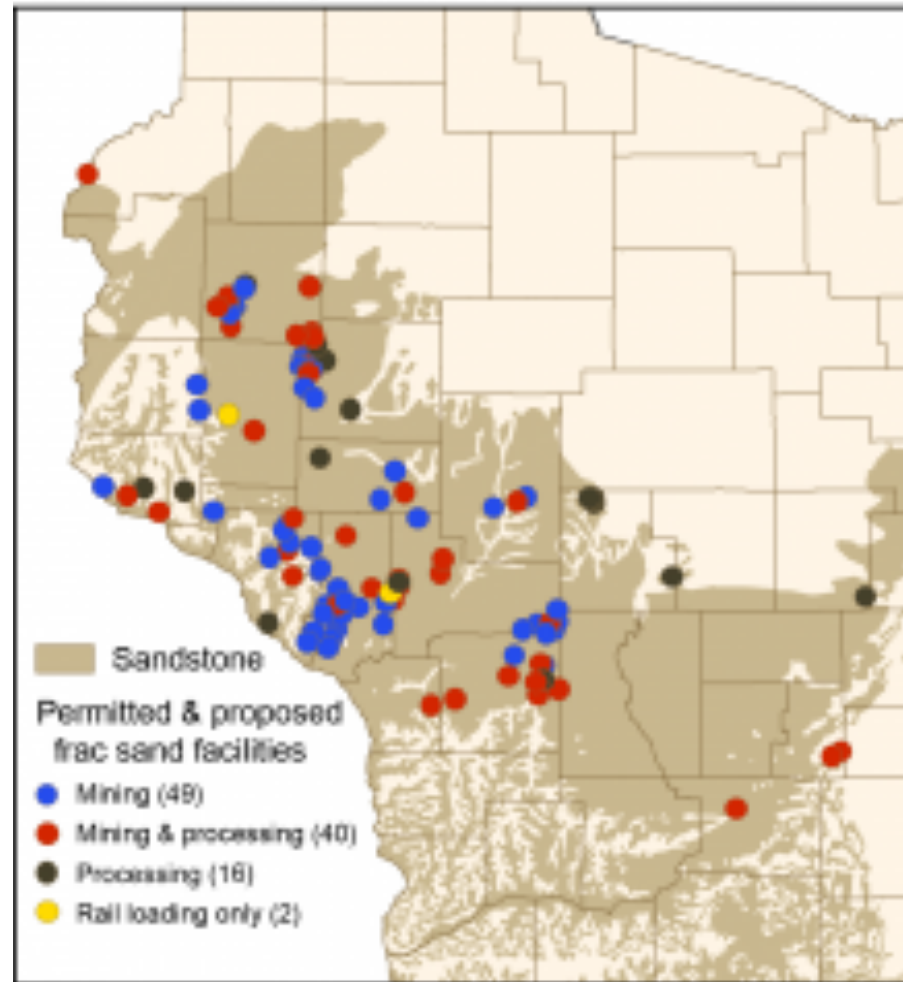


# Economic History

- Main costs of sand (in general, proppants) for hydraulic fracturing:
  - Cost of land
  - (Cost of materials for treated sand, or for manufactured proppants)
  - Cost of production
  - Transport to wellhead
- Typical prices paid by drillers, 2014:
  - \$70/ton FOB for sand
  - Up to \$170/ton for transportation

# Economic History

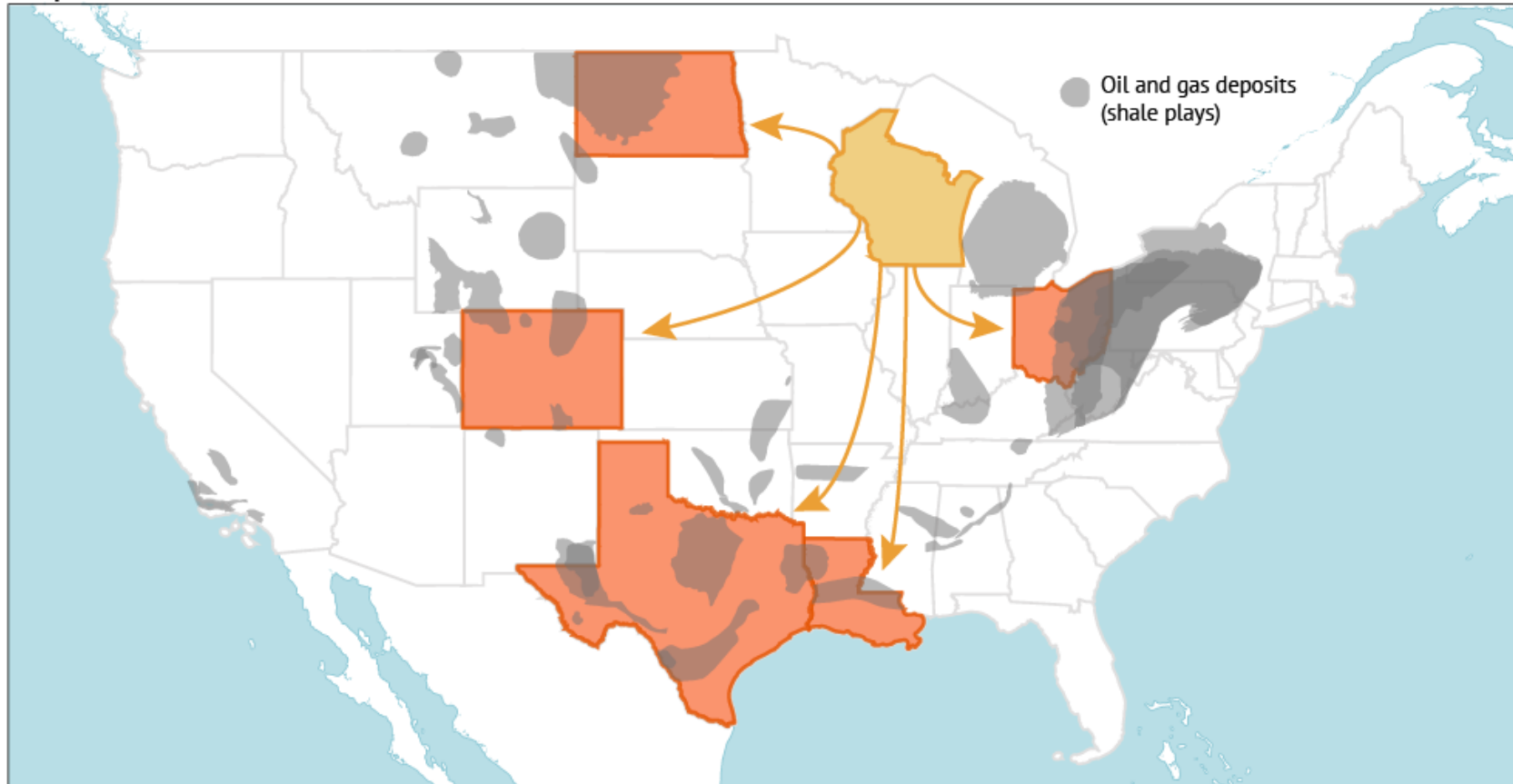
**Frac Sand Mining and Processing Facilities  
in Wisconsin, July 2012**



Credit: Kate Proganman, Wisconsin Center for Investigative Journalism  
Source: Sandstone, U.S. Geological Survey; Mine Sites, WCIJ reporting

# Economic History

Top U.S. destinations for Wisconsin frac sand



Source: Destinations, National Center for Freight & Infrastructure; shale, U.S. Energy Information Administration.  
Credit: Reporting, Taylor Chase, Wisconsin Center for Investigative Journalism. Map: Kate Golden.

