

# **SITE SELECTION PLANS FOR NEW AND EXPANDING AQUACULTURE FACILITIES IN MICHIGAN**



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# Creating a Site Plan for New and Expanding Aquaculture Facilities in Michigan

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## I. OVERVIEW

### 1) PREFACE

This guide is written to help those who are thinking about starting a new aquaculture facility, or expanding an existing facility, within the state of Michigan. It is written as a general guide to help individuals create an appropriate site plan.

By working through the steps of this guidebook and creating a site plan, as outlined in this document, there are three primary objectives that can be worked towards to enhance the ability of an aquaculture facility to operate successfully.

The three primary objectives are:

- 1) Environmental Protection
- 2) Social Considerations (neighbor relations)
- 3) Economic Viability

The Food and Agricultural Organization of the United Nations defines sustainable development in aquaculture as *“Management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such sustainable development conserves (land), water, plants and (animal) genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable.”*<sup>1</sup>

It is important to note that this is a general guide and will not necessarily be the only document you utilize when siting a new facility or expanding an existing one. Two additional resources referenced throughout this document, and available online, include the Commercial Aquaculture in Michigan Siting Guidebook<sup>2</sup> and the Aquaculture in Michigan Roadmap Through Regulation<sup>3</sup>. These along with other resources and expert assistance can help you create an appropriate site plan.

This guide was written with the consultation of multiple government agencies, the Michigan Aquaculture Association, private aquaculture operations, aquaculture academic researchers and public aquaculture facilities (i.e. hatcheries).

By completing the steps in this guide and outlining a site plan as stated in Section III of this document, you will be well on your way to expanding or starting a new facility. It is also important to note a detailed business plan should accompany your site plan. Before moving forward with your new or expanding facility you should:

- 1) Site your facility and create a site plan (by completing this guide).
- 2) Create a business plan.
- 3) Consult with experts and other resources to ensure all proper permits are acquired and regulations are followed.

Please visit the [Michigan Sea Grant website \(www.michiganseagrants.org\)](http://www.michiganseagrants.org) for additional helpful materials

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<sup>1</sup> <http://www.fao.org/faoterm/en/?defaultCollId=14>

<sup>2</sup> Michigan Sea Grant Commercial Aquaculture in Michigan Siting Guide <http://www.miseagrant.umich.edu/wp-content/blogs.dir/1/files/2018/08/18-201-Commercial-Aquaculture-Siting-Guidebook.pdf>

<sup>3</sup> Aquaculture in Michigan: Roadmap Through Regulation document: <http://michiganaquaculture.org/wp-content/uploads/2012/09/20120801-AIM-Roadmap.pdf>.

## 2) INTRODUCTION:

These site selection guidelines for new and expanding aquaculture facilities are written to help determine the suitability of sites for aquaculture facilities as defined under the Michigan Aquaculture Development Act (Act 199 of 1996). Aquaculture is regulated and afforded rights of agriculture enterprises under this act<sup>4</sup>.

Michigan aquaculturists are composed mainly of small single-family farms. Most aquaculture production in Michigan consists of rainbow trout in flow-through systems. Additional farmed species in the state have included largemouth bass, yellow perch, sunfish, yellow perch, tilapia, baitfish in tanks and pond systems, and marine shrimp in recirculating aquaculture systems (RAS) and aquaponics. Because of the diversity of species approved for aquaculture production in Michigan, the diversity of topography and water sources in Michigan, and the variety of husbandry systems used, recommendations for facility siting must be general in nature. More specific management practices for a wide variety of aquatic species and husbandry system types can be found through the search engine on the North Central Regional Aquaculture Center (NCRAC) web page: <http://www.ncrac.org/>; however, modifications to the recommendations for use in other regions of the U.S. may be required for use in Michigan.

