Development of GIS-based decision support tools for evaluation of Great Lakes lakebed alterations

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Co-Authors

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Background

--- Alternative energy movement in Michigan

--- Lack of integration of natural resource information in wind farm planning

--- Importance of natural resources in Michigan

Project Objectives

(1) Identify critical fish and wildlife habitats along the shoreline and shallow waters of the Great Lakes

(2) Assemble relevant base/political, cultural, and environmental data into a single GIS database

(3) Produce user-friendly, interactive maps that will aid decision-makers in evaluating permits and impacts of lakebed alterations (e.g., dredging, windfarm siting)

Data

Base/political features
- Urban areas
- Federal/state/tribal lands
- Transmission lines/sub-stations
- Shipping routes
- Military areas
- Ports
- Islands
- Water intakes
- Groundwater upwelling areas
- National Parks/Lakeshore

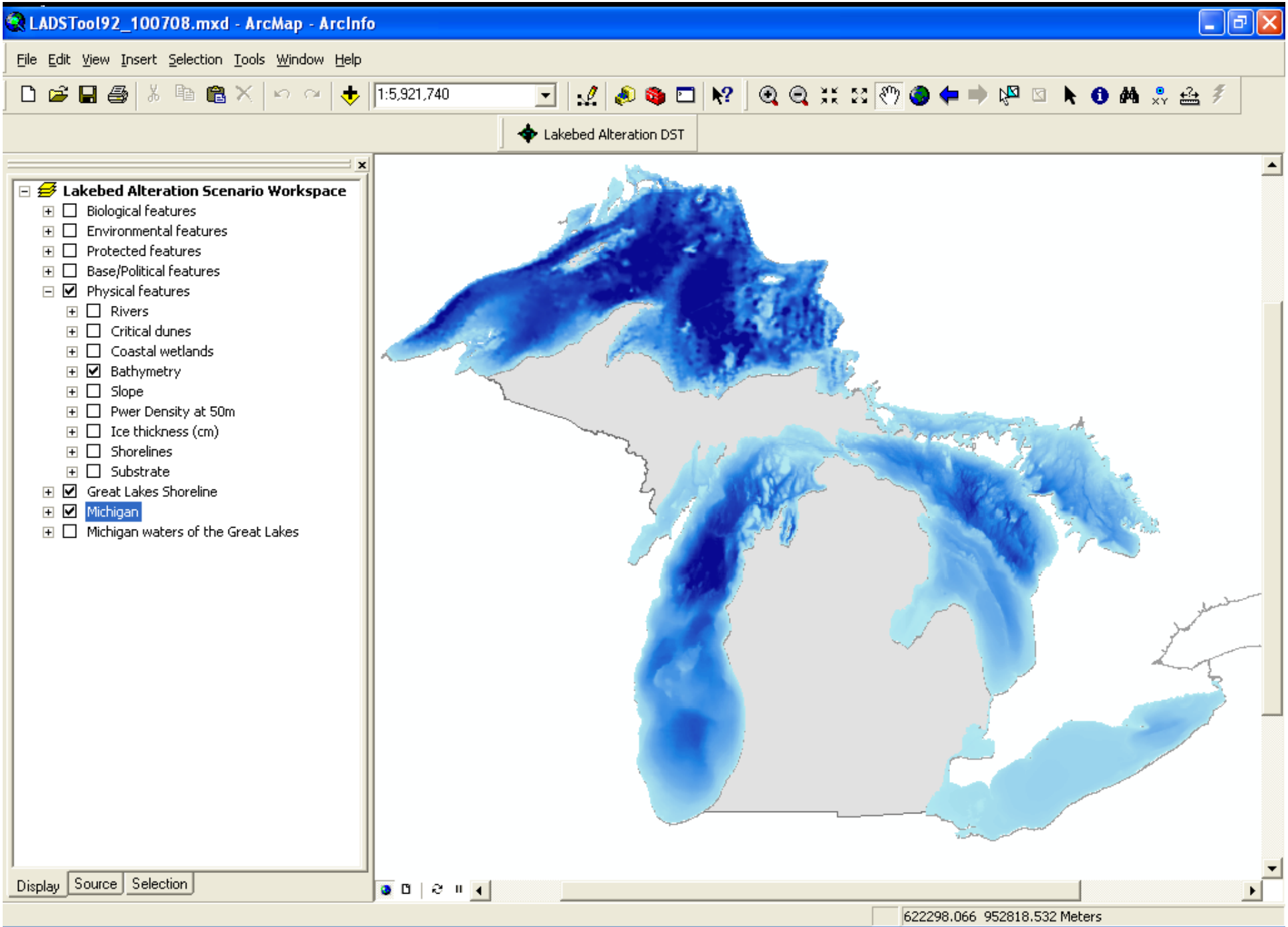
Biological features
- Fish spawning sites
- Bird nesting sites/stopovers

Environmental features
- Areas of Concern (AOCs)

Physical features
- Shoreline
- River mouths
- Substrate
- Bathymetry
- Coastal wetlands
- Wind power
- Sand dunes
- Ice thickness
- Shoreline hardening