# Economic History

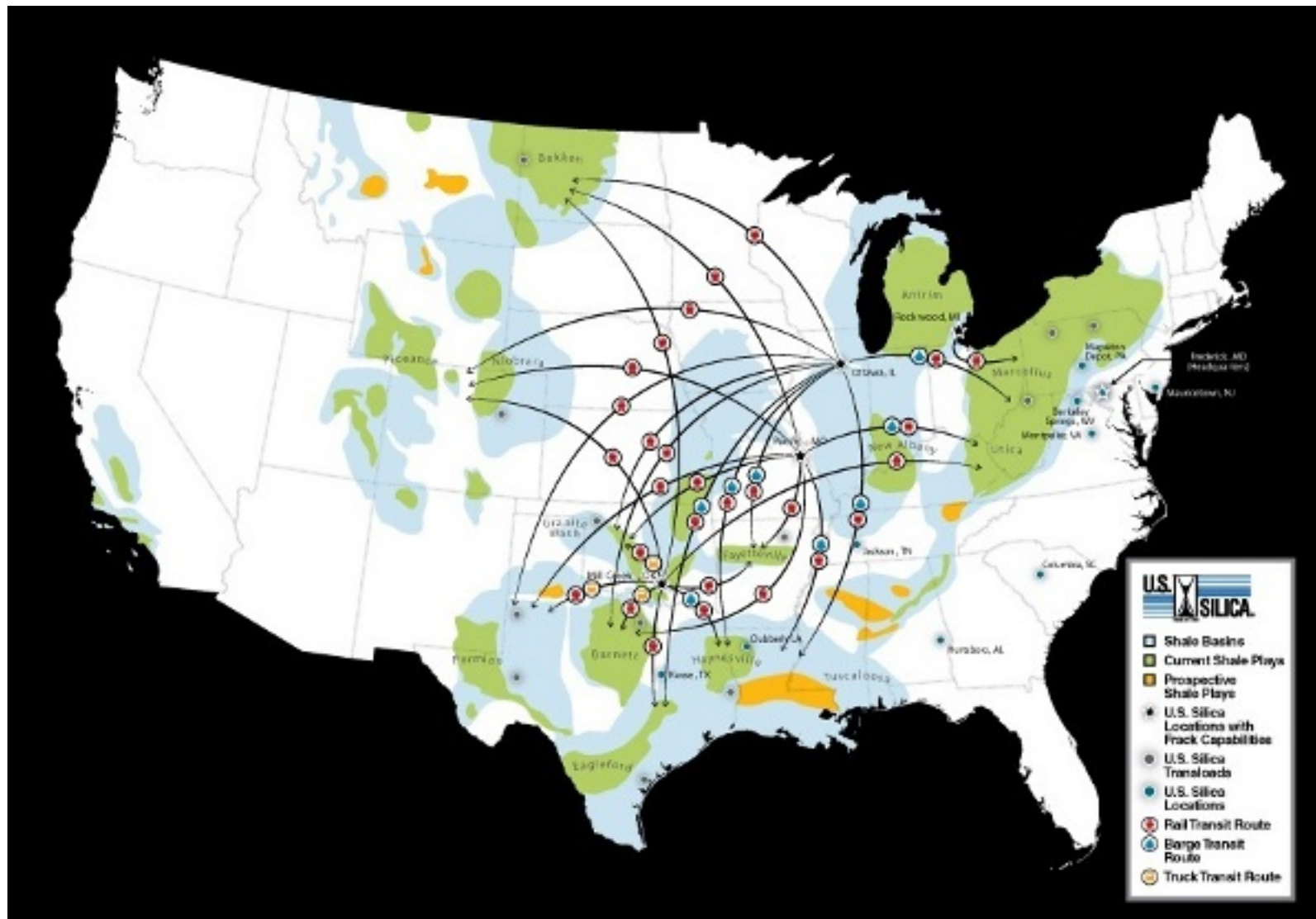


## US Silica

- Publicly-traded company
- Major US silica supplier
- Recommended by Motley Fool
- Ironically, has prominent info regarding sustainability on its web site



# Economic History



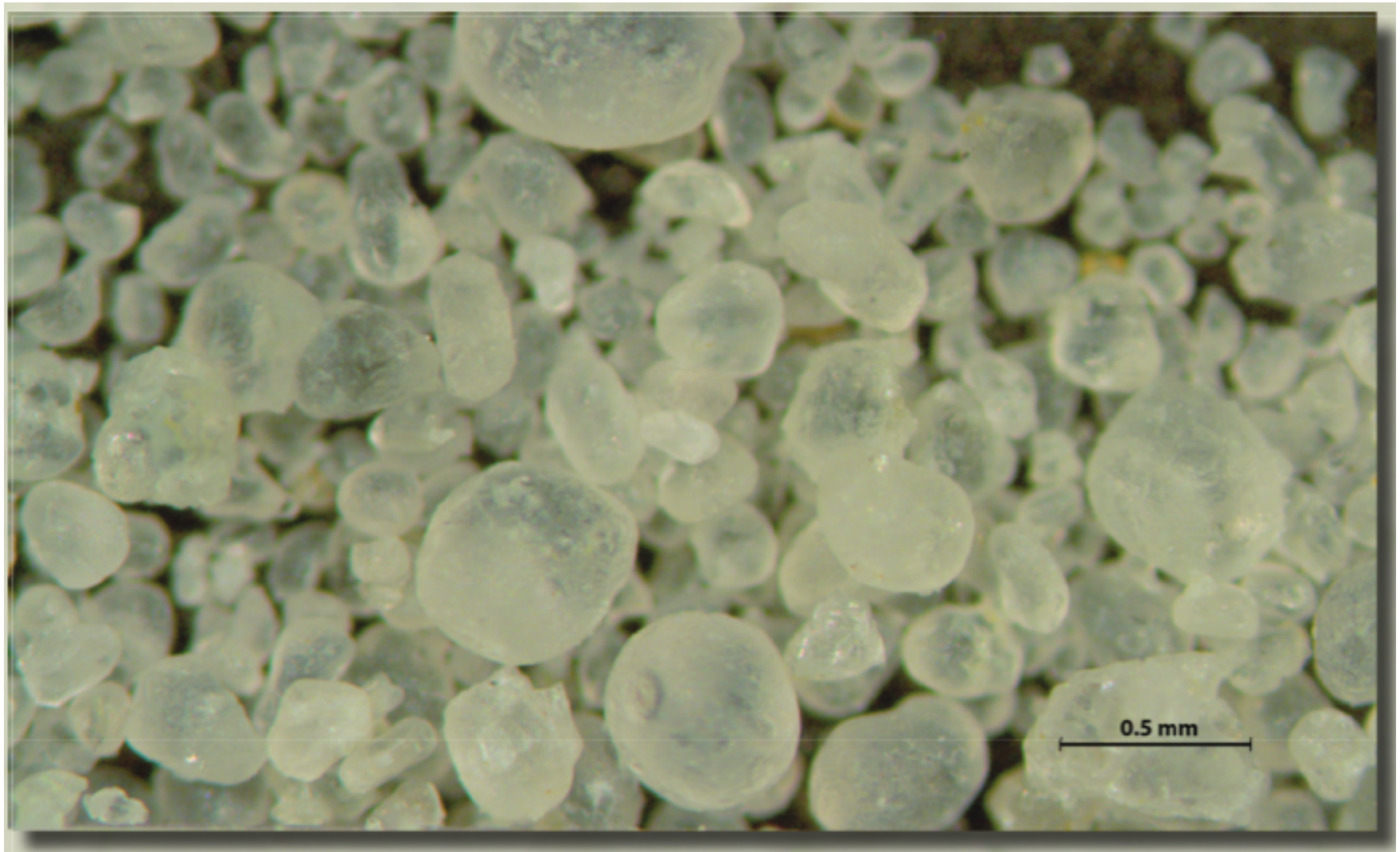
# Economic History

- Proppants:
  - “A proppant is a solid material, **typically sand**, treated sand or man-made ceramic materials, designed to keep an induced hydraulic fracture open, during or following a fracturing treatment. It is added to a fracking fluid which may vary in composition depending on the type of fracturing used, and can be gel, foam or slickwater–based. In addition, there may be unconventional fracking fluids. Fluids make tradeoffs in such material properties as viscosity, where more viscous fluids can carry more concentrated proppant; the energy or pressure demands to maintain a certain flux pump rate (flow velocity) that will conduct the proppant appropriately; pH, various rheological factors, among others. In addition, fluids may be used in low-volume well stimulation of high-permeability sandstone wells (20k to 80k gallons per well) to the high-volume operations such as shale gas and tight gas that use millions of gallons of water per well.”

