

## **CLEARAS WATER RECOVERY'S ABNR™ SOLUTION PROVIDES WASTE-WATER FACILITIES WITH COST RECOVERY OPPORTUNITY WHEN ADDRESSING NUTRIENT DISCHARGE REQUIREMENTS**

### **Tightening nutrient discharge requirements**

Many wastewater facilities are faced with the challenge of identifying, selecting and implementing nutrient recovery technologies to meet tightening nutrient discharge requirements. This is due to a number of political, regulatory, social, and economic factors that are driving demand and pressure to improve our nation's rivers, lakes and watersheds.

Constituents such as phosphorus and nitrogen are natural parts of aquatic ecosystems and they support the growth of algae and other aquatic plants. However, when excessive amounts of nutrients enter the environment through wastewater, industrial discharge or agricultural runoff, the receiving waters become polluted. This pollution, which has impacted numerous streams, rivers, lakes and coastlines for the past several decades, results in serious environmental, economic and human health concerns. These impacts have prompted the U.S. Environmental Protection Agency (EPA) to accelerate planning efforts with individual states on the implementation of water quality requirements and nutrient discharge standards.

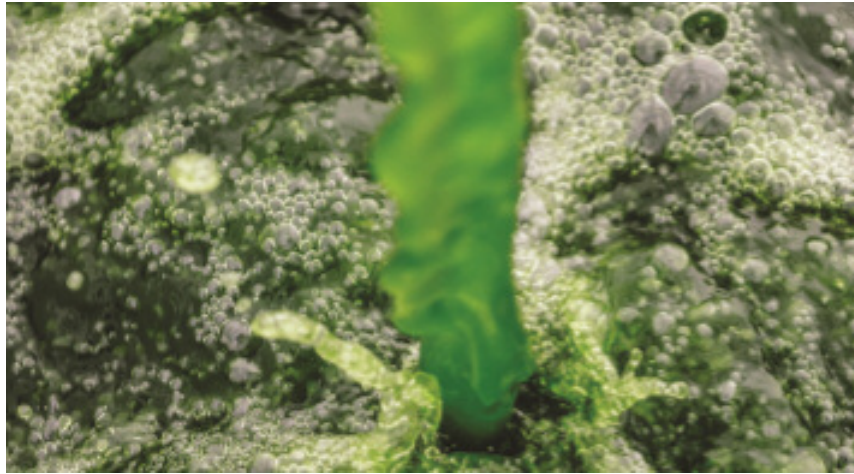
Existing, traditional treatment methods range from the use of conventional activated sludge and chemicals to filtration or other mechanical methods. These methods are costly to operate and maintain and contribute to increased sludge hauling demands. Because of this, many wastewater facilities are in search of zero-waste, chemical-free solutions to recover nutrients and reach ultra-low levels of detection while using it to their economic benefit.

### **A chemical-free, zero-waste solution available with cost recovery opportunities**

The CLEARAS Advanced Biological Nutrient Recovery (ABNR™) system, a chemical-free and biologically-based solution for municipal and industrial point source dischargers, leverages its zero-waste process to effectively achieve ultra low-level nutrient results. The system utilizes a process that consists of 3 core phases:

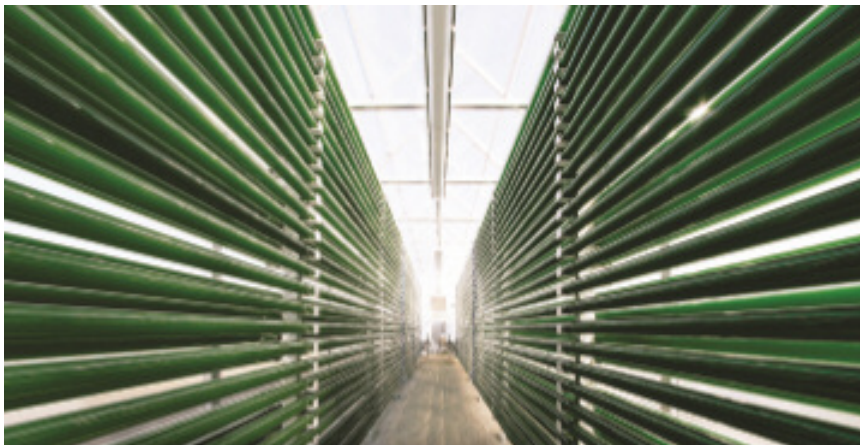
Phase I is the "Mix" phase. In this stage, phosphorus and nitrogen loaded wastewater is mixed with a biodiverse blend of algae and other micro-organisms to initiate nutrient recovery. This bio-diverse blend is referred to as the Mixture Flow.