Protected features
- Refuges
- Protected shorelands
- Protected bottomlands

Fisheries data
- Commercial fishing sites
- Recreational fishing sites



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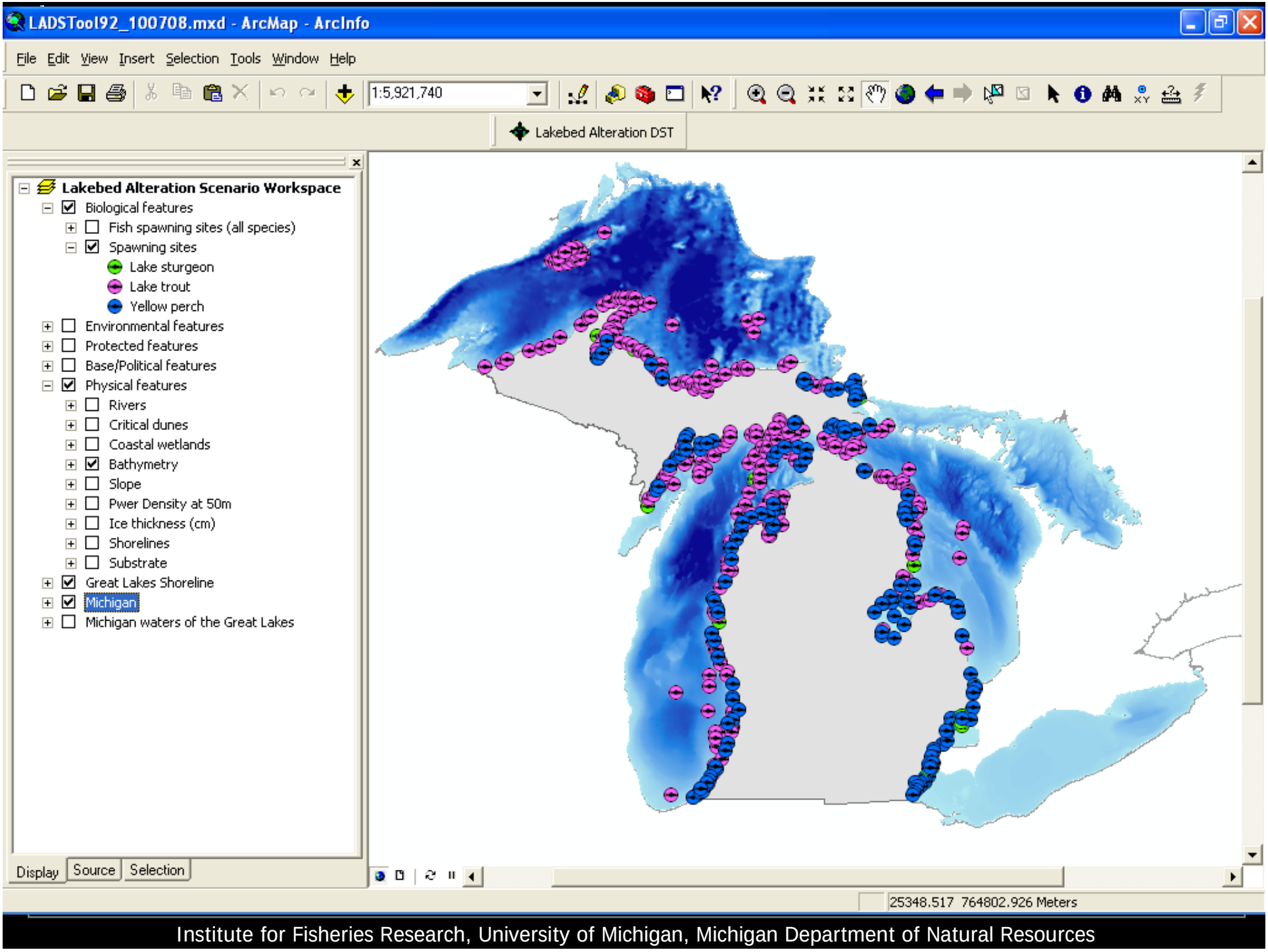
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Lakebed Alteration DST
Lakebed Alteration Scenario Workspace
Biological features
Fish spawning sites (all species)
Spawning sites
Lake sturgeon
Lake trout
Yellow perch
Environmental features
Protected features
Base/Political features
Physical features
Rivers
Critical dunes
Coastal wetlands
Bathymetry