# Economic History

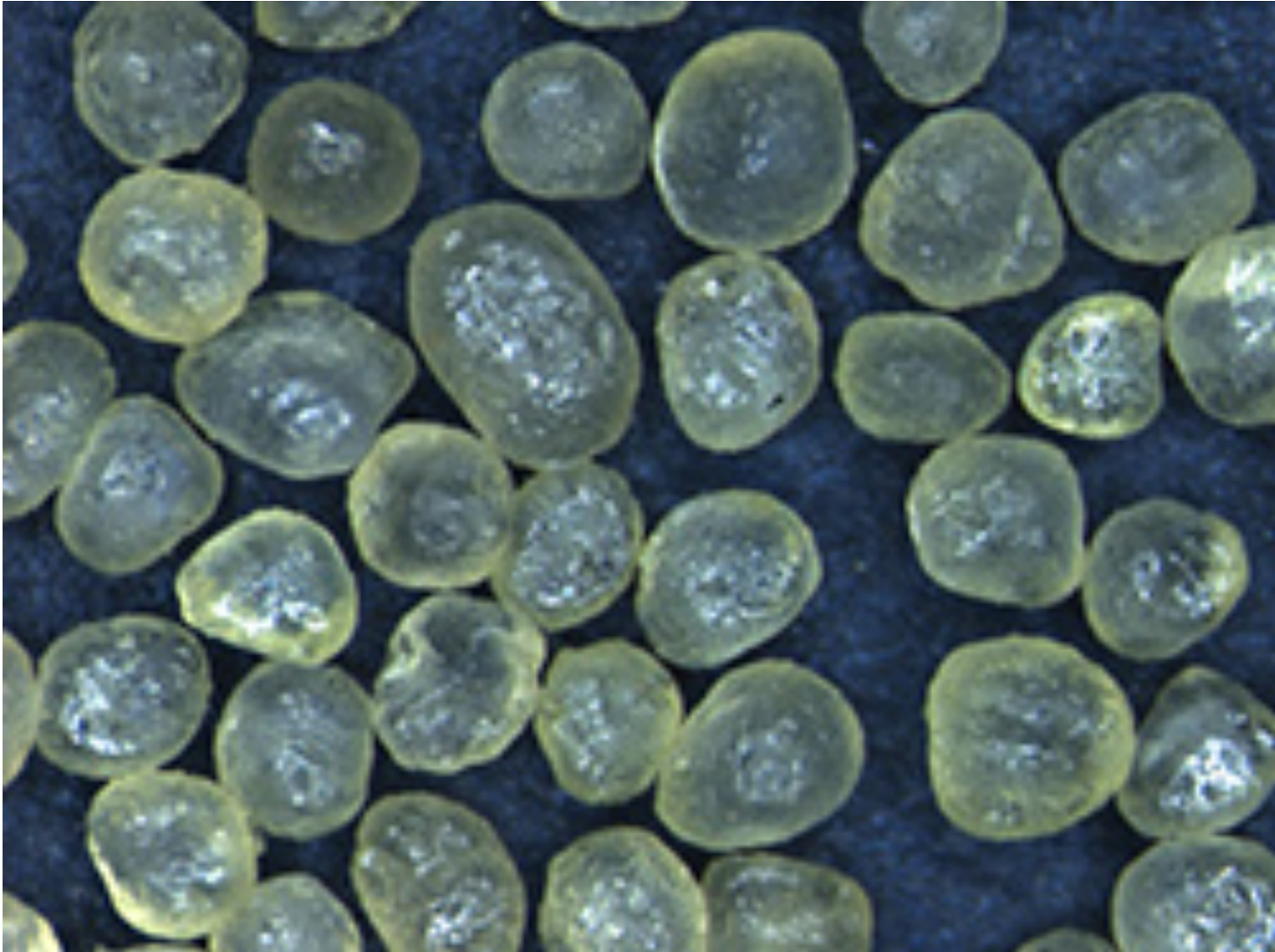
- Proppants:
  - Untreated sand
    - ◆ More easily crushed than other proppants, reducing permeability of gas through the fracture system
  - Treated sand (resin coated)
  - Bauxite
  - Ceramics
  - Artificial products (e.g. from Momentive)

