

Potential Research & Development Activity

While the comparative assessment indicates that similar areas of a similar scale and a tourism based economy are not likely to have significant traditional industrial or Research & Development activity, there are areas with a strong visitor base that do have such activity and the Research & Development component is growing. In all cases, the research is based on the area's water and land natural resources.

Areas with such activity include some of the best known vacation spots in the country, including the Outer Banks of North Carolina and the Keys in Florida. Generally, areas are situated along the waterfront and the research is often related to both water and nearby land activity. It is noted that the two aforementioned areas have not been afforded the transportation network benefits of Mackinaw City.

Resources

Mackinaw City has numerous resources upon which to build an economic structure beyond that which exist today. These resources include, but are not necessarily limited to:

- **Abundance and Variety of Natural Resources.** From a range of water bodies and water related resources that include, the Great Lakes, rivers, lakes and wetlands; to environments associated with forests; and to quality air and wind, the Mackinaw Village area has abundance of varied animal, fish, fowl, and wood species upon which to pursue research in a manner that preserves or enhances the natural resources, essential for maintaining and enhancing Mackinaw City's tourism and quality of life.
- **A Quality Transportation Network.** Included in the network is:
 - ✓ The interstate highway system that links the community to areas to the south;
 - ✓ A regional airport that has regular scheduled airline service, significant runway length and capacity, and modern recently expanded facilities;
 - ✓ Quality state road network to the east, west, and north;
 - ✓ Direct access to Canada; and
 - ✓ Ferry linkages to the island and potentially other locations.
- **Position in the Emerging Energy Technology Arena.** The Village is home to some of the first modern era wind turbines to be constructed in the Midwest. Also, Michigan's primary gas and electric producing energy companies have been in the forefront of stationary, on-site energy production development utilizing fuel cells and other environmentally sensitive technology.

- **Controlled Acreage.** The Village owns acreage that can be appropriately utilized for light industrial activity, including research and development. Thus, initial acquisition of additional acreage is not likely to be necessary to establish a base.
- **Proximity to Financial Resources and Existing Research Entities and Activity.** The development and maturation of a second home market, particularly in the area to the west of Mackinaw City, has resulted in an influx of affluence associated with corporate America. This resource along with several Michigan based higher education institutions represent a quality base upon which Research and Development could be anchored.
- **Quality of Life.** Quality of life is the one element most commonly sought in company and related entities location decisions.

Methodology

A significant research oriented process was involved in identifying Research and Development opportunities for Mackinaw City. The activity included:

- ✓ Identification of natural resources in the area upon which activity could focus.
- ✓ Identification of appropriate broad areas associated with emerging technology or activities.
- ✓ Identification of specific, detailed existing research activity.
- ✓ Identification of companies, universities and non-profit groups involved with the Research & Development activity in the broad and specific areas.

It is noted that because research is underway using a specific animal, bird, plant, etc. does not mean that there are not other opportunities associated with the same species or another in the area. It also does not mean that other areas of research cannot and should not be opened.

Broad Areas of R & D Activity

There are six appropriate broad areas of Research and Development identified that represent opportunities for Mackinaw City. These are:

1. **Invasive Species.** Most likely to involve research and continued research than both research and development of products. It is noted that invasive species are a continual and growing problem both upon the land and waterway. Increased international trade is likely to facilitate increasing numbers of species that damage the existing environments in areas.
2. **Natural Resources.** Most likely to involve research into their use for bio-medicine, other related human and animal health activity, and new product development.
3. **Biomass.** Most likely involves product development opportunities but also includes research. The product development opportunities often are associated with environmental enhancement or mitigation of current conditions, including lessening of dependence on oil and related products.

4. PCB and Other clean-up. Most likely to involve business development activity based on previously conducted research.
5. Animal cognition. Most likely to involve new and continued research and not product development for assistance with hear and human disease using assorted species that have shown promise in assisting with Dementia, Alzheimer's, hearing disorder and the military.
6. Other Alternative Energy. Most likely to involve both product testing (pilot projects) and research associated with the activity. Also has the potential to create administrative office related activity in the Village.

Invasive Species

There are numerous invasive species in the area upon which research is currently being conducted and still others are yet to be defined and researched. Just some examples of invasive species currently being studied for eradications or mitigation/control of their impact include:

- Purple loosestrife. (Its thick growth above and below water has displaced many native plants and animals. Nesting places, open swimming areas, and food sources have been visibly reduced in many streams and ponds.)
- Sea lampreys. (St. Mary's River remains the major contributor of sea lamprey infestation to northern Lake Huron where parasitic lamprey account for an annual mortality of many if not the majority of adult lake trout.)
- Zebra and quagga mussels. (Overtaking indigenous species. Some potential benefit to water clarity, but also many costs requiring control if not eradication.)
- Greenside darter. (Research into DNA markings underway to differentiate species.)
- Emerald Ash Borer. The borer is known to affect white, black and green ash trees and some varieties of horticultural ash. Emerald Ash Borer infestations are fatal. Ash trees begin to die within 3-5 years of infestation.