Aquaculture facilities are required to obtain an annual registration from the Michigan Department of Agriculture and Rural Development (MDARD). Rearing of fishes for the aquarium trade in closed indoor systems is exempted. People involved in production of fish for stocking public waters require a permit from the Michigan Department of Natural Resources (MDNR). Michigan's laws and permits requirements for aquaculture and baitfish industries are summarized on the North Central Regional Aquaculture Center (NCRAC) website.<sup>5</sup> Additional permits may be required for water withdrawal or diversion, building, and effluent and solid waste discharge. For additional information on permitting read the Michigan Aquaculture Association document "Aquaculture in Michigan: Roadmap Through Regulation."<sup>6</sup> Because regulations can change it is important to check with MDARD, MDNR, and Michigan Department of Environmental Quality (MDEQ) for updates or unique situations planned for your facility. MDARD has a suite of resources online that will help any aquaculturists navigate the regulatory system and provide farm planning guides.<sup>7</sup>

Early contact with state agencies will advance the identification of possible permit requirements and the application review process. The MDARD Environmental Stewardship Division and Michigan State University Extension/Michigan Sea Grant may be helpful in identifying potential sites. Site selection for new or expanding aquaculture facilities should consider potential environmental, social, and economic impacts. This in turn should help meet regulatory compliance. A qualified environmental consultant familiar with regulatory requirements may also be helpful in the site selection and design process.

To fully utilize the recommendations in this document, it is important to create a siting plan in accordance with the guidelines in Section II and III of this document. Information on the process for siting plan creation can be found in Section III of this document.

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<sup>4</sup> Michigan Aquaculture Development act:

[http://www.legislature.mi.gov/\(S\(3f5ucxpq01cqlar2yhqtv5r4\)\)/documents/mcl/pdf/mcl-Act-199-of-1996.pdf](http://www.legislature.mi.gov/(S(3f5ucxpq01cqlar2yhqtv5r4))/documents/mcl/pdf/mcl-Act-199-of-1996.pdf)

<sup>5</sup> NCRAC Regional laws and codes website: [https://www.ncrac.org/import\\_regulations/michigan](https://www.ncrac.org/import_regulations/michigan)

<sup>6</sup> Aquaculture in Michigan: Roadmap Through Regulation document: <http://michiganaquaculture.org/wp-content/uploads/2012/09/20120801-AIM-Roadmap.pdf>.

<sup>7</sup> MDARD Aquaculture in MI Overview: [http://www.michigan.gov/mdard/0,4610,7-125-48096\\_48099\\_48140-345145--,00.html](http://www.michigan.gov/mdard/0,4610,7-125-48096_48099_48140-345145--,00.html)

### 3) DEFINITIONS:

*Aquaculture* is the commercial husbandry of aquaculture species on the approved list of aquaculture species, including, but not limited to, the culturing, producing, growing, using, propagating, harvesting, transporting, importing, exporting, or marketing of aquacultural products under an appropriate permit or registration.

*Aquaculturist* means a person involved in or engaged in any aspect of aquaculture.

*Aquaponics* is a recirculating system of aquaculture in which the waste produced by farmed fish or other aquatic species supplies nutrients for plants grown hydroponically, which in turn reduces nutrient loads in the water.

*Dam* means an artificial barrier, including dikes, embankments, and appurtenant works, that impounds, diverts, or is designed to impound or divert water or a combination of water and any other liquid or material in the water; that is or will be when complete 6 feet or more in height; and that has or will have an impounding capacity at design flood elevation of 5 surface acres or more. Dam does not include a storage or processing tank or standpipe constructed of steel or concrete, a roadway embankment not designed to impound water, or a dug pond where there is no impoundment of water or waste materials containing water at levels above adjacent natural grade levels.”

*Flow-through system* means a system designed to provide a continuous water flow to waters of the United States through chambers used to produce aquatic animals. Flow-through systems typically use rearing units that are either raceways or tank systems. Rearing units referred to as raceways are typically long, rectangular chambers at or below grade, constructed of earth, concrete, plastic, or metal to which water is supplied by nearby rivers, springs or wells. Rearing units composed of tank systems use circular or rectangular tanks and are similarly supplied with water to raise aquatic animals. The term does not include net pens.

*MDARD* is the Michigan Department of Agriculture and Rural Development.