Slope
Pwer Density at 50m
Ice thickness (cm)
Shorelines
Substrate
Great Lakes Shoreline
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Michigan waters of the Great Lakes
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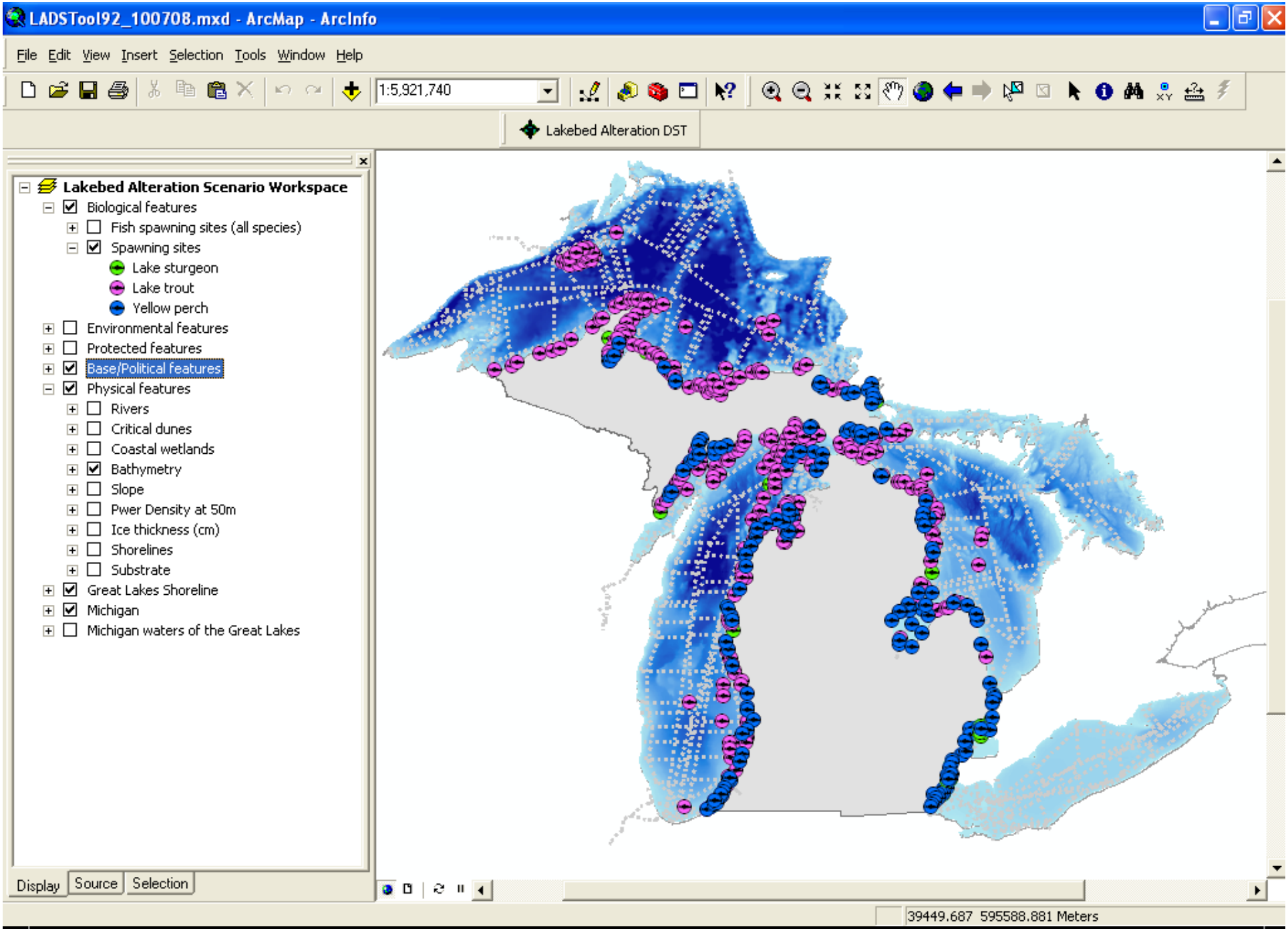
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Critical dunes
Coastal wetlands
Bathymetry
Slope
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Ice thickness (cm)
Shorelines
Substrate
Great Lakes Shoreline
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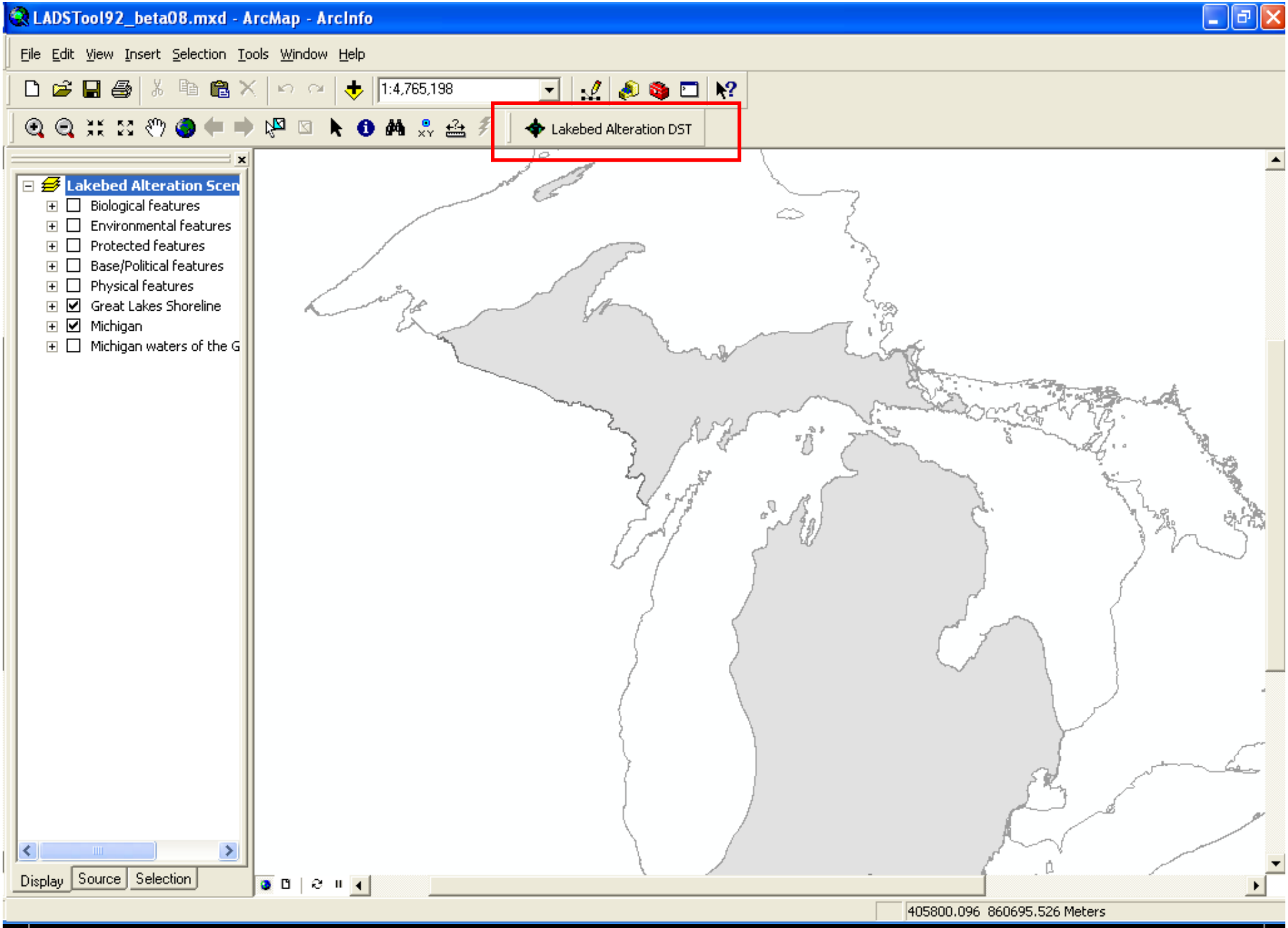
Example