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*Figure 1: Mix Phase*

Phase II is the “Recover” stage. In this stage, the Mixture Flow enters a photobioreactor (PBR) which optimizes biological activity and promotes photosynthesis where phosphorus, nitrogen, and carbon dioxide are rapidly consumed.



*Figure 2: Recover Phase*

Phase III is the “Separate” stage. In this stage, the wastewater, now free of nutrients (and other constituents), is separated from algae and other microorganisms and results in an oxygenated clean water stream for discharge or reuse. A majority of the biomass stream is then returned to the Mix stage as Return Activated Algae (RAA) to sustain the treatment process. Additionally, a side stream of the RAA is wasted (or harvested in the case of ABNR) where biomass is processed for a wide-range of downstream market opportunities which results in cost recovery for the wastewater plant.

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Figure 3: Separate Phase

The ABNR process is very similar to the well-known activated sludge process in the sense that it takes advantage of aerobic micro-organisms but, in the case of the ABNR system, an activated algae stream is returned back into the cycle to continue the systems’ process. And unlike the conventional activated sludge process, the ABNR process eliminates the need for chemical addition and can reduce hauling costs.

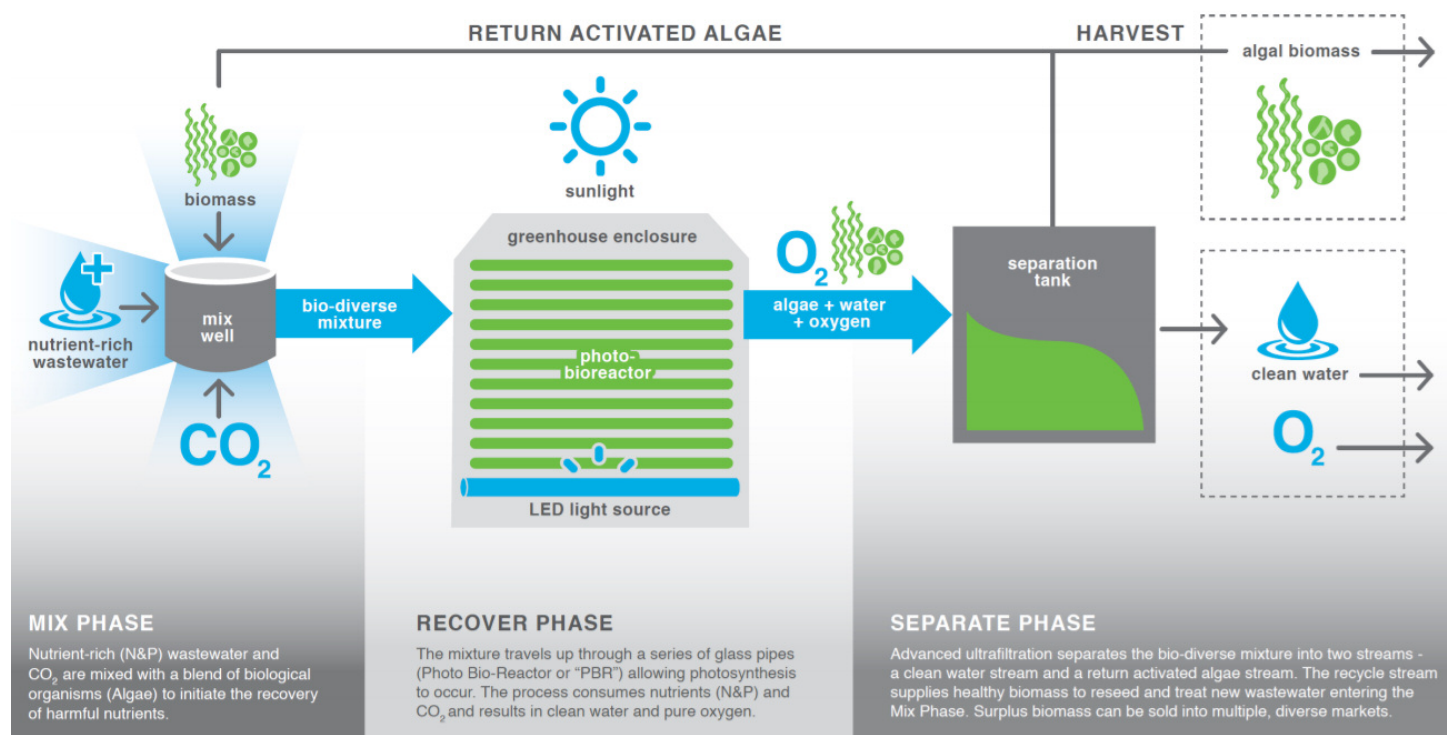


Figure 4: The ABNR Process

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In addition to the more common constituents such as phosphorus and nitrogen species, the ABNR system is the only solution in the market to recover additional constituents as well as recycle greenhouse gasses such as carbon dioxide, which are beneficially used in the process.