*MDEQ* is the Michigan Department of Environmental Quality.

*MDNR* is the Michigan Department of Natural Resources.

*NREPA* stands for the Natural Resources and Environmental Protection Act, 1994 PA 451.

*NPDES* is the National Pollution Discharge Elimination System.

*TMDL* is Total Maximum Daily Load.

*Recirculating aquaculture system (RAS)* means a system that filters and reuses water in which the aquatic animals are produced prior to discharge. Recirculating systems typically use tanks, biological or mechanical filtration, and mechanical support equipment to maintain high quality water to produce aquatic animals. Recirculating systems can either be full recirculating, or partial recirculating in which case there is a continuous discharge (beyond evaporation) and the addition of new water.

## II. SITING CONSIDERATIONS FOR AQUACULTURE FACILITIES

### 1) GENERAL SITING SUITABILITY CRITERIA

Aquatic animal husbandry facilities vary widely in type. Michigan aquaculture facilities employ three general types of systems: flow-through, recirculating and pond production systems. Hybridization of different types of systems may also be found. Given the vast differences between these systems, this site selection guide for new and expanding aquaculture facilities in Michigan is broken down into two sections. General Siting Suitability Criteria (Section II.1) are considerations that should apply to most proposed aquaculture facilities. System Specific Siting Suitability Criteria (Section II.2) contain recommendations specific to flow-through, pond or recirculating systems. For Section II.2 you will only need to meet the requirements for your type of system, not for all three.

#### A. Registration

All aquaculture operations in the state of Michigan must be registered with the Michigan Department of Agriculture and Rural development per Act 199, PA of 1996 Michigan Aquaculture Development. A description of the license and application can be found on the MDARD Aquaculture Webpage.<sup>4</sup> Site plans should include documentation that you have applied for an aquaculture license.

#### B. Total Maximum Daily Load (TMDL)

When a lake or stream does not meet state-defined Water Quality Standards (WQS), a study must be completed to determine the amount of a pollutant that can be put in a water body. A TMDL is a document that describes the process used to determine how much pollutant load a lake or stream can assimilate. Water bodies that have a TMDL in place may not always be suitable for siting or expanding an aquaculture facility, although in some cases they may. A TMDL can be established for a number of reasons, some of which bear no relevance to aquaculture facility discharge, such as *E. coli*, mercury, and PCBs. TMDL water bodies that are possibly relevant to aquaculture siting include those that are established due to nutrient pollution, nitrates, dissolved oxygen concerns, and in some cases sediment. A new or expanding aquaculture facility may need to make special considerations so that their discharge aligns with the TMDL document.

Maps of TMDL locations and MDEQ contact information can be found on the MDEQ TMDL website page.<sup>8</sup> Relevant TMDL locations are also mapped in the Commercial Aquaculture in Michigan Siting Guidebook, Figure 15. If the planned facility is located at a site that withdraws, discharges into or may otherwise impact a water body with a TMDL, contact with MDEQ should be documented in a site plan to demonstrate TMDL concerns are addressed.

#### C. State and Federal Special Designated Surface Waters

Specially designated surface waters include U.S.-designated National Wild and Scenic Rivers and state rivers designated in the Michigan Natural Rivers Program. In general, these water bodies will require special consideration before siting or expanding a flow-through aquaculture facility on or alongside them. Each of these designated water bodies have a specific management document, which may add additional restrictions or regulations to that water body. If a new or expanding facility is planned for one

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<sup>8</sup> MDEQ Total Maximum Daily Load Website: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_3681\\_3686\\_3728-12464-,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3681_3686_3728-12464-,00.html)

of these rivers, care should be taken to address in the site plan how the facility will be in compliance with the management plan of the designated river.