# Untreated Sand



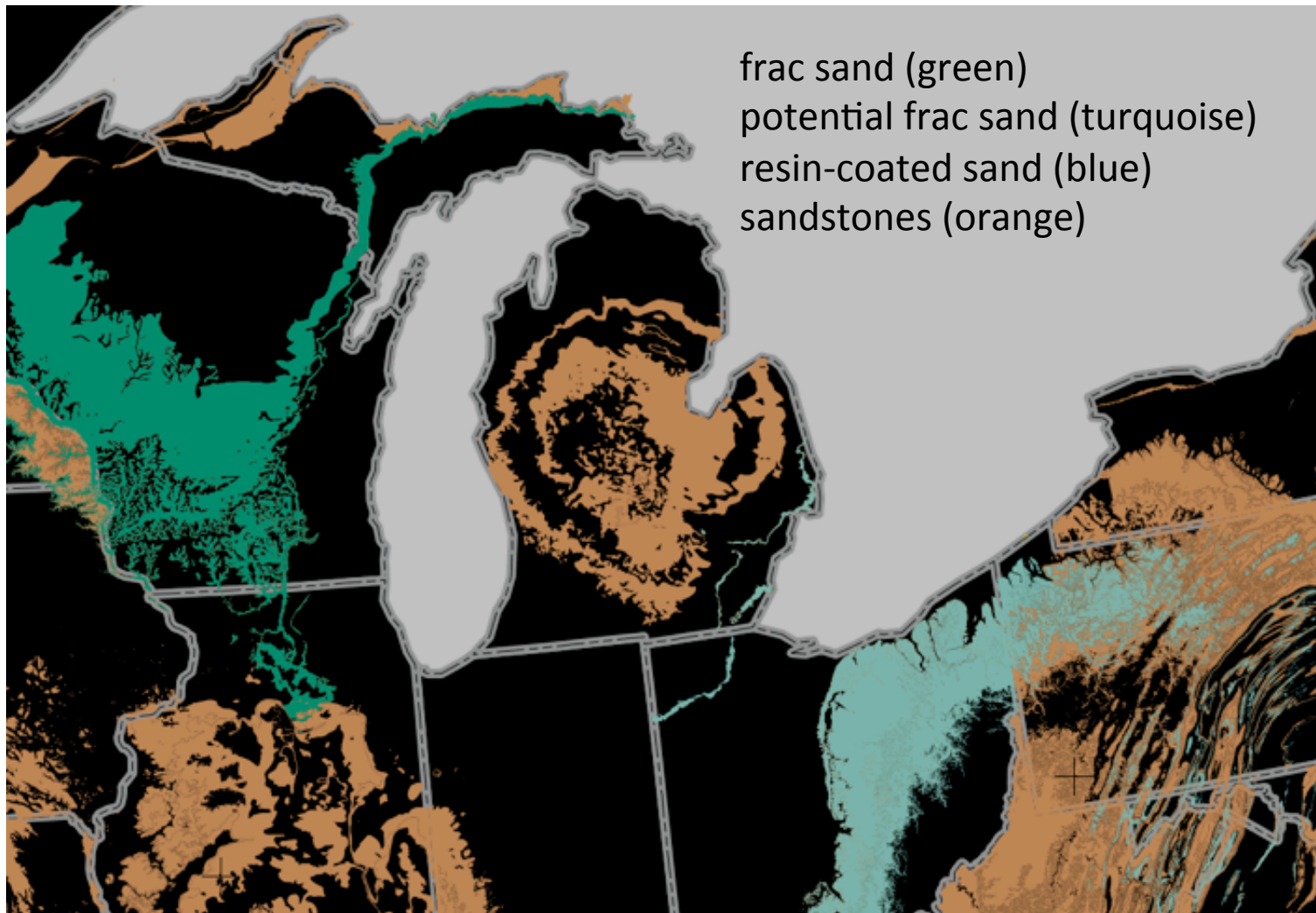


# Treated (Coated) Sand



# Economic History

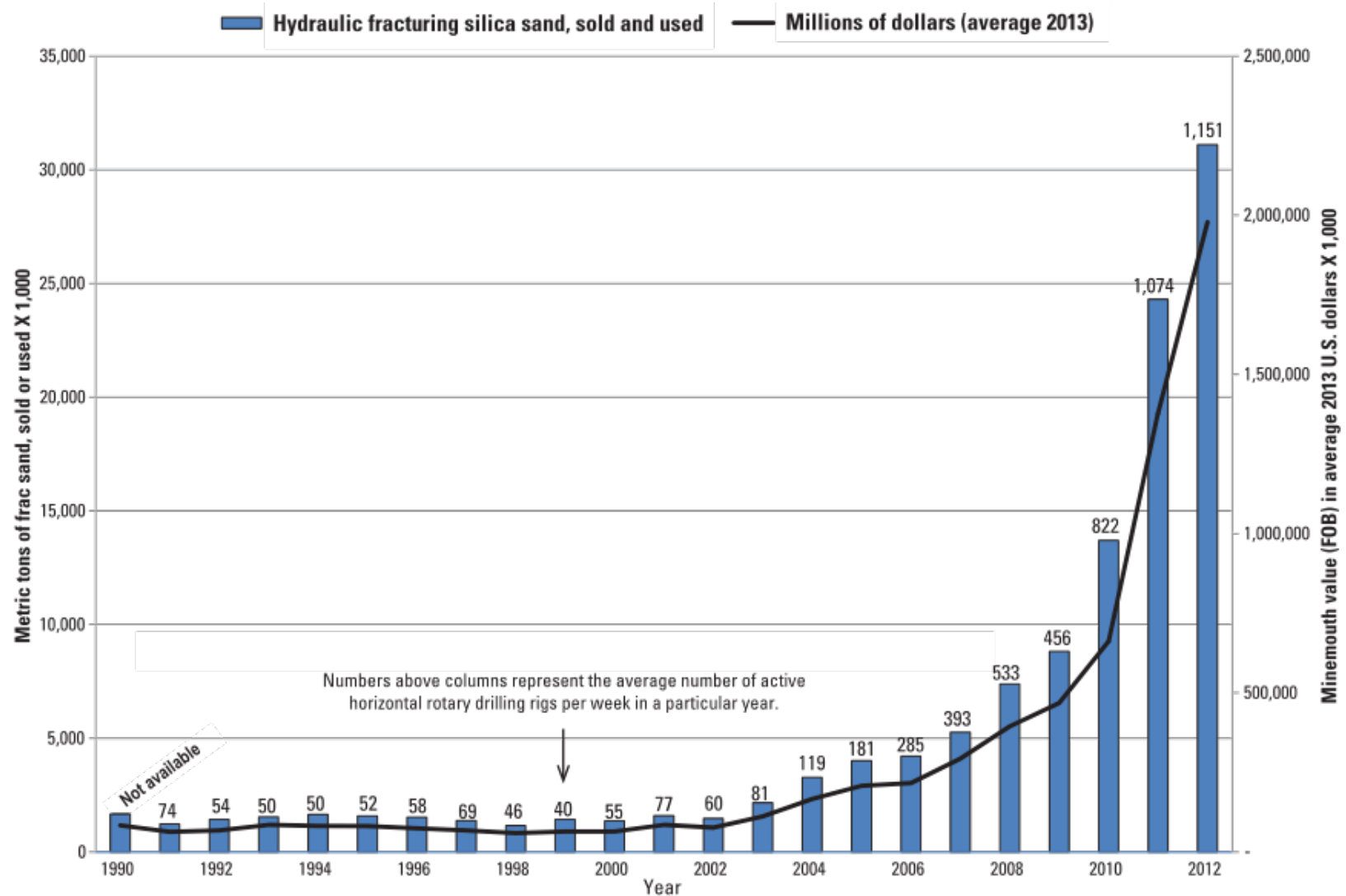
- The sources of sand for hydraulic fracturing



