204,810.00 | \$ 102,600.00 | \$ - 0 - | \$ 307,410.00 | \$ 228,242.66 | \$ 118,195.78 | \$ - 0 - | \$ 346,438.44 |
| Supplies and Materials | \$ 62,462.00 | \$ - 0 - | \$ - 0 - | \$ 62,462.00 | \$ 53,447.19 | \$ 4,691.82 | \$ - 0 - | \$ 58,139.01 |
| Rent | \$ 5,400.00 | \$ - 0 - | \$ - 0 - | \$ 5,400.00 | \$ 9,406.85 | \$ - 0 - | \$ - 0 - | \$ 9,406.85 |
| Equipment | \$ 9,320.00 | \$ - 0 - | \$ - 0 - | \$ 9,320.00 | \$ 1,763.28 | \$ - 0 - | \$ - 0 - | \$ 1,763.28 |
| Subcontracts | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - |
| Awards | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - |
| Participant Support Costs | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - | \$ - 0 - |
| Facilities and Administrative Costs | \$ - 0 - | \$ 7,500.00 | \$ - 0 - | \$ 7,500.00 | \$ - 0 - | \$ 1,727.78 | \$ - 0 - | \$ 1,727.78 |
| Total | \$ 310,292.00 | \$ 124,100.00 | \$ - 0 - | \$ 434,392.00 | \$ 310,292.00 | \$ 139,957.82 | \$ - 0 - | \$ 450,249.82 |

Description of Variations between Budgeted and Actual Expenditures

- 1) Repair and Maintenance (actual R & C expenditures was lower than budgeted): There was a significant amount of effort expended on equipment repair, maintenance and replacement during the project. Since this work was a normal part of the work routine for technicians and engineer, the labor costs were credited to Contracted Services, and the parts costs were credited to Supplies and Materials.



- 2) Contracted Services (actual expenditures were higher than budgeted for both R & C Funds and Matching Funds): a) we modified the work plan to run our own chemical analyses of water samples rather than sending them to an outside lab, which lowered the overall cost of testing but raised labor costs for technicians and engineer; b) we performed more laboratory work than originally planned, which raised labor costs but produced a better result; c) maintenance and repair labor was included in this category; d) matching fund expenditures were greater than budgeted due to extra R & D work that was performed during the project.

- 3) Supplies and Materials (R & C Funds actual were lower than budgeted and Matching Funds were higher): a) expenses for outside laboratory analyses were lower than budgeted due to work being done in-house; b) materials for aquarium tests and distribution of research results to prospective customers were contributed with Matching Funds but not originally budgeted.

- 4) Rent (actual were higher than budgeted): We required more indoor laboratory space for wintertime work than originally budgeted, which resulted in higher rental and utility costs.

- 5) Equipment (actual expenditures were lower than budgeted): a) items such as pumps and mixing equipment that had individual costs of less than \$500 each were originally listed as Equipment but were shifted to Supplies and Materials; b) costs for diversion structures were originally listed under Equipment but were shifted to Contracted Services.

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D . C o m m e r c i a l i z a t i o n P l a n

This grant project has provided empirical data that establishes the ability of BioHaven® Floating Islands to improve water quality. Armed with this data, Floating Island International can aggressively market BioHavens® to the Environmental Remediation market.

BioHavens® have many applications, and have already been successfully introduced into markets that do not depend upon water quality improvement data. The ornamental pond market is one example. Floating islands as wildlife habitat, particularly for fish and waterfowl, is another. But the most significant market, commercially and environmentally, is the “regulatory market,” where contaminated water is required to be cleansed to a specific standard to avoid heavy penalties for non-compliance. BioHaven® Floating Islands, backed by solid data and capable of providing compliance to these standards, are now able to enter this market.

Product Description

BioHavens® are artificial floating wetlands offering a concentrated surface area for the growth of microbes and plants, which together offer a natural means to cleanse water of troublesome pollutants such as nutrients and heavy metals. A non-woven matrix made of 100% recycled plastic is fabricated into floating mats which are planted with a variety of vegetation and launched onto a water body. It is a very simple concept, based on naturally occurring floating peat bogs, which allows a complex process of microbial and chemical interrelationships to be optimized for the removal of pollutants.

These island wetlands are beautiful as well as natural, versatile and functional, and now they are effective problem-solvers. The problems they solve are among the most significant to the ultimate survival of our planet.