The following steps should be taken:

- 1) Determine if your sited project lies within a U.S.- designated National Wild and Scenic River<sup>9</sup> or a Michigan Natural Rivers Program<sup>10</sup> river and note this in your site plan. A general map of these water bodies is provided in the Commercial Aquaculture in Michigan Siting Guidebook, Figure 12.
- 2) If your proposed facility is to be sited within the designated protected region of one of these rivers, review the management plan for that river. Determine if your facility will be in compliance with the regulations outlined in the management plan. Note in your site plan any regulations in the management plan that are relevant to your facility and how you plan to achieve compliance. Management plans can be found at the corresponding program websites.<sup>11 12</sup>

## D. Wetlands

New and expanding aquaculture facilities cannot alter or remove a wetland as defined under the Wetland Protection Act (MCL 324.30301; NREPA, PA 451 of 1994, as amended) unless first obtaining a permit from the MDEQ. It is possible to obtain a permit to alter or remove an existing wetland, but projects seeking this permit must demonstrate that the benefits of the facility will offset the environmental degradation costs. In addition, most permits will require mitigation of the altered or removed wetland. In your site plan you should:

- 1) Utilize the Michigan Wetlands Mapping system to determine if your proposed facility will be in an existing wetland.<sup>13</sup>
- 2) If required, apply for a joint wetlands permit from MEDQ.<sup>14</sup>

## E. Floodplains

Aquaculture facilities are often placed within an area where they would be inundated with surface water during a 25-, 50-, and 100-year flood event. Special permits and considerations may be needed in these situations. The State of Michigan's Floodplain Regulatory Authority is found in Part 31 of NREPA. In your site plan you should include the following:

- 1) Determine if your site is within a state designated flood using MDEQ Flood Plain Mapping Website.<sup>15</sup> If so, provide a description or map of the flood plain in your site plan.
- 2) Documentation of your permit or permit application if required. Permit information at MDEQ.<sup>16</sup>
- 3) In addition to your permit or permit application, your site plan should include a containment plan for the species under culture in the case of a flood event. Examples may include physical barriers, emergency harvest or transfer plans and/or use of approved species in event of escape.

<sup>9</sup> US National and Wild Scenic Rivers Maps: <https://www.rivers.gov/michigan.php>

<sup>10</sup> Michigan Natural Rivers Program Maps: [https://www.michigan.gov/dnr/0,4570,7-350-79136\\_79236\\_82211---,00.html](https://www.michigan.gov/dnr/0,4570,7-350-79136_79236_82211---,00.html)

<sup>11</sup> US National and Wild Scenic River Management Plans: <https://www.rivers.gov/management-plans.php>

<sup>12</sup> Michigan Natural Rivers Management Plans: [https://www.michigan.gov/dnr/0,4570,7-350-79136\\_79236\\_82211---,00.html](https://www.michigan.gov/dnr/0,4570,7-350-79136_79236_82211---,00.html)

<sup>13</sup> Michigan Wetlands Mapping System: <http://www.mcgi.state.mi.us/wetlands/>

<sup>14</sup> Joint Permit Application: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_3687-10813--,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3687-10813--,00.html)

<sup>15</sup> MDEQ Assistance with Floodplain Mapping: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_3684\\_3725-11268--,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3725-11268--,00.html)

<sup>16</sup> MDEQ Flood Plain Permits: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_71520\\_24403---,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_71520_24403---,00.html)



## F. Source Water

Choosing an appropriate source of water will most likely have the greatest impact on the success of a new or expanding flow-through aquaculture facility. Understanding both quantity and quality of incoming water will be of vital importance when siting a facility. Water can be sourced either from ground water (from an artesian or a pumped well), a natural spring, a surface water diversion (from a natural year round river or stream), or a municipal source. Ultimately you will need to choose a water source that will provide the quantity and quality necessary for your production needs.

