# The Great Lakes State & Algae Biofuels: Does Michigan's Water Use Regulation Scheme Allow for Fuel-Scale Algae Production?

**Colin W. Maguire, J.D.**
**The Thomas M. Cooley Law School**
**&**
**Dr. Philip Walsh, P.Geol.**
**Ted Rogers School of Management, Ryerson University**

## Introduction

We know that algae biofuel production is incredibly more efficient than using corn or soy beans.

We know that any algae production process requires a lot of water. In many cases, you need a lot of freshwater.

So, here are two really important questions:
(1) Which jurisdiction has enough freshwater; and
(2) Would that jurisdiction's statutory scheme allow enough freshwater withdrawal to produce algae at a fuel-scale?

The answer to question (1) is "Michigan."
The answer to question (2) is "it depends on what available technology you use and how you use it."

## Michigan's Scheme

In the U.S., individual states regulate water withdrawal. Michigan employs a statutory scheme to deal with water withdrawal. On February 28, 2006, Mich. Comp. Laws §§ 324.327-8 became effective. This statutory scheme is part of a larger compliance movement within the Great Lakes-St. Lawrence River Basin Agreement and Great Lakes-St. Lawrence River Basin Compact (http:// www.cglg.org/projects/water/Agreement-Compact.asp.).

Michigan's scheme is not as restrictive as many observers would like. The following shows just how much water an algae biofuel producer could withdraw and the related stated steps:

| Gallons Per Day (GPD) | Ground Water | Great Lakes Water |
|---|---|---|
| 100,000.00 | No reporting or permit | (same) |
| 100,000.01 | Must report and consider ARI from this point on | (same) |
| 250,000.01 | Special Bottling Permit needed | (same) |
| 1,499,999.99 | Up to this point, you need not report specifics of withdrawal | (same) |
| 1,500,000.00 | At this point and beyond, must report specifics | (same) |
| 2,000,000.01 | Permit required from state | No permit needed |
| 5,000,000.01 | | Permit required from state |

You can withdraw up to 5,000,000 gallons per day from the Great Lakes without a permit. For ground water, no permit is needed up to 2,000,000 gallons per day.

Withdrawal is contingent on the area where the water is withdrawn from. The state requires an Adverse Resource Impact assessment (ARI) for any withdrawal over 100,000 gallons per day.

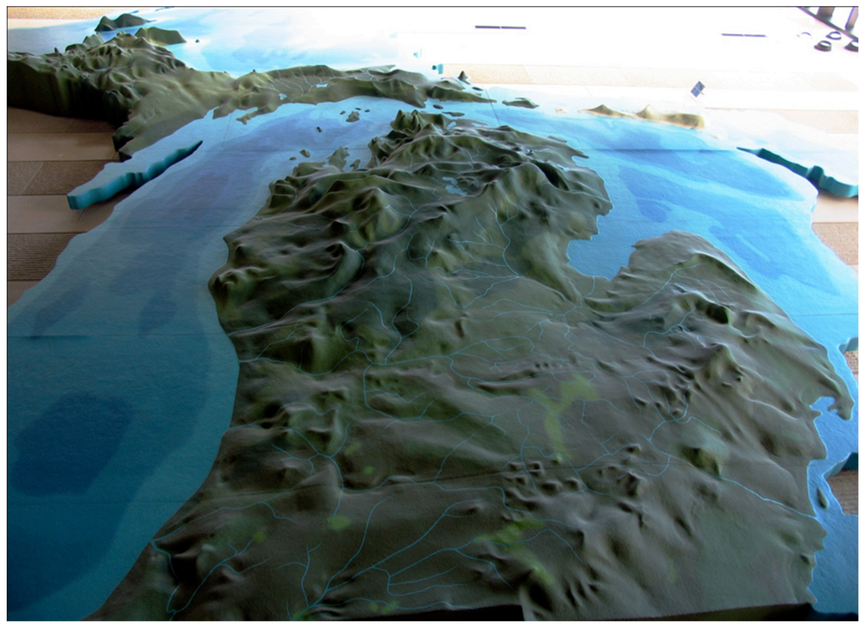
There are some important aspects of the regulatory scheme which further promote a high level of water use. First, agricultural interests tend to receive friendly treatment under the scheme. Second, the scheme does not cover treated "gray water" or other waste water previously withdrawn.

Still, you might notice that there is a special provision in the statutory scheme for water bottling. This was in response to a high-profile lawsuit in the northwest lower peninsula of Michigan known as *Michigan Citizens for Water Conservation v. Nestle Waters North America, Inc.*

In *Nestle Waters*, local citizens won a partial, but significant, victory over one of the world's largest corporations. Nestle was withdrawing significant amounts of ground water in order to sell relatively cheap bottled water.

The citizens proved that the bottling operation was causing significant reductions in stream and lake levels; limiting recreational activities.

The citizens were able to get Nestle's water withdrawal permit cut in half – lesson for future withdrawers adopted into state statute.



Source: http://greatlakesgazette.wordpress.com/2013/01/24/celebrate-michigans-statehood-on-saturday/

## Algae as a Biofuel

The U.S. government supports less-efficient fuel bases and algae through subsidies and an established Renewable Fuel Standard.

The U.S is now positioned as an energy leader through the production or petroleum and natural gas, but why stop there?

The U.S. can produce algae biofuel and establish a more sustainable model for fuel needs. The U.S. has an impressive array of water resources and infrastructure.

In the short term, algae biofuel use could allow less sustainable fuels to be exported. In the long term, algae biofuel will be established when the less sustainable resources like petroleum are gone.