The Target Market

As a result of the success of this project, the commercialization focus of BioHaven® Floating Islands will be on Environmental Remediation Specialists – government entities and private companies who offer diverse environmental services that include watershed management and land use planning; wetland determination and mitigation; and environmental education.

Projects where floating islands can substantially contribute to cleaner water are common to virtually any community and generally fall into three main areas:

- Tertiary treatment of wastewater that has been through a wastewater treatment facility but still contains high levels of phosphate which enter the water column
- Primary treatment of wastewater in communities that do not have a wastewater treatment plant but rely instead on the evaporation process to deal with their effluent in lagoons
- Stormwater ponds which contain pollutants of all kinds, including toxic metals such as copper and zinc

In the first area, floating islands can supplement the engineered solution; in the second, they are a very competitive option to the engineered solution, especially in communities which cannot afford a wastewater plant; and for the third scenario, treatment of stormwater ponds, BioHavens® provide an additional stewardship tool—a concentrated floating treatment wetland that can provide one acre’s worth of wetland surface in a 250 sq. ft. island.

Data generated by this study and applied in a real life setting promise to save municipalities like our own capital city of Helena as much as 90% of the



Commercialization Plan *cont.*

conventional cost of an expanded sewage treatment system. In Helena, based on numbers provided by that city's sewage treatment manager, our island technology could save the city in excess of \$50,000,000 in installation costs compared to other options under consideration—a significant impact to a city of 28,000 people. Beyond Montana, virtually every community in the U.S. and around the world can benefit from floating islands in at least one of these three major areas. Other common municipal applications where efficacy data will be required include acid mine drainage, golf courses, zoos, and farm effluent ponds.

Size of the Market

The size of this market is immeasurable. Environmental Remediation entities are located in every state and most cities in the United States. Major headquarters offices for government land agencies tend to cluster in Washington D.C. and Colorado, but all have regional and area offices in other states—two of significance in Montana are the Bureau of Land Management and the Bureau of Reclamation. The pressure to clean up our water and restore our wetlands is increasing every year. In California, for example, if the Salton Sea restoration project proceeds as planned, costs are estimated at \$6 billion. In many countries outside the US, environmental remediation is an even greater focus than it is here.

Marketing Strategy

Our current marketing strategy has several facets:

- Distributor-led marketing
- Publications – articles in journals, magazines, newspapers, press releases
- Web site positioning – www.floatingislandinternational.com
- Delphi System – where our contacts use their contacts to

introduce potential licensees to us

- Licensing in Montana – FII is in the final stages of assigning the US license to a Montana organization who will become the production facility for the whole of the U.S.
- Licensing world-wide - FII plans to license island production to appropriate entities around the world while retaining R&D in Montana. We cemented our first license almost a year ago, and have three others in advanced stages of negotiation.
- Pilot Projects – We are planning large-scale pilot projects in China and Singapore which we believe will lead to licenses in those countries.
- Contracting with a world-class marketing firm for a complete go-to-market campaign

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Production/Manufacturing Plan

Currently, island production is occurring in the plant located adjacent to FII's Shepherd Research Facility. Production at that facility is limited to islands that are 25 sf or larger. In the last year, 3000 islands have been shipped from FII's production facility, and in 2008 we expect island production to increase 10-fold with the anticipated licensing of Floating Island America (FIA), a Montana-based group planning to build a larger production facility in Shepherd.

The growth of FII and the licensing of island production/sales outside Montana and the US, may lead to additional production facilities outside of Montana. These potentials are discussed in various places in this report; an abbreviated bullet list can be found under Economic Impacts. Regardless of the licensing locations, the FII Research Center will remain stable in Shepherd, Montana, and FII expects the premier product to be produced here.



Commercialization Plan *cont.*

Business Risk Assessment

Patent Protection

1. Piracy – FII has surrounded its technology with extensive patent protection, in 42 countries around the world. However there remains the risk of piracy, particularly in economies not noted for IP compliance. The risk of pirated floating islands hitting retail stores in the U.S. is perhaps higher in the “general” market. The municipal market is relatively protected from this given the large scale of most municipal projects, the custom-built nature of solutions and the relatively high integrity of public servants (on the whole). FII is protecting itself from piracy within a suspect licensed territory by charging a much higher downstroke and lower royalty than it would elsewhere.
2. Cost of IP Enforcement – Probably the greatest risk associated with FII’s position is the company’s ability to cash flow through an IP enforcement action. Regarding this risk factor, the company has partnered with an IP enforcement specialist law firm. In addition, we will not advance aggressively in countries that do not honor intellectual property.