**Water quality notes:** When siting a water source for your facility, a site should be chosen where water is suitable for the species you want to grow, or is able to be treated to suit the species you want to grow. Water temperature and chemistry are critical factors to the success of your facility and in many cases the water can be adjusted to meet ones needs. Having an awareness of upstream land uses as well as historical land uses within the area around the new or existing aquaculture facility will be important in determining what concerns may exist. Care should be taken to never site a facility where water sourcing will come from ground or surface water that has known contaminants such as heavy metals, polychlorinated biphenyls (PCBs), dioxins, per- and polyfluoroalkyl substances (PFAS), pesticides, herbicides, or other hazardous chemicals. For ground water, sending in a water sample for testing can be a way to assure avoidance of these issues and to understand the chemical profile of your water. Municipal water sources typically have a chemical profile available through the municipal authority in charge of the water (be aware most municipal water contains chlorine which needs to be removed before adding to a system). For surface water you may need to consult multiple sources to obtain an understanding of the water. The Commercial Aquaculture in Michigan Siting Guide contains a map of contaminated water sources on Figure 16. In addition, local MDEQ offices, conservation districts, and watershed councils can have records of water quality testing for surface waters. A site plan should include general parameter and toxicity tests results of the source water.

**Water source permits:** When choosing a water source the following permits/reporting may be required:

1) Ground water withdrawal reporting is required when a large quantity withdrawal can or will take place. In Michigan large quantity withdrawals are defined as having a combined capacity of 70 or more gallons per minute (or 100,000 gallons per day). Reporting for aquaculture facilities that have this capacity is required and information on reporting can be found on the MDARD website.<sup>17</sup>

In some high volume situations, a water withdrawal permit may also be required. MDEQ's Water Withdrawal Assessment Tool<sup>18</sup> can help you determine if a water withdrawal permit is likely to be granted in your location. Permits<sup>19</sup> can be submitted through the MDEQ or MDARD; however, MDARD is often preferred for aquaculture facilities since aquaculture is an agricultural activity. Permit applications or acquired permits should be added to your site plan.

2) When construction is planned to divert water from a lake, stream, the Great Lakes, or a reservoir, a joint permit (land/water interface permit) will need to be filed.<sup>20</sup> Permit applications and acquired permits should be added to your site plan.

<sup>17</sup> MDARD Water Withdrawal Reporting: [http://www.michigan.gov/mdard/0,4610,7-125-1599\\_29980-89234--,00.html](http://www.michigan.gov/mdard/0,4610,7-125-1599_29980-89234--,00.html)

<sup>18</sup> Water Withdrawal Assessment Tool: [http://www.deq.state.mi.us/wwat/\(S\(wbspwhtwifkewuzy5etqi1n\)\)/default.aspx](http://www.deq.state.mi.us/wwat/(S(wbspwhtwifkewuzy5etqi1n))/default.aspx)

<sup>19</sup> Water Withdrawal Permit Applications: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_3684\\_45331---,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3684_45331---,00.html)

<sup>20</sup> MDEQ Joint Permit Application: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_71520\\_24403---,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_71520_24403---,00.html)

3) If you are withdrawing from a municipal source, it is important to consult the managing agency of the municipal drinking water to ensure the municipal source can handle your withdrawal. Site plan should include documented approval from the municipal source for your planned withdrawal.

**Source water summary:** A site plan for a new or existing aquaculture facility should include:

- 1) The source of water for the facility.
- 2) Chemical and physical parameters of that water (example: pH, nitrogen, phosphorus, dissolved oxygen, dissolved nitrogen gas, temperature).
- 3) Estimated daily/annual water input (daily for RAS and flow-through, annual for ponds).
- 4) Total water holding capacity of facility.
- 5) Diagram of water flow throughout the facility.
- 6) Documentation of water withdrawal permits, surface water diversion permits, or municipal water withdrawal consultation, when applicable.

## G. Topography and Soil

Topography and soil considerations can vary substantially across the types of aquaculture systems utilized. Because gravity feed can be an important production factor in economic viability for some types of facilities, a topographical review is recommended. This can be demonstrated by including a topographic map in the site plan.<sup>21</sup>

Appropriate soil can be an important consideration for aquaculture holding structures. Site plans should include a soil map, or indicate why soil types are not important in facility construction. Various soil composition maps can be found on the USDA Web Soil Survey Website.<sup>22</sup>

For all system types, water table depths can cause significant challenges or opportunities. The depth of the water table can significantly alter the cost of construction in a facility. Understanding your water table depth is a recommended item for your site plan.