Because the ABNR technology relies on the biological growth activity of algae, biomass is constantly harvested to maintain optimal system performance. The asset of harvested algae is demanded in a wide range of markets, presenting facilities with the unique opportunity to recover nutrients and utilize the algae as a cost recovery mechanism. The demand for bio-based sources of supply continues to increase and CLEARAS partners with each facility to sell the algae into a variety of diversified markets.

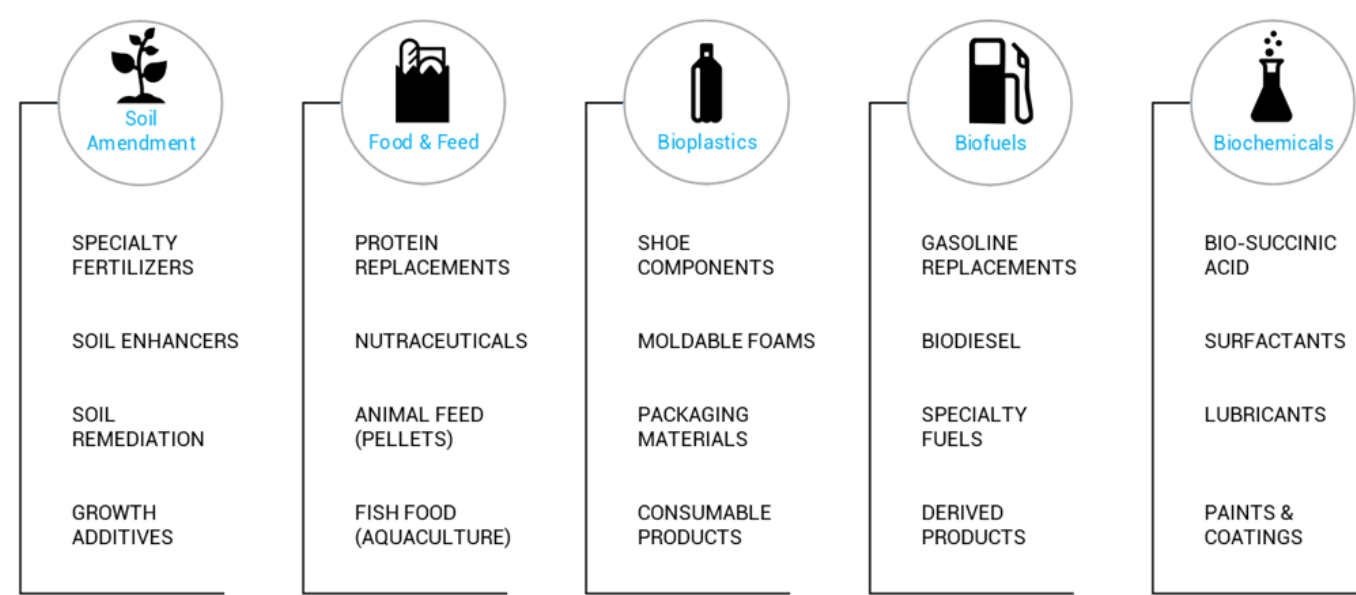


Figure 5: Algae for diversified markets

**A proven resource recovery solution**

The ABNR technology has been proven in 45+ pilots across Wisconsin, Utah, Minnesota, Illinois, Kansas and Ohio, and applicable in a broad spectrum of wastewater applications such as municipal, pulp and paper, food and beverage, and aquaculture industries.

One recent application is with the Fond du Lac Regional Wastewater Treatment and Resource Recovery Facility (FDL) that, like many wastewater facilities in North America, is faced with the challenge of identifying, selecting and implementing a nutrient recovery solution to meet tightening regulatory discharge nutrient requirements. FDL received notice from the Wisconsin Department of Natural Resources that their phosphorus discharge limit may be set at 0.04 mg/L. In response, FDL began to explore solutions to implement. After reviewing the ABNR systems’ process and advantages such as achieving low-level Total Phosphorus (TP)

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results, FDL engaged CLEARAS to conduct a continuous flow on-site nutrient recovery commercial demonstration using ABNR technology. The primary objective was to recover phosphorus from secondary effluent to levels at or below 0.04 mg/L and at the same time positively impacting other, high-priority contaminants in secondary effluent. The results of the commercial demonstration showed that the ABNR successfully achieved the targeted phosphorus requirement. Furthermore, the demonstration provided substantial data to optimize a full-scale design and costs associated with its installation at FDL.