Natural Resources

There is substantial work done on many of the natural resources found in the Mackinaw City area. Purposes of the research include: elimination of disease in plant and animal species; genetic manipulation and cross-breeding of species to produce species less prone to certain diseases; tracking relationships between diseases in cows and other animals that can be transmitted to humans and those transmitted among deer (Bovine TB for example); and generating new energy from non-oil and natural gas sources. Included among many areas of research is research into:

- Bovine TB in deer. Found in white-tailed deer, elk, black bear, bobcat, coyote, opossum, raccoon and red fox
- Transgenics. Transgenic technologies are used for improving milk production and the meat in farm animals as well as for creating models of human diseases and enhancing the ability of vegetation to fight diseases that decimate populations. South Korean scientists have developed a technology which they claim will open the door to the mass production of biomedical materials, including a cancer-fighting enzyme, in a couple of years.

Environmental Clean-up

There are many man made contaminants that have impacted and will continue to impact the environment. Increasing concern is for areas that emerging from the development perspective situated along water bodies. Research in the area continues to be substantial with funding available through government and private corporate interests. One area of concern remains:

- PCB Contaminates. The St. Mary's River is a 112 km connecting channel between Lakes Superior and Huron. The Area of Concern extends from the head of the river at Whitefish Bay (Point Iroquois - Gros Cap), downstream through the St. Joseph Channel to Humburg Point on the Ontario side, and to the straits of Detour on the Michigan side.

A second example is:

- Fish Tumors and other deformities or reproductive problems. The prevalence of hepatic neoplasms in excess of 5% should be interpreted as an indicator of environmental degradation. White suckers sampled from the St. Mary's River (1985-1990) exhibited tumor prevalence in excess of 9% (n=185). It is likely that hepatic cancers are associated with exposure to chemical contaminants, such as PAHs in contaminated sediments. Liver cancers have also been identified in brown bullheads from Munuscong Bay.

Biomass

Alternative energy could be a major focus for Mackinaw City for a variety of reasons. Mackinaw has already moved in the direction by facilitating wind turbines in the area. Many other opportunities exist. One of the major opportunities, because of the location having an abundance of natural "raw materials", is that associated with bio-mass and related bio-fuels. The Mackinaw City opportunities for research and product development include but are not limited to:

- Recycled wood waste. Pellet fuel is a renewable, clean-burning and cost stable home heating alternative currently used throughout North America.
- Virgin forest biomass. It is estimated that 190 million acres of federal forests and rangelands face very high catastrophic risks of fire and that this program can play a major role in minimizing these hazards while simultaneously improving the growth and harvesting of woody biomass.

- Forest Floor Collective Biomass. The effects of partial and clear-cut harvesting on forest floor physical, chemical, and biological properties, forest floor mesofauna, and nutrient cycling were investigated in conifer- and deciduous-dominated stands (of Alberta's) mixed wood boreal forest.
- Bio-Fuels, including switchgrass and blue-green algae of the Great Lakes. Pelletized switchgrass is being used in pellet stoves for general home heating in some rural areas, and has great potential as a clean-burning alternative to coal or imported fossil fuels. Organic materials such as grasses, weeds and other quick-growing plants can be converted into electricity or clean-burning fuels in an environmentally-friendly and sustainable way. The more efficient a particular plant is at converting that solar energy into chemical energy, the better it is from a bio-fuels perspective. Among the most photosynthetically efficient plants are various types of algae.

Animal Cognition & Hearing

Studies of animal cognition have provided a comparative and ecological perspective on issues of the mind and intelligence. Other studies have shown how sensory functions and levels of cognition can depend critically on early experience. Through research with animals, the scientific community has learned about adaptation to change, including evolution, development, and all types of learning. The research has identified important connections between stress and disease and has suggested psychological interventions for coping with stress more effectively. The importance of this activity is growing as population dynamics in this country undergoes changes resulting in increasing numbers of people with Dementia and Alzheimer's. The military is also extremely interested in research in this arena. Recent research includes topics such as:

- Numerical competence in squirrel monkeys.
- Sun compass orientation in food storing birds.
- Effects of early learning on adult mate choice.
- Spatial orientation in pigeons.
- Predator recognition in birds.
- Timing in bumblebees.
- Photoperiodic control of bird behavior.
- Episodic memory in rats.