## H. Effluent and Solid Waste Management

Effluent and solid waste management is an important consideration when siting a facility. Various types of systems will require a variety of treatment methods. Site plans should include any waste storage or processing structures or features. Examples of waste treatment features include assimilation of nutrients by natural organisms within the water body being discharged for smaller facilities, or capture and removal of solids by treatment ponds or wetlands for larger facilities.

Siting considerations for effluent treatment options must also coincide with the National Pollutant Discharge Elimination System (NPDES).<sup>23</sup> NPDES permits are typically required for facilities discharging 30+ days per year and producing 20,000 lbs. or more of cold water fish species or 100,000 lbs. or more of warm water fish species. These are general guidelines for NPDES permits, and in some cases an

<sup>21</sup> Michigan Topographic Maps: [https://www.michigan.gov/cgi/0,4548,7-158-52927\\_53037\\_12540\\_13085-31264--00.html](https://www.michigan.gov/cgi/0,4548,7-158-52927_53037_12540_13085-31264--00.html)

<sup>22</sup> USDA Web Soil Service website: <https://websoilsurvey.nrcs.usda.gov/app/>

<sup>23</sup> NPDES Permits [http://www.michigan.gov/deq/0,4561,7-135-3313\\_71618\\_3682\\_3713---00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_71618_3682_3713---00.html)

NPDES permit can be required for smaller facilities.

Aquaculture facilities may also require a ground water discharge permit depending on waste management plan and treatment systems of the facility. These are most often on a case-by-case requirement. For example, a flow-through system discharge is typically very diluted in terms of nutrient concentration, whereas RAS discharge may be exceptionally high in nitrates.

Consult with the MDEQ online resources and local MDEQ agent<sup>24</sup> to determine if you will need to obtain a waste discharge permit. Permits or permit applications should be included in your site plan.

For some facilities a municipal wastewater system may be an appropriate source for discharge of effluent. It is important to contact the managing agency and document approval if your facility plans to discharge into a municipal source in your site plan.

Ultimately it is important to think about how your site will lend itself to liquid and solid waste removal and disposal. There are a large variety of best management practices that can be implemented to reduce nutrient pollution from a facility and the economic and environmental constraints of your site will help determine which are best to use.

### 3) SYSTEM SPECIFIC SUITABILITY CRITERIA

#### A. Flow-through Aquaculture Facilities

A flow-through system provides continuous water flow into, and out of, fish-rearing units, typically of raceway, tank or earthen pond design. These types of systems most often incorporate a high volume of flow to take advantage of efficient economic utilization of water, and are the preferred system used by existing trout producers in Michigan. Ideally, flow-through systems would be located to utilize spring, artesian flow, or surface water sources such as a river or stream.

**Topography and soil characteristics:** Flow-through sites are often located where topography allows for gravity-fed reuse of source water into one or more rearing units. This greatly reduces pumping costs and allows for passive aeration between rearing units. Flow-through sites can exist on a wide variety of topographic conditions but it is important to consider topographic and soil conditions when siting your facility. It is also important to not build earthen raceways out of known contaminated soils. A list of known contaminated sites can be found using the MDEQ Environmental mapper.<sup>25</sup>

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<sup>24</sup> Groundwater discharge permits information: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_4117-9782--,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_4117-9782--,00.html)

<sup>25</sup> MDEQ Environmental Mapper contaminated sites: <http://www.mcgi.state.mi.us/environmentalmapper/>

## B. POND AQUACULTURE FACILITIES

Pond culture is typically considered the rearing of fish in ponds in which water is added only at a rate to keep the pond full (to make up of loss of water via evaporation or seepage). In many cases ponds will be drained and refilled on an annual or intermittent basis to assist with harvest or pond maintenance. In some cases, a continual (as in flow-through systems), or intermittent, addition of water to a pond system is utilized to help control temperature or water chemistry.

For this document pond culture can be placed in three categories based on discharge. There are ponds with no discharge, intermittent discharge, and continuous discharge. For ponds with continuous discharge, refer to section above (Section II.2.A) on flow-through facilities.