Scenario 1

- Fish spawning sites (Lake Herring)
- Bathymetry
- Wind power density
- Bottomland preserves



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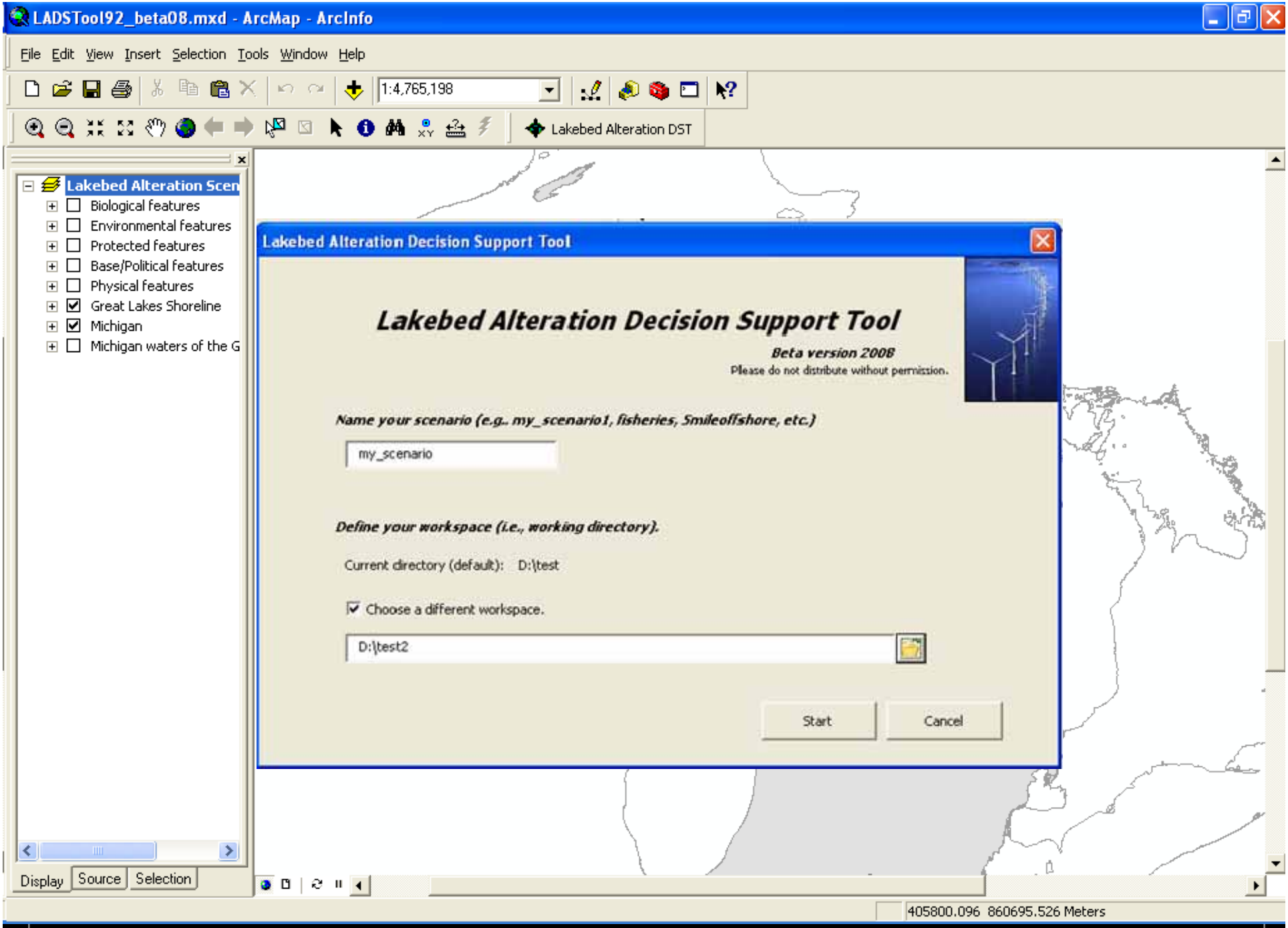