# ACTIVE COASTAL SAND DUNE MINING SITES



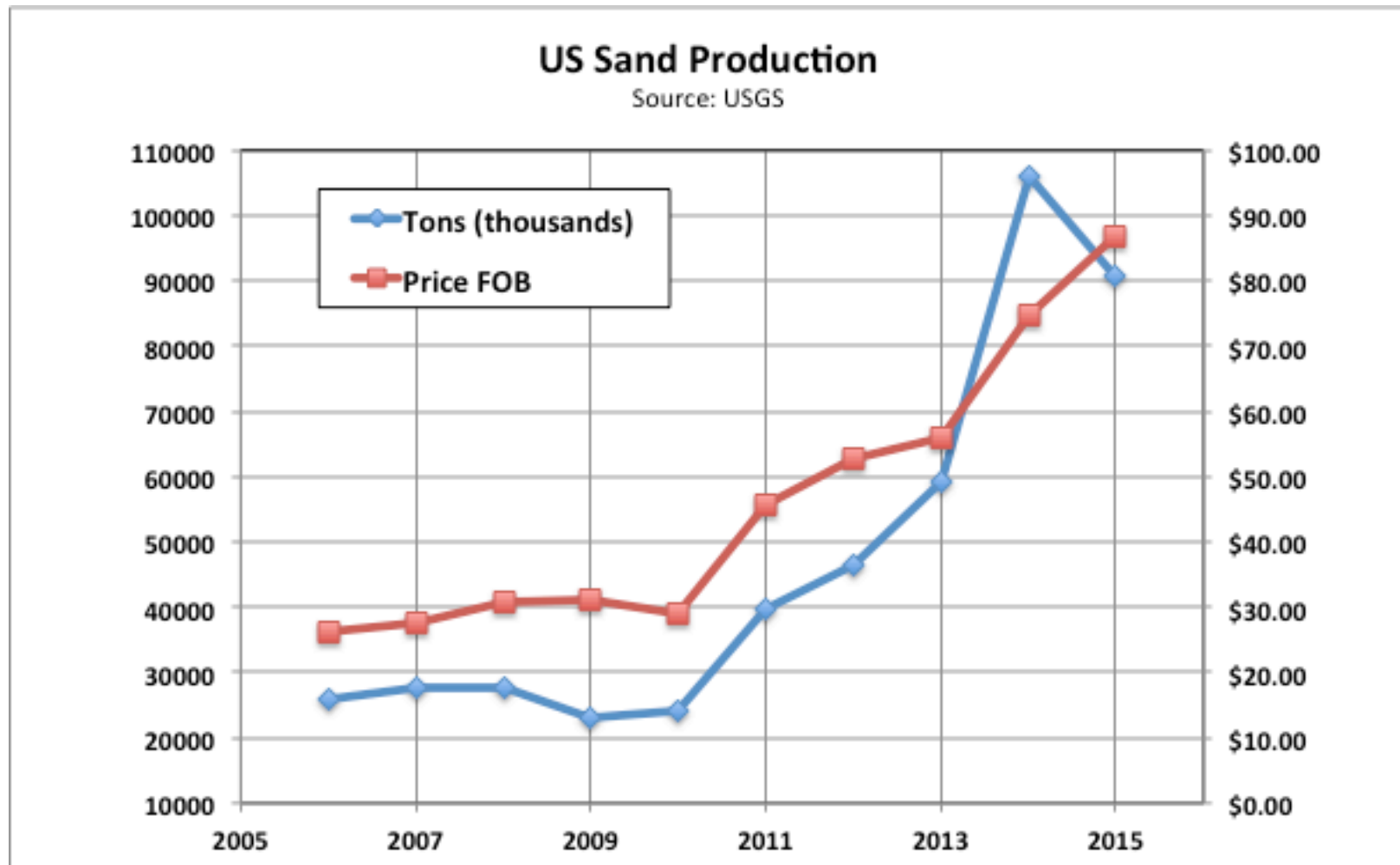
# Economic History





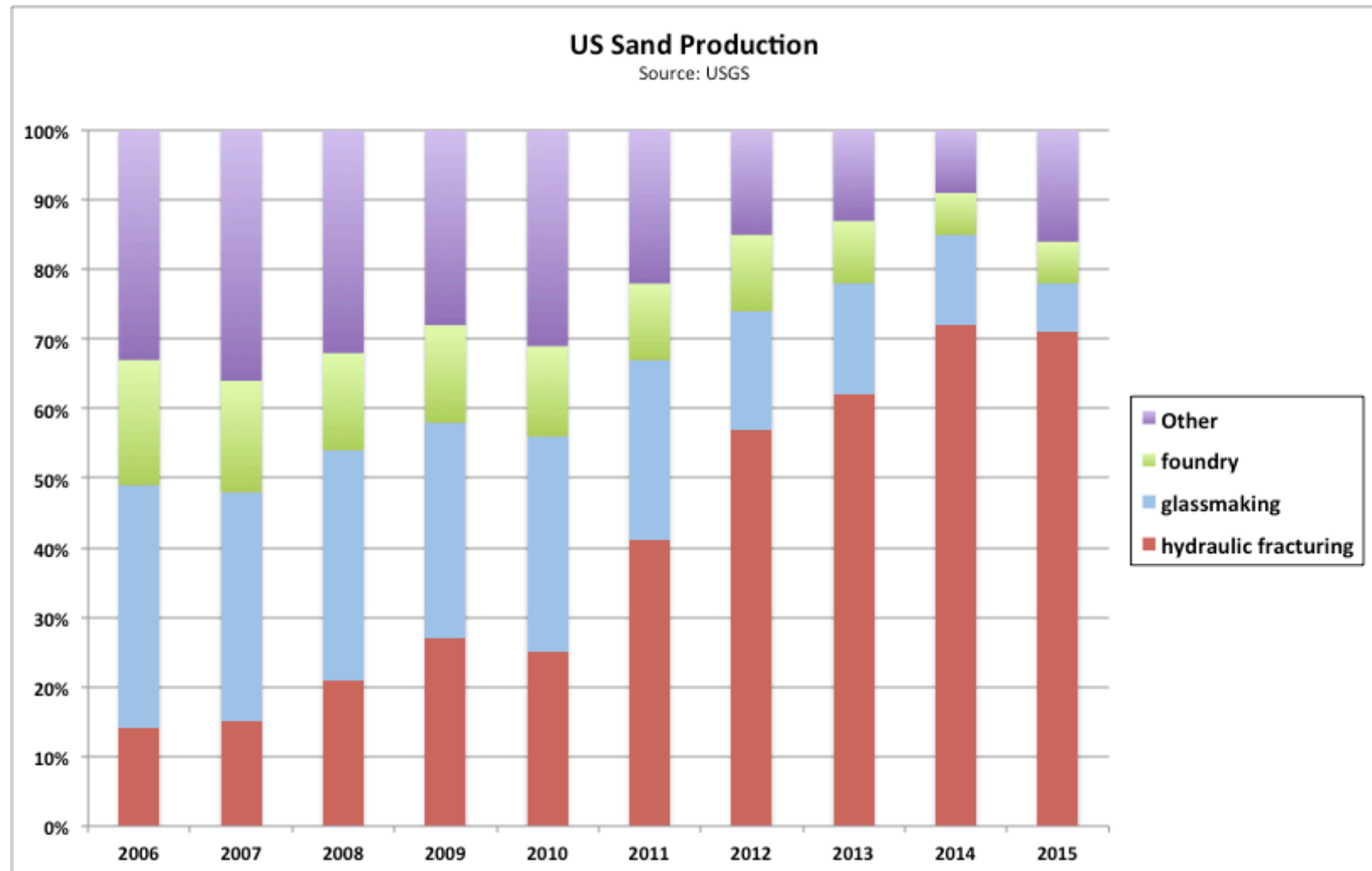
# Economic History

- The economics of mined sands for hydraulic fracturing



# Economic History

- The economics of mined sands for hydraulic fracturing



# Economic History

- “The Midwest is not only home to the four principal lower Paleozoic frac sand sources, but it also hosts unusually pure Quaternary dune sand deposits on the eastern shore of Lake Michigan that are mined for silica, some of which is used for frac sand (Sargent Sand, 2014). Sargent Sand Company, located north of Ludington (pl. 1) in Mason County, Michigan, produces from these Lake Michigan shore sands a highly crush resistant 30/70, 30/50, 40/70, and 100 mesh frac sand that meets or exceeds API specifications (Sargent Sand, 2014). The sand that is suitable for frac sand at this mine represents only a small portion of the glacially reworked aeolian deposits along the lake shore and is not featured as a mapped unit in this report.”

# Economic History

(from Sargent Sand web site)

- Located in Ludington, Michigan, Sargent Sand Co. has estimated reserves of 40,000,000 tons of high quality, high crush northern gold API frac sand and specialty sand.
- With a new state-of-the-art processing and drying facility we are capable of producing 800,000 tons annually of 30/70, 30/50 and 40/70-frac sand that meets and exceeds API specifications.
- Our sand is has a high silica content and low acid demand enabling us to serve other specialty markets.
- The Ludington operation is an extremely low cost option for our customer base. With minimal waste due to the high silica content and extraction done via dredge, Sargent Sand Co. is a highly efficient mining and processing company.
- Sargent Sand Co. also has many logistical advantages due to our location. Located on a state highway, we are able to get sand to the market at a highly cost competitive rate. We are also strategically located with several rail options available and potential truck transportation direct to the terminal, foundry or plant location.

# Economic History

# Economic History

## Sargent Hamlin Township Taxes

Parcel	2015
007-028-003-00	\$1,250.40
007-029-003-00	\$4,384.12
007-032-003-00	\$659.73
007-033-026-00	\$7,158.95
007-033-028-00	\$1,581.23
007-033-030-00	\$1,362.61
007-033-037-00	\$423.15
007-440-291-00	\$268.69
007-480-067-00	\$614.68
<b>Total</b>	<b>\$17,703.56</b>