**Topography and soil characteristics:** Topography and property boundaries typically are major factors in determining what types of ponds will be built at a particular site.

Site topography should allow construction of ponds and any required treatment facilities. Typically, ponds are constructed in low gradient landscapes with average slopes <5%. Construction of facilities and access roads should not alter natural water flows needed to maintain surrounding habitats.

Soils should be suitable for pond construction, permit compaction, provide stable levees, resist erosion, and provide low hydraulic conductivity. Ponds should be constructed with soils having a sufficient range of particle sizes to prevent seepage and construct stable embankments. Ponds constructed on sites with proper soils will reduce environmental impacts by isolating pond water from underground water supplies and reducing erosion of levee slopes. Ponds can be sealed by replacement with clay, although such measures can be expensive. For non-impervious soil, plastic liners can be used instead of clay to prevent seepage.

Ponds should not be constructed in sites with contaminated soils. Soils previously exposed to certain agricultural, industrial, or urban activities may be contaminated with chemicals that may affect the health of the cultured species or accumulate in tissues affecting product quality or safety. A list of known contaminated sites can be found using the MDEQ Environmental mapper.<sup>26</sup>

## C. RECIRCULATING AQUACULTURE FACILITIES

Recirculating aquaculture systems (RAS) incorporate mechanical and biological filtration to reuse water on a continual basis for aquatic animal production. For the purpose of this site plan guide, an aquaponics system -- one that raises fish and plants together in the same system -- is considered a RAS. However, it is important to note that RAS systems and aquaponics systems have very different systems designs, operations, business models and maintenance. Because RAS typically employs high pumping rates and filtering systems to reduce nutrient loads, they can generally be placed in most locations that have access to an adequate power source. A disadvantage to RAS is facility construction costs and operational costs can be 2-3 times greater than flow-through or pond production systems. It is also important to note that a large amount of expertise is required for RAS systems to maintain the delicate water quality balance that must be achieved when reusing and circulating water. In addition, aquaponics systems require even more extensive knowledge of hydroponics, plant growth and greenhouse or light production management. From an economic basis, siting plans should closely consider means to reduce construction and operational costs as well as the level of expertise required for RAS and aquaponics.

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<sup>26</sup> MI Environmental Mapper Contaminated sites: <http://www.mcgi.state.mi.us/environmentalmapper/>

**Urban areas**

Given the high amount of control in a RAS facility, urban areas often present potential suitable options for siting a RAS facility. However, local ordinances may not allow agricultural uses in urban zones. A site plan should document approval from local municipalities in accordance with local zoning.

**Topography and soil characteristics**

In general topography and soils are not a major consideration when siting a RAS facility. Water table depth should be considered to avoid floating empty tanks in saturated conditions. Do not place a storage tank below the local water table level.

**Siting considerations for effluent and solid waste management**

In general, RAS facilities discharge much less effluent in terms of volume per unit production than flow-through systems, but at times it can contain much higher concentrations of various nutrients. There may be times during harvest or during an event where nutrient concentrations exceed critical levels for fish tolerance, where a major water exchange is required. Your site plan should include where you would discharge in the case that 50% or more of your water would need to be discharged.

Site plans should also include any waste storage or processing structures or features. Examples for RAS facilities typically include features such as large filters or tanks designed for waste solids collection or breakdown.

### III. AQUACULTURE FACILITY SITE REVIEW PROCESS

#### 1) AQUACULTURE SITE PLAN OUTLINE

A site plan is a helpful comprehensive layout for an aquaculture facility, and should include the following:

- A site map, or maps, including the following features:
  - Property lines, easements, rights-of-way, and any deed restrictions.
  - Positions of buildings, wells, septic systems, culverts, drains and waterways, walls, fences, roads, outdoor raceways, outdoor ponds, outdoor tanks, and other paved areas.
  - Position and size of any waste storage or processing structures or features.
  - Location, type, and size/capacity of existing utilities.
  - Location of wetlands, streams, and other bodies of water.
  - General water flow diagram including water flow directions, water inflow and water outflow locations. Include where your water will go when it leaves your facility.
  - General layout of where fish production will occur on the facility.
- Additional maps for surrounding areas
  - A soils map of the area where aquaculture facilities are to be located.
  - A topographic map of site and surrounding area.
  - Existing land uses for contiguous land (a map, or list, of what directly adjacent land is used for such as residential, industrial, agricultural, etc.)
  - Names and contact information of adjacent property owners.
- General questions about your facility
  - What type of aquaculture system are you using (flow-through, pond, RAS)?
  - What is your source of water?
  - What are the results of your chemical analysis of your water?
  - What is the total water holding capacity of your rearing systems?
  - For flow-through and recirculating systems what is your expected daily source water addition?
  - For pond facilities what is your expected annual source water addition?
  - What species do you plan to culture?
  - What is the maximum pounds of aquatic organisms you plan to culture within your system at one time?
  - If you have a RAS facility, and needed to discharge 50% or more of your water, what would be your discharge plan?
  - Do you plan to withdraw or discharge into a municipal waste water system? If yes, attach documentation of contact and approval from the municipality (letter or email).
  - Are you applying for an NPDES permit?
  - Will your facility discharge into a TMDL water body? If yes, please attach documents confirming you have addressed any potential concerns with MDEQ (email or letter).
  - Is your proposed facility in a wetland?
  - Are you applying for a wetland permit? If yes, attach permit.
  - Are you within a 100-year flood plain? If yes, what is your containment plan in case of a flood event?
  - Are you applying for a flood plain permit? If yes, attach permit.
  - Are you applying for groundwater discharge permit? If yes, attach permit.
  - Are you applying for a wellhead protection permit? If yes, attach permit.
  - Are you applying for an aquaculture facility permit? If yes, attach permit.

## 2) AQUACULTURE SITE PLAN SAMPLE FORMS

**Blank Form** (Sample Form that is filled out is available upon request: send requests to [elliottne@msu.edu](mailto:elliottne@msu.edu) or contact MI Sea Grant at [michiganseagrant.org](http://michiganseagrant.org))

### Part 1: Maps

- 1) **Site Map:** Insert below, or staple to back of form
  
- 2) **Soil map of property:** Insert below, or staple to back of form
  
- 3) **Topographic map of property and surrounding area:** Insert below, or staple to back of form
  
- 4) **Existing use for contiguous lands:** Insert below, or staple to back of form
  
- 5) **Names and contact information of adjacent property owners:** Insert below, or include in previous map

**Part 2: Site Information**

- 1) What type of aquaculture system are you using (flow-through, pond, RAS)?
- 2) What is your source of water?
- 3) What are the results of your chemical analysis of your water?
- 4) What is the total water holding capacity of your rearing systems (gallons)?
- 5) For flow-through and recirculating systems what is your expected daily source water addition (gallons per day)?
- 6) For pond facilities what is your expected annual source water addition?
- 7) What species do you plan to culture?
- 8) What is the maximum pounds of aquatic organisms you plan to culture within your system at one time?
- 9) If you have a RAS facility, and needed to discharge 50% or more of your water, what would be your discharge plan?
- 10) Do you plan to withdraw or discharge into a municipal waste water system? If yes, attach documentation of contact and approval from the municipality (letter or email).
- 11) Are you applying for an NPDES permit?
- 12) Will your facility discharge into a TMDL water body? If yes, please attach documents confirming you have addressed any potential concerns with MDEQ (email or letter).
- 13) Is your proposed facility in a wetland?
- 14) Are you applying for a wetland permit? If yes, attach permit.
- 15) Are you within a 100-year flood plain? If yes, what is your containment plan in case of a flood event?
- 16) Are you applying for a flood plain permit? If yes, attach permit.
- 17) Are you applying for groundwater discharge permit? If yes, attach permit.
- 18) Are you applying for a wellhead protection permit? If yes, attach permit.
- 19) Are you applying for an aquaculture facility permit? If yes, attach permit.