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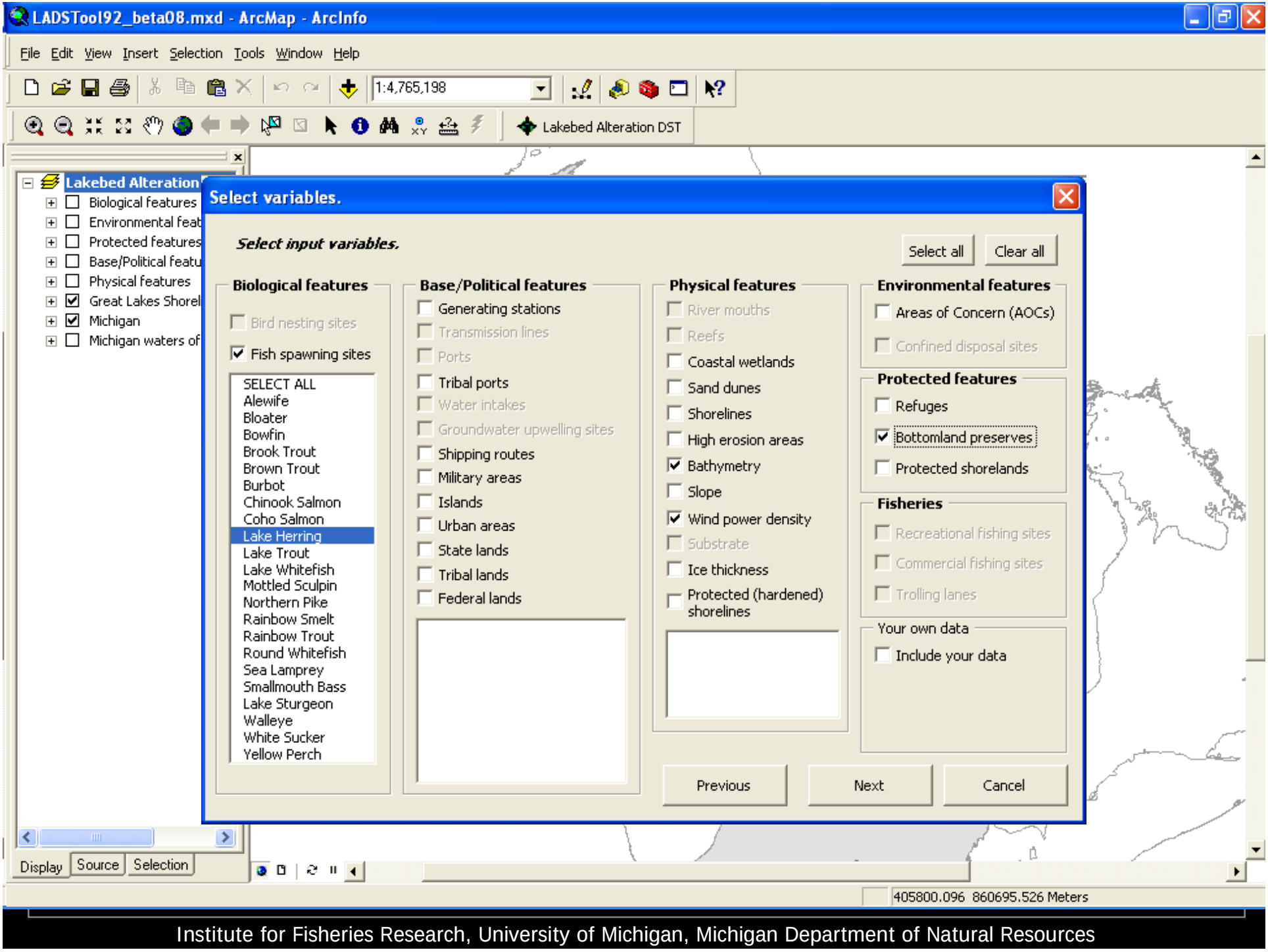
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Biological features
Bird nesting sites
Fish spawning sites
SELECT ALL
Alewife
Bloater
Bowfin
Brook Trout
Brown Trout
Burbot
Chinook Salmon
Coho Salmon
Lake Herring
Lake Trout
Lake Whitefish
Mottled Sculpin
Northern Pike
Rainbow Smelt
Rainbow Trout
Round Whitefish
Sea Lamprey
Smallmouth Bass
Lake Sturgeon
Walleye
White Sucker
Yellow Perch
Base/Political features
Generating stations
Transmission lines
Ports
Tribal ports
Water intakes
Groundwater upwelling sites
Shipping routes
Military areas
Islands
Urban areas
State lands
Tribal lands
Federal lands
Physical features
River mouths
Reefs
Coastal wetlands
Sand dunes
Shorelines
High erosion areas
Bathymetry
Slope
Wind power density
Substrate