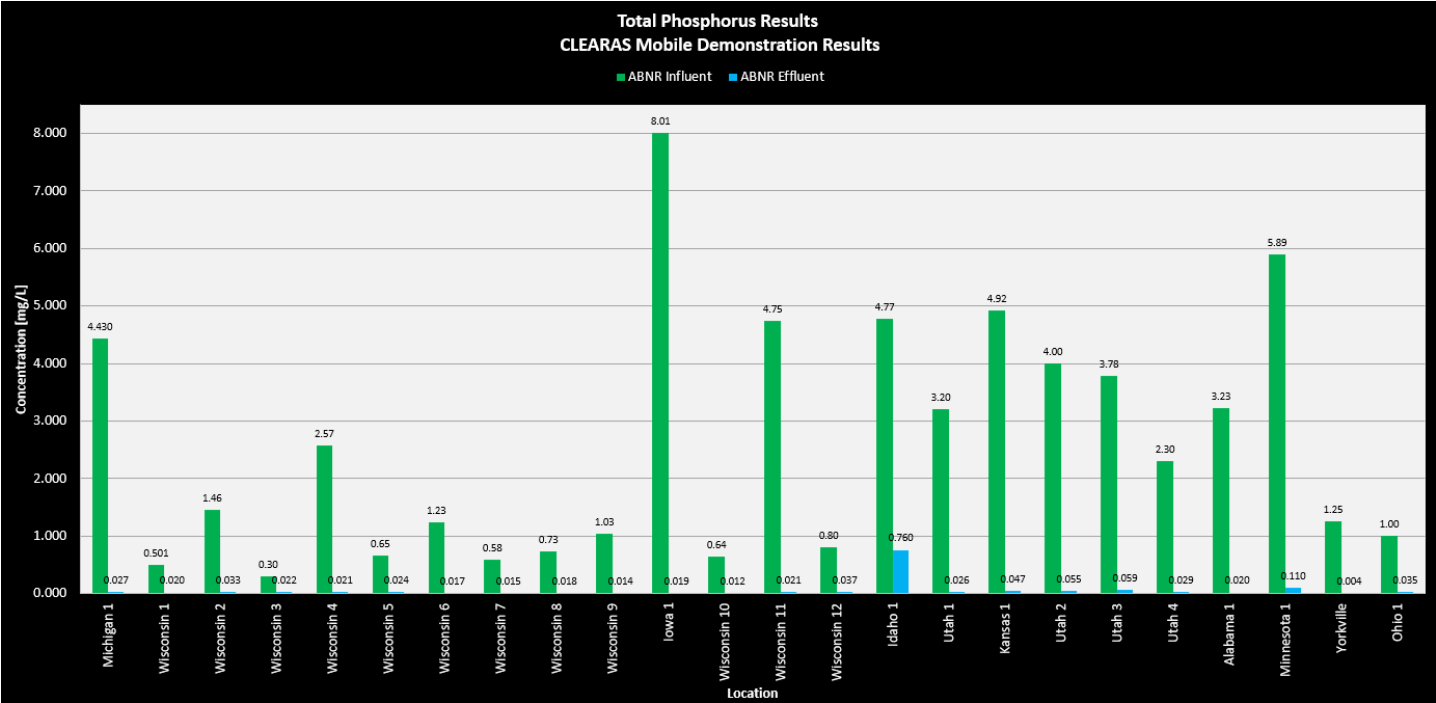


Figure 6: CLEARAS Mobile Demonstration Results

In another application, a large paper company was faced with the need to achieve an average TP discharge limit of less than 0.075 mg/L on its 3 MGD plant located on the Spokane River. In pursuit of this effort, the company evaluated traditional solutions and none were able to achieve the desired results. After looking into the ABNR system as a viable option, the company moved forward with a commercial demonstration. Once the obtained data was reviewed, it was validated that the ABNR system provided the ability to recover phosphorus with an average recovery of 85%.


Currently, the ABNR system’s full scale commercial installation is underway at the 4,000,000 gallon per day South Davis Sewer District in an effort to meet current and future nutrient discharge regulations. The system will bolt on to existing South Plant wastewater infrastructure and is part of a larger upgrade which includes the construction of a food waste to energy process, producing 2,500 decatherms of renewable natural gas.

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## Clearas Water Recovery Continued

The CLEARAS ABNR solution is the only ultra-low, multi-resource recovery technology that provides a sustainable and chemical-free option to wastewater treatment facilities for addressing nutrient discharge requirements. The proven and comprehensive approach produces high-quality effluent water and converts captured nutrients into valuable assets that maximize cost recovery for a facility. The ABNR system is modular and easily expands to meet increased flow and loading requirements to grow with a facility well into the future.

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24978 225<sup>th</sup> Street  
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