Large-scale Island Failure

To combat this, as well as other risks such as incomplete projects, FII is negotiating an insurance bonding arrangement with a Montana insurance firm. At this point, FII has no long-term debt so the risks associated with outright failure are reduced.

Projected Sales Revenues

| | | |
|------------------|------------------|------------------|
| 2008 – \$650,000 | 2009 – \$625,000 | 2010 – \$250,000 |
| 2011 – \$250,000 | 2012 – \$400,000 | |

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E . E c o n o m i c I m p a c t s

The economic impacts resulting from this project are expanding almost daily—in Montana, throughout the U.S., and around the world.

New Production Facility in Montana – FII is in the final stages of assigning the license to a Montana-based group who will become the production entity for the entire US market. Their operation, Floating Island America (FIA), will be based in Shepherd, Montana, and is expected to contribute significantly to the state’s economy. The production facility will be designed and built by Montanans, and when complete, will initially create 16 new jobs—3 production staff, 1 production manager, 3 sales and marketing staff , 2 administrative staff, and 2 senior managers to oversee the operation. We also expect the need for 5 science and engineering professionals to provide specification support and island launching expertise to support and train franchise holders across the U.S.

Impact on Related Montana Businesses – In addition to the direct creation of new jobs, the ripple effect will touch other Montana businesses—transport providers like Roadway, plant nurseries, and a network of potential distributors. As FIA franchise holders increasingly place islands into the state’s waterways, numerous related businesses will begin to feel the positive impact.

The Montana Invention Company – FII, based in Shepherd, Montana, will continue as an invention company, developing prototypes and Intellectual Property, and contracting with Montana firms for patent work, engineering, and ongoing scientific research. Royalties generated by FIA’s sales will come back to Montana and be used to further develop environmental solutions to benefit the planet.

P r o j e c t R e p o r t

Returns from Beyond Montana – The results of the MBRCT study are set to have a profound affect on FII’s business. Though it is early, and municipal authorities are slow to act, some projects have been initiated as a direct result of the data achieved through the Grant study:

- Lower Seletar Reservoir, Singapore – 2000 sq. m floating island for water remediation, via PUB. FII will install and supervise a pilot project in February 2008 which is likely to lead to an order generating revenue for the Montana-based scientists and engineers who spec and supervise the study.
- Wiconisco – a successful pilot study would open the doors to floating islands being used to treat wastewater in communities all over the United States, each installation being worth from \$1 – 5 million and upwards.
- New River, California – floating islands are being proposed to treat this heavily polluted waterway which flows into the environmentally sensitive Salton Sea. FII’s solution is one of the few cost-effective options that will actually work, as nutrient loading, wave action, and habitat decimation are three of the major issues we can remediate. Conventional solutions are estimated to cost billions of dollars, and authorities have understandably balked at this cost. We are committed to providing an affordable solution to the extent that we are planning to build a facility in California to facilitate this project. FII has received initial support from the State government which will enable us to fulfill their goals to increase plastics recycling and to restore the Salton Sea. This project will utilize Montana expertise in science, engineering, and manufacturing, and will create a revenue flow from sales back to this state.



Economic Impacts *cont.*

- New Zealand – The grant’s research data with concurring data generated by the National Institute of Water & Atmospheric Research (NIWA) has been influential in Kauri Park Nurseries’ decision to purchase a license from FII for New Zealand and Australia. NZ has millions of acres of degraded waterways and the will to remediate. Floating islands have been well-received and promise to generate royalty revenue for FII, new patents as R&D continues in a new environment, and partnerships between US and NZ scientists.
- Seven other major projects are in progress with similar benefits to the state of Montana, FII, and its associates.

In the last two years, and over the course of the grant project, FII or Bruce Kania has appeared in 15 magazine articles, 3 books and numerous newspapers across the US and Canada, and on Canadian TV. Many of the news articles are available on our website: www.floatingislandinternational.com and most will be included in the more comprehensive Annual Report. We believe that as a result of the empirical data made possible through research funded by this grant, we have made significant strides toward our goal to provide a natural biomimetic solution to revitalize degraded fisheries, wildlife habitats, and human water resources. We are grateful to the Montana Board of Research & Commercialization Technology for their support.





*Red wing blackbird nest on floating island in the pond
at FII's Shepherd Research Facility.*