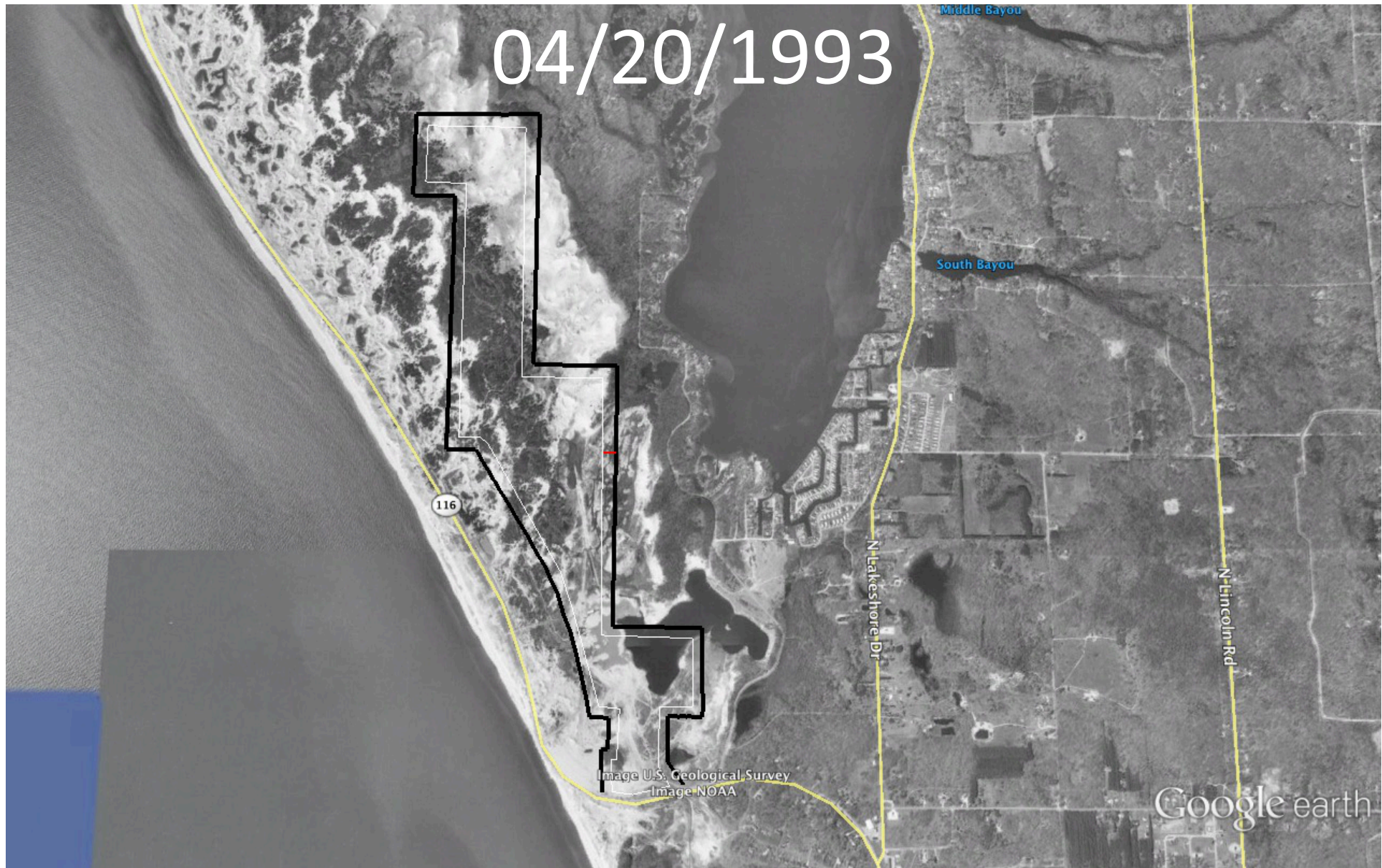


# Economic History

- The economics of recreational lands

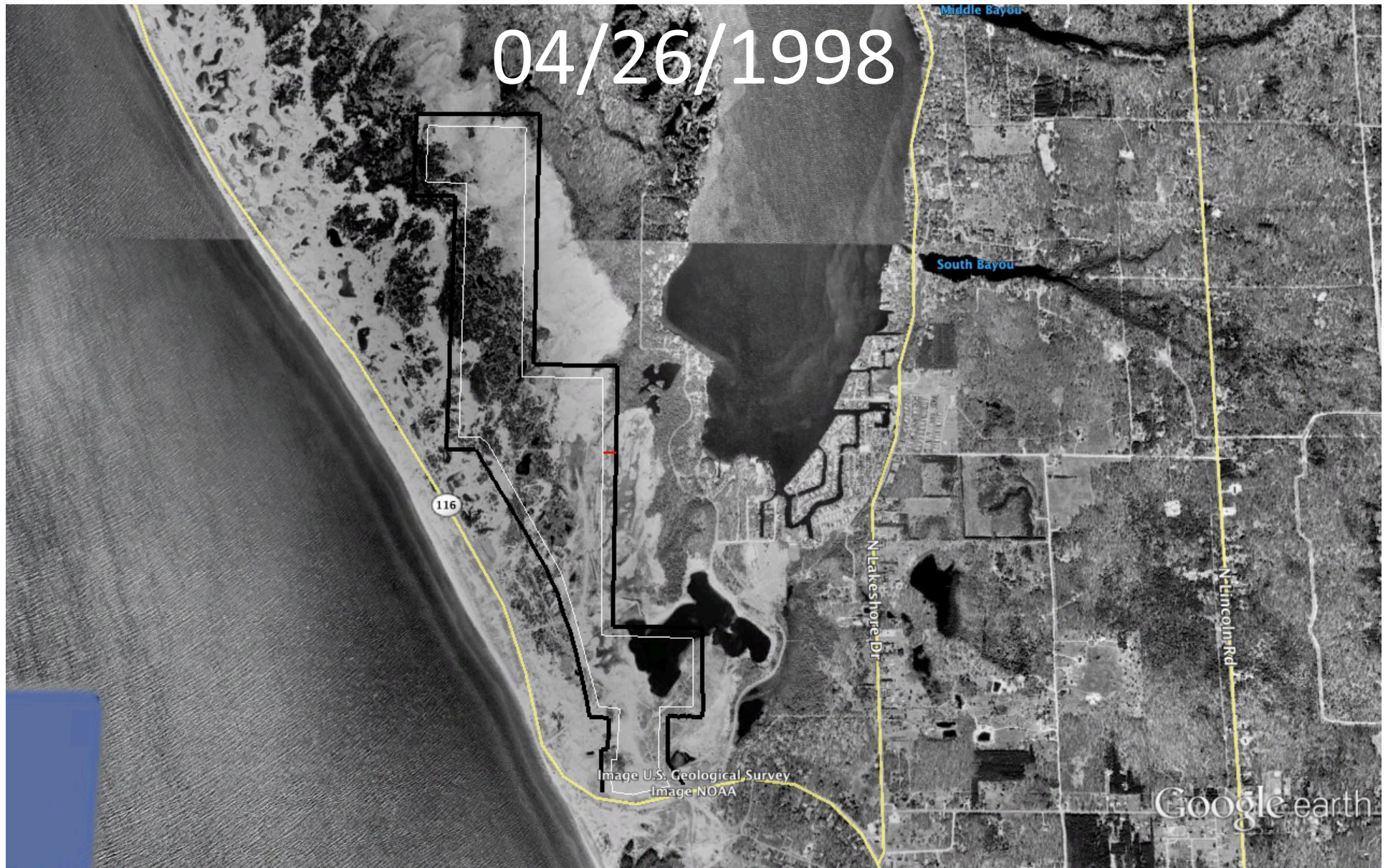


04/20/1993



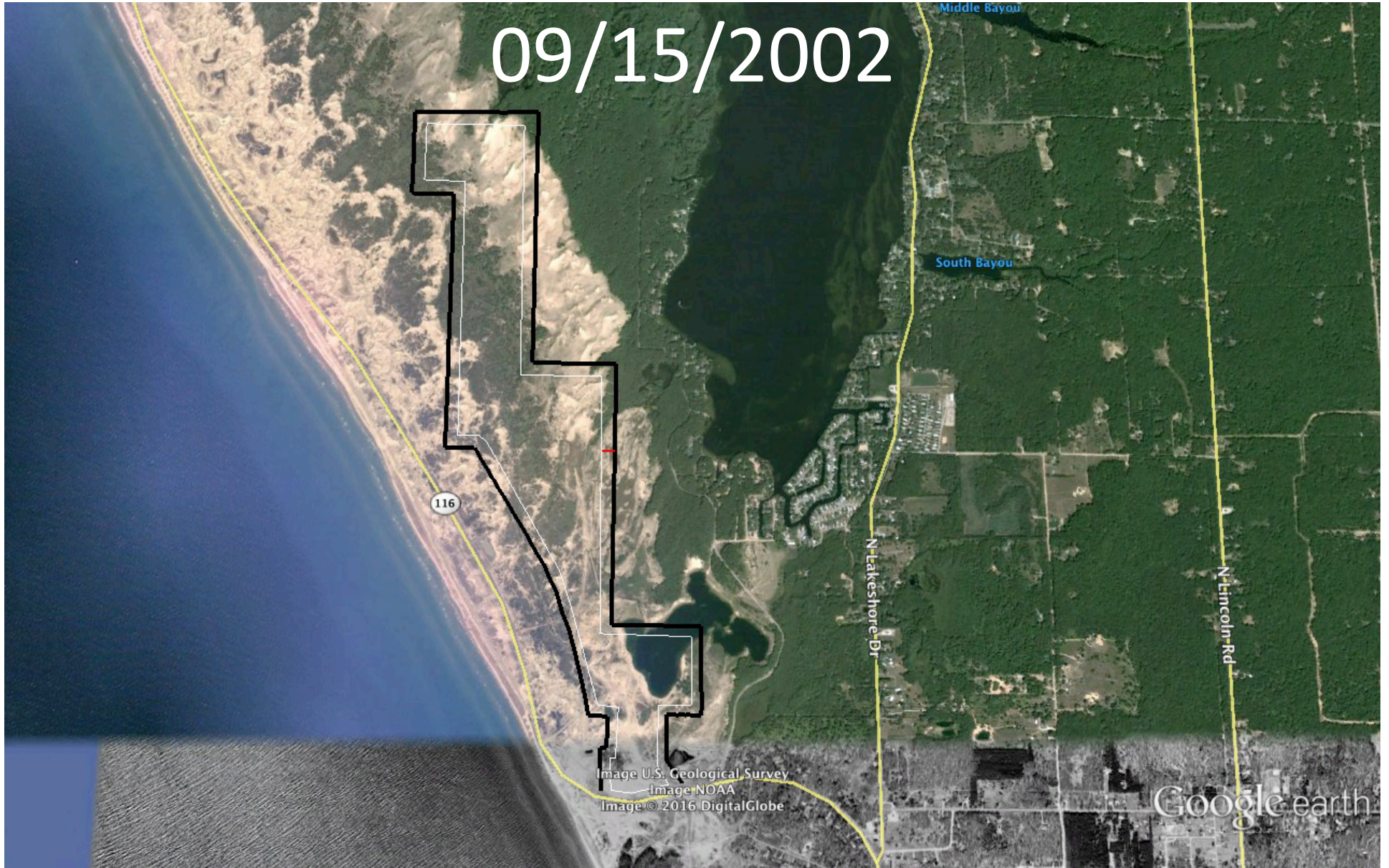


04/26/1998



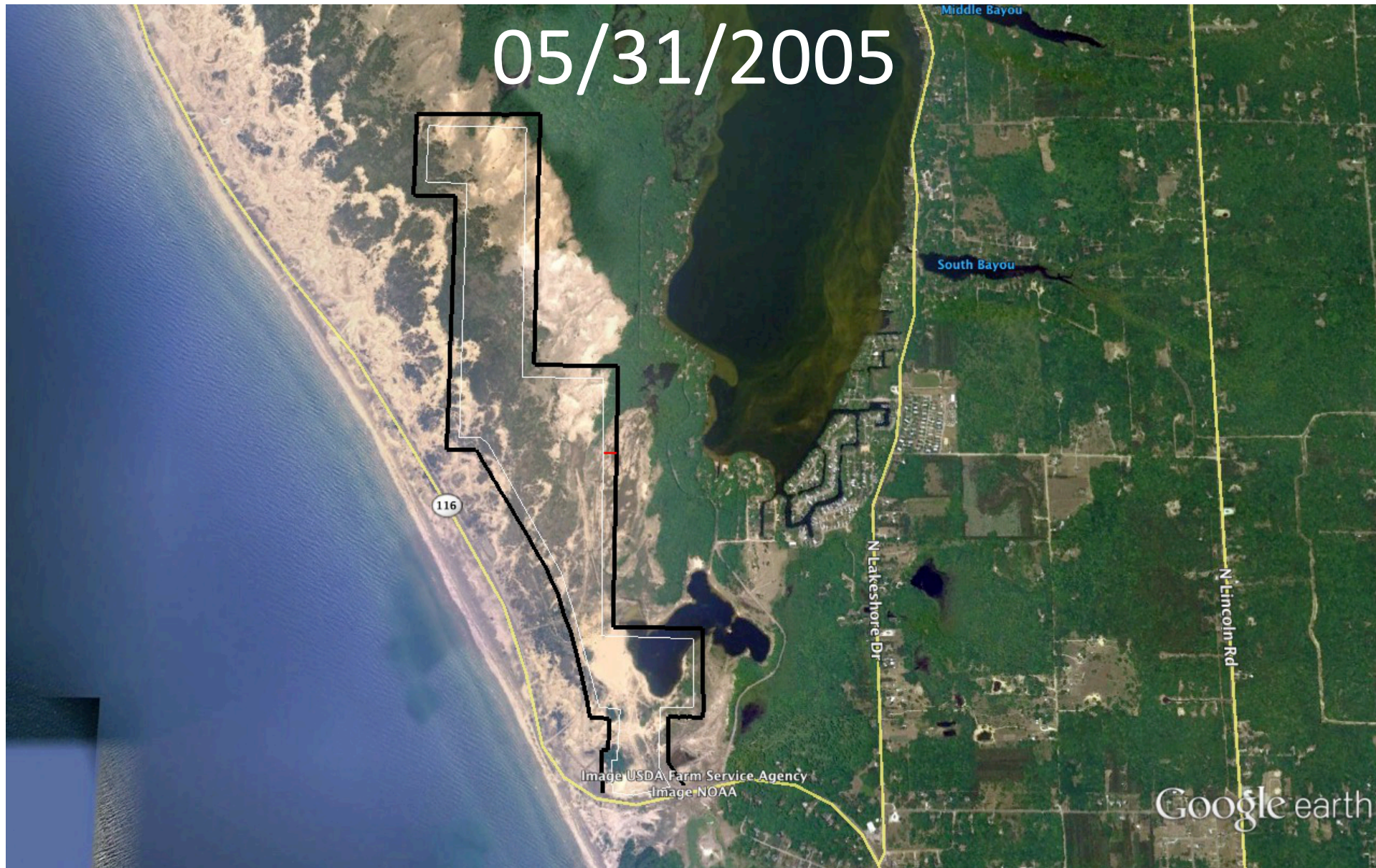


09/15/2002





05/31/2005





12/31/2005



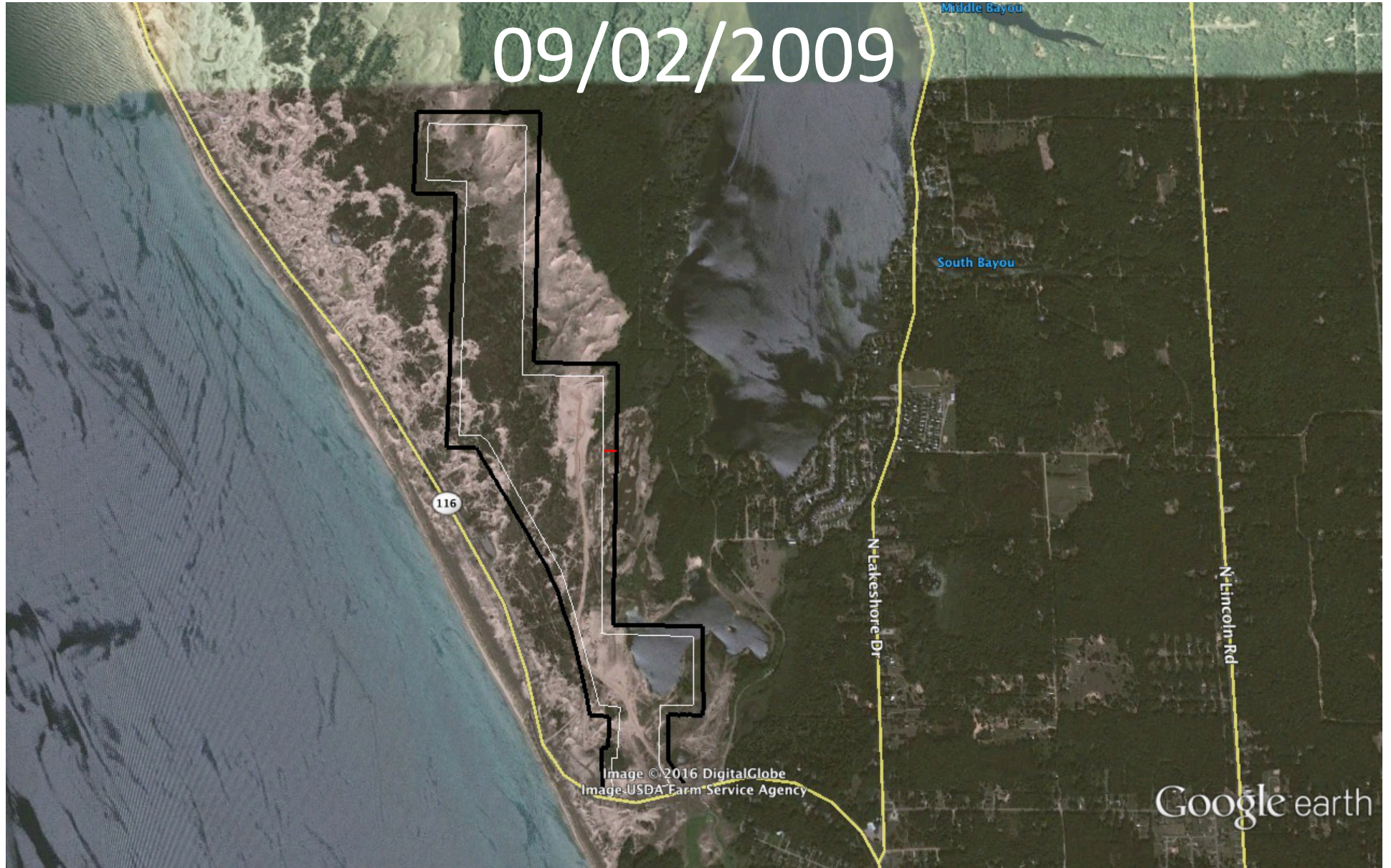


06/02/2006





09/02/2009



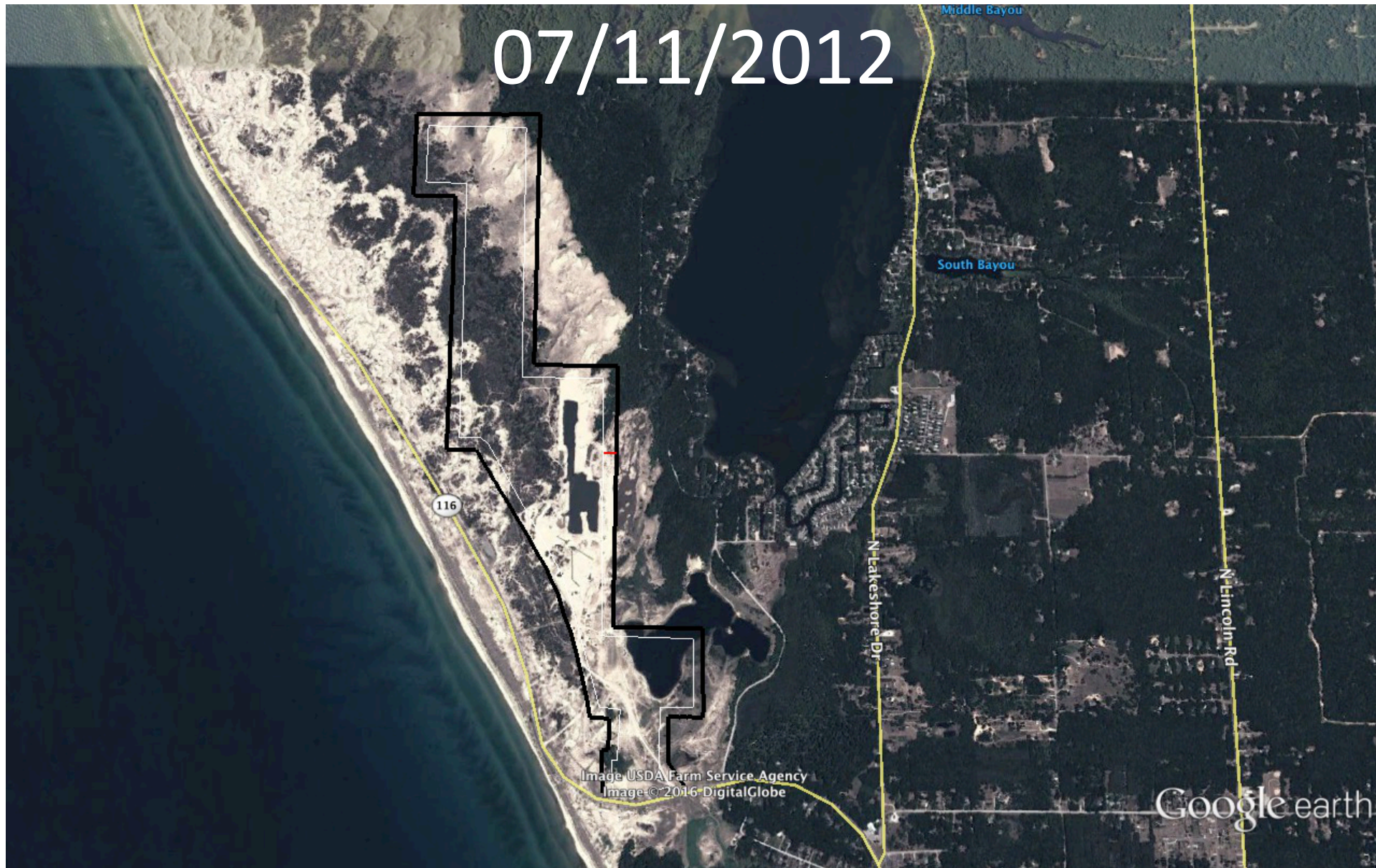


07/25/2010



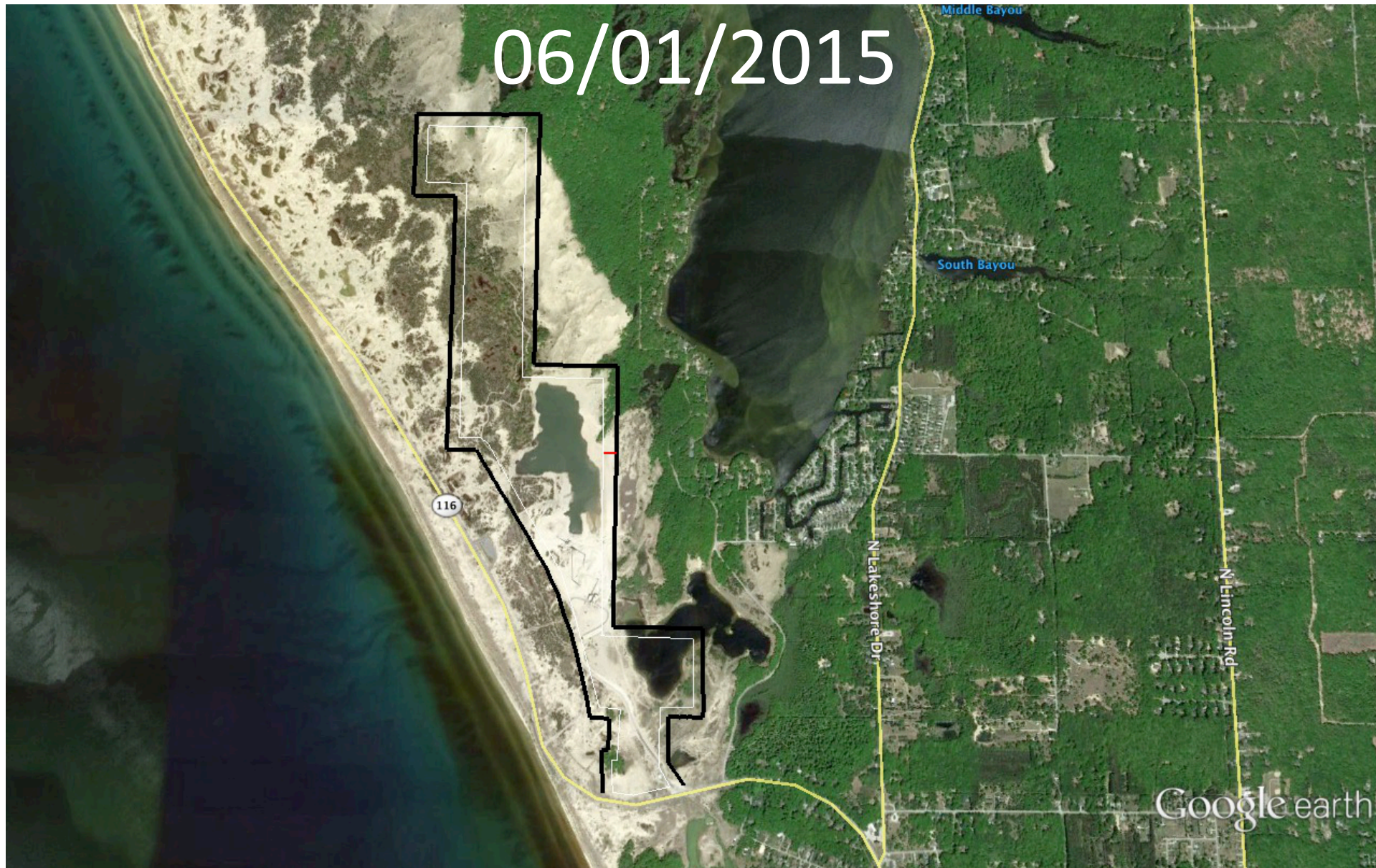


07/11/2012





06/01/2015



# The Future

- Evolution of Mason County Economy
- Evolution of US Energy Sources and Consumption: See LLNL links
- Evolution of US Oil and Natural Gas Production:
  - Hydraulic fracturing is high-cost source, relative to e.g. Saudi Arabian oil
  - Quote from Saudi oil minister
  - Commodity dislocations
- Evolution of Proppants for Hydraulic Fracturing:
  - Sand
  - Other sources
  - Commodity dislocations

# The Future

- Sargent Sand:
  - Heavy capital investment, according to one source with technical expertise in frack sands (not sure I buy this argument)
  - OTOH, operational costs low; highly profitable; nimble, flexible, little debt