Ice thickness
Protected (hardened) shorelines
Environmental features
Areas of Concern (AOCs)
Confined disposal sites
Protected features
Refuges
Bottomland preserves
Protected shorelands
Fisheries
Recreational fishing sites
Commercial fishing sites
Trolling lanes
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Include your data
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Next
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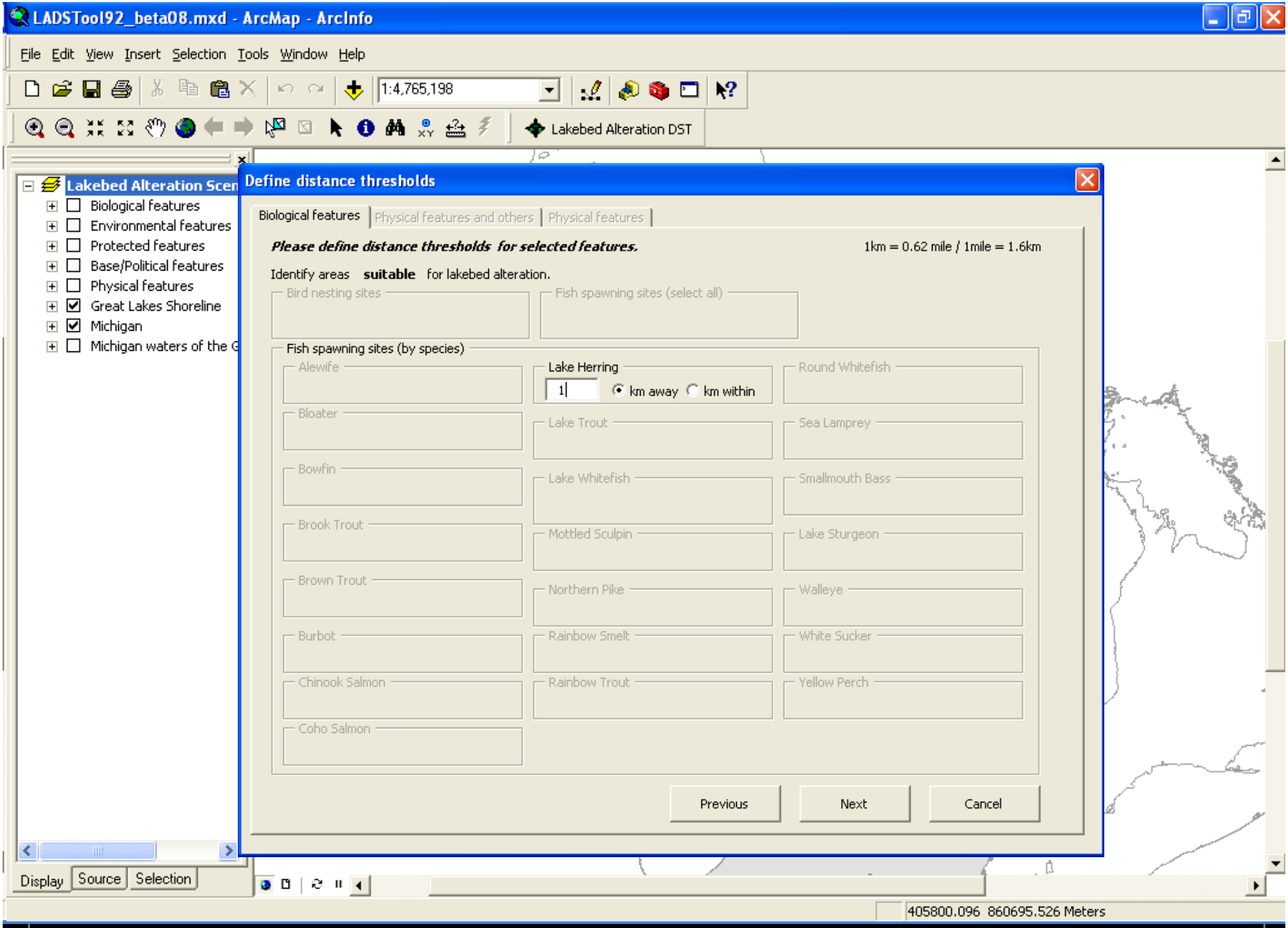
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Physical features and others
Physical features
Please define distance thresholds for selected features.
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Fish spawning sites (by species)
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Round Whitefish
Bloater
Lake Trout
Sea Lamprey
Bowfin
Lake Whitefish