Some of the entities upon which research has focused or is now focused include:

- Blue jays. Jays demonstrate cache and cache recovery behavior. More than two decades ago, they saw the potential in the fact that seed-caching birds are self-motivated to return to inconspicuous points in the landscape to retrieve hidden food, and they began to employ the cache-recovery paradigm as a model system for studying learning, memory, and "spatial information processing". This has led to enormous advances in the understanding of spatial learning in birds.
- Bats. Echolocation is a sense with which humans have difficulty understanding. An animal echolocates by sending out pulses of sound and listening to the echoes that return. The echoes contain clues to what is out there in the environment. Research into echolocation has already yielded practical benefits. For example, sonar is a primitive form of echolocation.

- Chickadees. The tiny bird can alert its flock to how dangerous a predator is by upping the length of its calls. The diminutive black-capped chickadee sings one of the animal kingdom's most intricate alarm calls, a new study reveals.
- Sparrows. Sparrows can piece together a complete song by only hearing parts of it. The findings could help researchers establish how memory works in humans.
- Squirrels. Ground squirrels emit an ultrasound squeal to warn other animals that a predator is approaching. Bats and toothed whales are already known to use ultrasound for echolocation, but little is known about ultrasound communication in the rest of the animal kingdom. Some rodents, including rats and hamsters, emit ultrasound calls, but it is not sure what they mean.
- Butterflies. Butterflies may seem to be silent, but new research reveals that many species of these insects actively communicate with one another using a "Morse Code" type of clicks.
- Zebrafish. May hold key to understanding human nerve cell development. (While not indigenous to the area, could be studied anywhere.)
- Plainfin Midshipman Fish. Researchers have found that a humming fish has evolved a way to avoid deafening itself with its own noise. They say the same mechanism could be at work in other animals, including humans, helping to tone down the senses and avoid overpowering them with self-generated signals.

Other Alternative Energy Possibilities

As previously defined, a potential strong area upon which Mackinaw City can focus is alternative energy. In addition to the biomass and bio-fuel noted, there are other potential areas including:

- Wind. Wind is a renewable resource, unlike fossil fuels. Mackinaw City has already installed two wind turbines for production of energy, thus embracing this alternative energy form.
- Fuel cells. Fuels cells, fueled by a variety of products is, much like wind power, an old technology that is being re-evaluated and explored as a clean, reliable on-site energy technology. The primary utility companies in Michigan have been associated with some of the premier stationary fuel cell development activity in the entire country.

Interests & Sponsorships

The following is a partial list of entities that are involved with research & Development in areas and activities identified as opportunities for Mackinaw City. It is noted that they include:

- ✓ Some of the largest corporate entities in the world.
- ✓ Small start-up operations that may not survive if the research is not successful, could be bought out by another or larger entity, or may merge with another entity in the foreseeable future.
- ✓ Universities operating elsewhere in the country or internationally.
- ✓ Non-profit associations and consortiums.

Further and detailed information on the research activity and these entities are found in the appendix to this document.

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| ▲ A&L Agricultural Laboratories, Inc. | ▲ BASF |
| ▲ American Tank & Equipment, Inc. | ▲ Dow |
| ▲ Banko Manufacturing Company | ▲ DuPont |
| ▲ Bill Hunt Company | ▲ Eli Lilly |
| ▲ Greenleaf Technologies | ▲ GlaxoSmithKline |
| ▲ John Blue Company | ▲ IBM |
| ▲ Kennco Manufacturing. | ▲ The NOAA Great Lakes Environmental Research Laboratory (GLERL) |
| ▲ KZCO, Inc. | ▲ Biomass Energy Research Association |
| ▲ Clariant International (Germany) | ▲ Dell-Point Inc. |
| ▲ H & S Chemical | ▲ Harman Stoves Work |
| ▲ Bayer | ▲ Aladdin Industries |
| ▲ Sherwin | ▲ Rose Lake Plant Materials Center |
| ▲ Great lakes Genetic Laboratory | ▲ The Office of Fuels Development (D of E) |
| ▲ US Department of Agriculture (USDA) | ▲ Changing World Technologies |
| ▲ The Foundation for Research, Science and Technology (FRST) | ▲ TranXenoGen |
| ▲ ImmunoVaccine Technologies | ▲ University of Nebraska |
| ▲ Cooperative Aquatic Animal Health Research Program of LSU | ▲ The Animal Cognition Research Group at the University of Western Ontario |
| ▲ Centre for Environment, Fisheries & Aquaculture Science (Cefas) | ▲ The Organization for Bat Conservation |
| ▲ Polyflon Company | ▲ University of Utah |
| ▲ Canano Technologies (Canada) | |