  - Not clear Ludington Dunes sands meet most-desired specifications of the industry
  - Favorably situated for transport
  - Sargent is small compared to e.g. US Silica (potential acquisition target)
  - Organizationally, Sargent is creating a web of shell companies; reasons unknown, but effect is to hide purpose and success of their businesses from the public eye
  - At \$70/ton FOB for frack sand, and \$70+/ton for transportation, manufactured proppants will be developed:
    - ◆ Cost per ton will drop substantially
    - ◆ More importantly, the proppants will be manufactured close to the point of consumption, reducing transportation costs even more dramatically

# The Future

- Sargent Sand upsides:
  - Support for local sports teams
  - New Hamlin township fire truck
  - Hamlin Township property taxes
  - Some monies from Sargent employees spent locally (fuel, meals, some shopping)
  - Business supports Towne Brothers, local shipping company
  - Probably some benefit from railhead at old H-W site

# The Future

- Sargent Sand downsides:
  - Most employees are not local
  - Truck impacts on roads and quality of life
  - Noise for local residents: major issue, actively ignored and discounted by DEQ
  - Worker long-term health? (silicosis, causes problems similar to black-lung after long-term exposure)
  - Inherent unsustainability of surface mining, especially on economics of outdoor recreation
  - Detrimental effects on wildlife and plants, especially given contiguous relationship with Ludington SP

# The Future

- Vision
  - For permit renewal December 2016, look for ways within Part 637 to address the matter which DEQ will accept
  - Limit days and hours of operation (especially in several years if/when market picks up again)
  - Work with DNR, Nature Conservancy, Open Space Trust organizations to purchase parcels at north end of SS property
  - Expand recreational opportunities; create long-term, sustainable vision for year-round, recreation-based use of the property, including the dredge pond: Eco-lodge, hunting, fishing, developed campgrounds, fish hatchery (unlikely), environmental interpretive center, hiking, X-C skiing, boating
  - Encourage Sargent to work together to effect land swap for nearby, state- or private-owned lands atop appropriate sand formations; naming rights to Sargent for the new land additions to LSP (enhanced branding)