Smallmouth Bass
Brook Trout
Mottled Sculpin
Lake Sturgeon
Brown Trout
Northern Pike
Walleye
Burbot
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White Sucker
Chinook Salmon
Rainbow Trout
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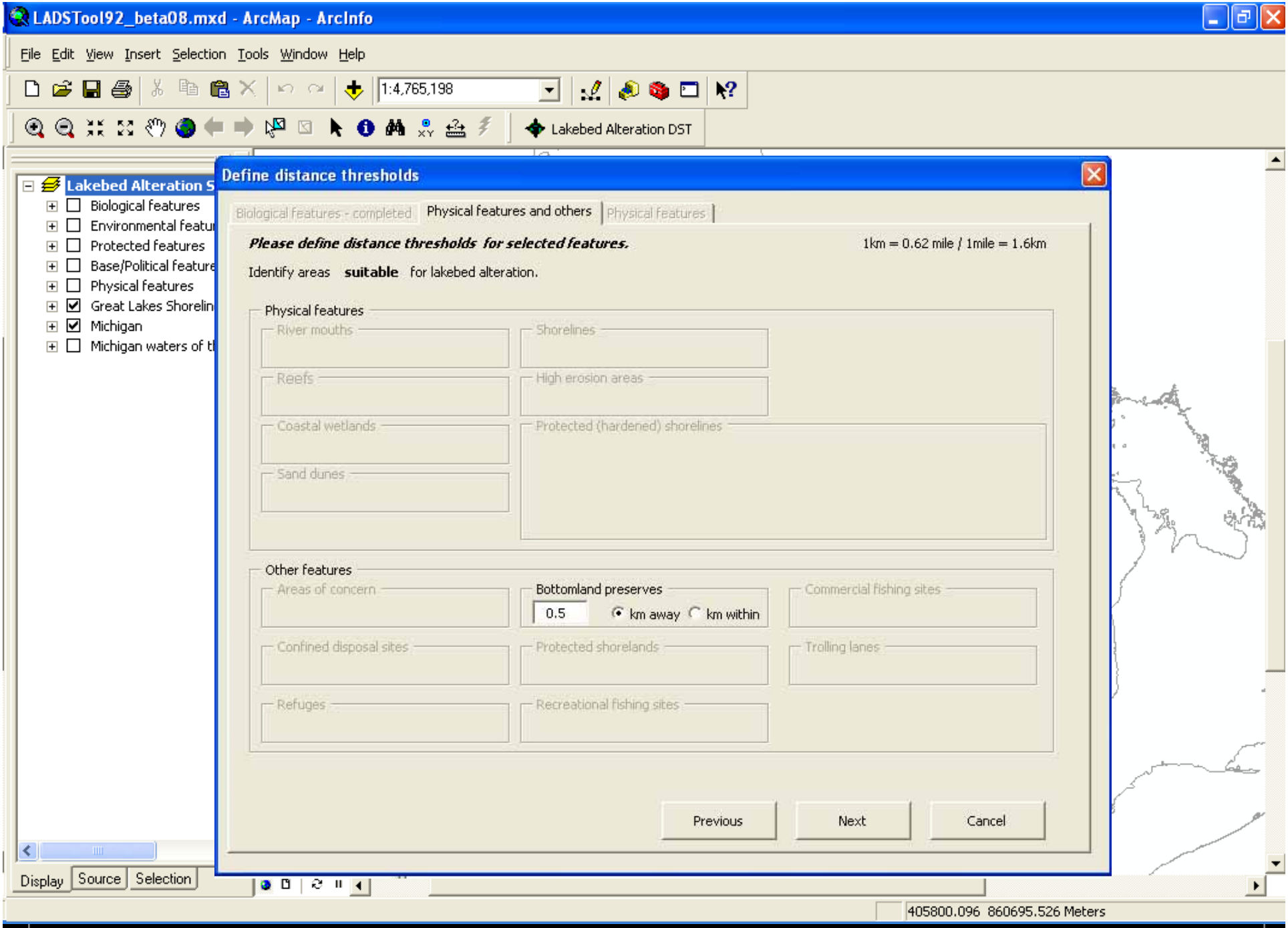
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Identify areas suitable for lakebed alteration.
Physical features
River mouths
Shorelines
Reefs
High erosion areas
Coastal wetlands
Protected (hardened) shorelines
Sand dunes
Other features
Areas of concern
Bottomland preserves
0.5
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Commercial fishing sites
Confined disposal sites
Protected shorelands
Trolling lanes
Refuges
Recreational fishing sites
Previous
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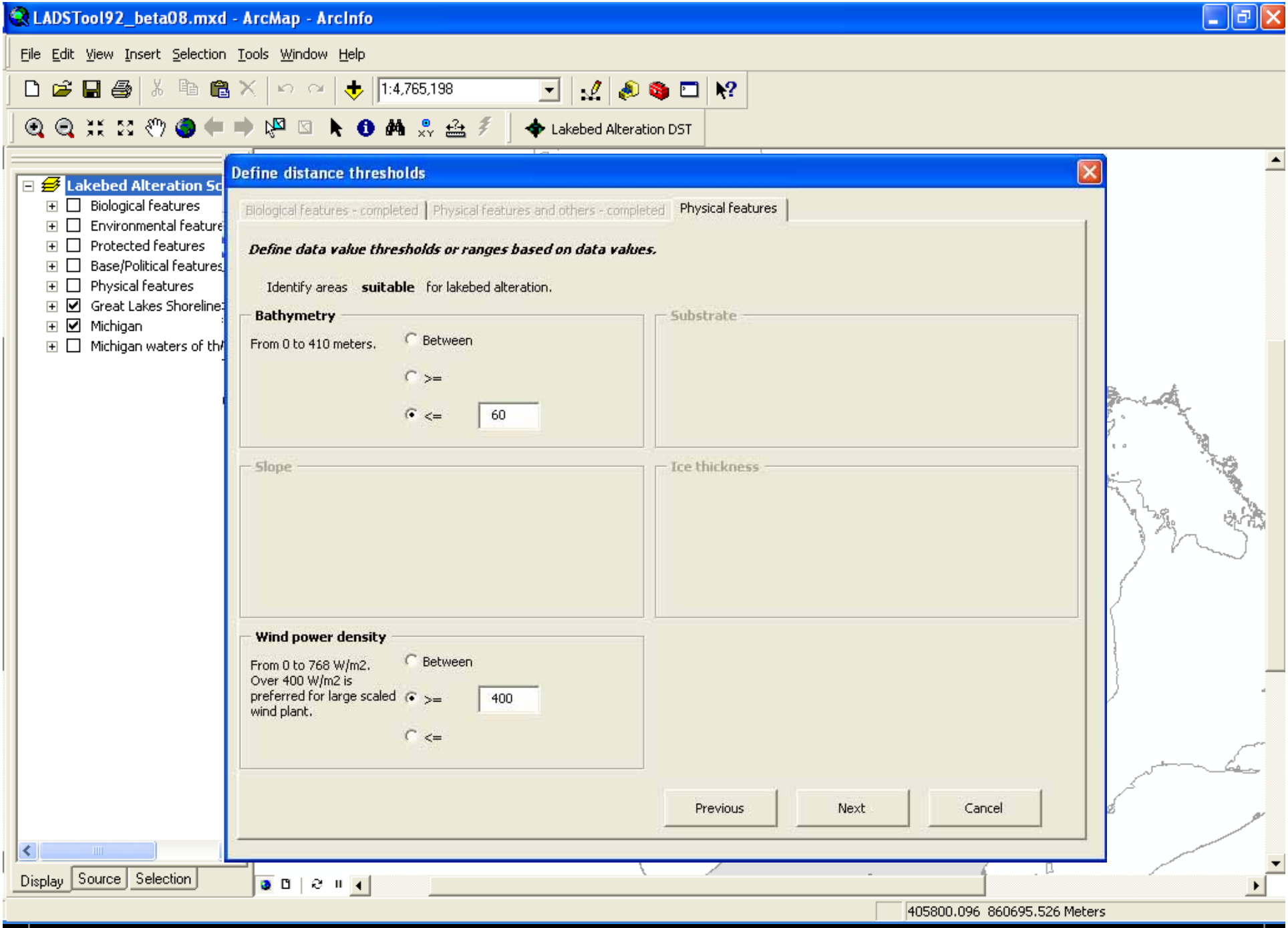