Michigan has the most important resource for algae production – water.

## Pond Method of Algae Production

Aquatic biomass species grow prolifically. Using ponds to grow algae is a more traditional method utilized by companies like Sapphire Energy and Valicor Renewables.

Though non-freshwater ponds can grow some algae species, the water in Michigan is fresh water. Michigan is connected to four of the Great Lakes - which comprise as much as 20% of the world's freshwater. Plus, a series of giant aquifers run beneath the state; resulting in relatively little direct withdrawal from the Great Lakes. Yet, the pond method is ineffective in Michigan because it relies on sunlight and moderate temperatures – not Michigan's strong-suit.

Worse, this method require as a great deal of water to get to fuel scale. Just to fill the necessary ponds, you may need to withdraw as much as 32.585 billion gallons of water. Even if you have enough sunlight to produce algae consistently, evaporation would require you to refill the ponds to the tune of 58.653 billion gallons per year.

Therefore, you would need some kind of state permit to withdraw that amount of water. It also stands to reason that an ARI issue could arise with the appropriate state agencies.

Plus, you would have to use indoor ponds for any sustained period of algae growth, which would require a great deal of energy.

Such algae ponds are used by companies like Blue Lagoon Iceland, but Iceland also has impressive geothermal energy resources.

## Closed System Photobioreactors

This type of system is superior in terms of water consumption. First, a fuel-scale algae producer may need as much as 50 million gallons of water to start, but this water will be spread out over numerous systems and a long time period.

Second, the system will generally lose only 10% its water per algae extraction, or 5 million gallons per year.

This number is much more manageable in Michigan's statutory scheme. Still, you might need a permit from the state and may run into ARI issues. Plus, such a significant water withdrawal could create a *Nestle Waters* issue all over again.

This type of technology could be used in Michigan in conjunction with anaerobic digesters.

Because anaerobic digesters rely on biomass, there is an added benefit from the water consumption stand-point…the biomass may well cover the 10% of water lost.

Similarly, anaerobic digesters take a great deal of time to set up. It also takes time to develop the infrastructure for biomass collection. This means that the initial water withdrawal process will also be spread out over time.

Because of the time and infrastructure needed, this system will probably work better with local government entities. Indeed, the production of algae at fuel scale would be a collateral benefit of anaerobic digester energy production.

Still, there are practical concerns: anaerobic digesters are not very common in Michigan, and you may have to divert a significant amount of energy the process produces to power artificial lighting.

## Heterotropic Production

This is the process of growing algae in the dark by feeding it sugar. It is generally an efficient process that can produce very high yields of algae oil. Similar to other processes, it still requires a lot of water. But it also requires a feed crop of some kind like sugar cane, miscanthus, or switchgrass.

There are concerns that large-scale fuel production using crops has a negative environmental impact because it can lead to the destruction of forests or wetlands. That would not be an issue in Michigan if you were to utilize Michigan's existing sugar beet industry.

Sugar beets are difficult to grow as they are incredibly water-intensive. The Michigan Sugar Company reports that in order to create 970 million pounds of pure sugar per year, it has to remove 450 gallons of water from its sugar beets at great cost. Therefore, Michigan Sugar Company is based in the "Thumb" of Michigan's Lower Peninsula – a low level area surrounded by Lake Huron.

Companies like Solazyme are producing algae using the highly-efficient heterophic process of industrial fermentation. Solazyme claims it can achieve yields up to 80%. This would put the starting amount of water needed, as a conservative estimate, at 6.25 gallons of water to reach fuel scale. The amount of replacement water needed would be around 5 million gallons per production process. If this process were repeated monthly, you would have to replace around 60 million gallons per year.

That seems like a lot of water and is far above the numbers even contemplated in Michigan's statutory scheme. However, the sugar beets themselves, already turned into a watery pulp through the initial refining process, could provide all 60 million of those gallons.

This would require Michigan Sugar to divert 13.3% of their product to the algae production process, but the company would have already gathered the vast majority of the water it would need.

Plus, agricultural concerns tend to receive preferential treatment in the permitting process for water withdrawal. Therefore, it follows that they could receive an initial withdrawal permit for the 6.25 million gallons from nearby Lake Huron. Even if the company needed to withdraw additional water from the ground to supplement its process, it could do so.

Per Michigan's withdrawal scheme. There are limited reporting requirements for withdrawing less than 1.5 million gallons per day. Using Michigan's ARI online tool, one can see that such a withdrawal at the site of Michigan Sugar's main facility would have a negligible environmental impact.

It is also worth pointing out that a company could cooperate with a local municipality to repurpose available treated gray water in order to supplement smaller water needs.

We feel this type of approach is more appropriate for private businesses looking to see a return on investment. The process is more efficient, and the water withdrawal process is feasible in a short time in Michigan's regulatory scheme.

## Conclusion

Why wait? Why not do what we **can** do now so that we are not trying to establish this process when we **must**.

The U.S. federal government supports biofuel technology, but needs to move in a direction away from corn or soy-based ethanol. There is a broad concern that certain biofuel production will spread with disastrous consequences for water resources because biofuel processes may require lots of water. Indeed, water law as a whole may require reforms if biofuels begin to reach their potential.

Still, Michigan already has a permissive water withdrawal scheme; so much so that ARI issues may bother water users far before permitting requirements.

However, this paper has identified two conceivable methods wherein potential algae producers could sell algae biofuel on a large platform and comply with Michigan's water withdrawal statutory scheme.