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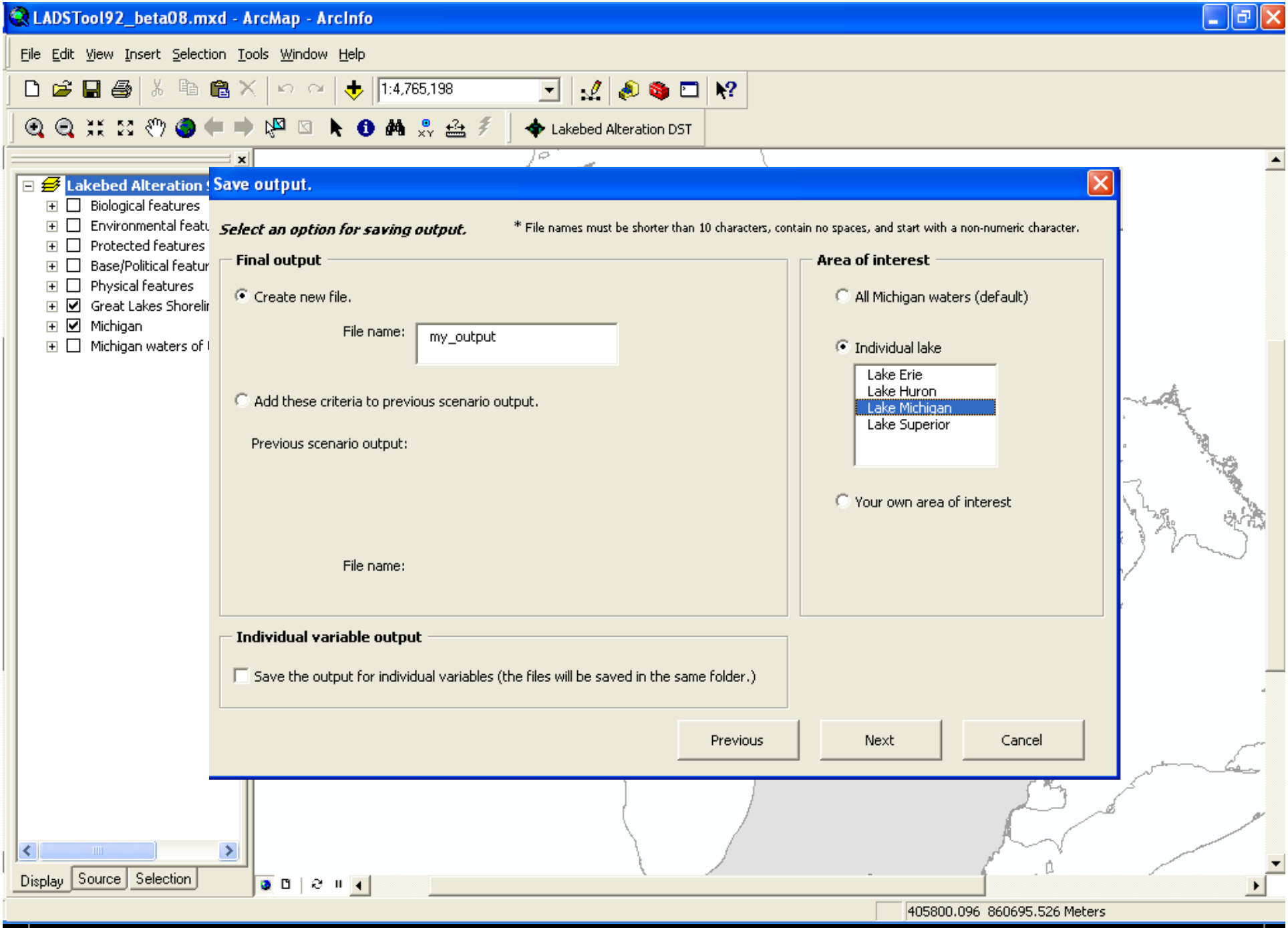
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Save output.
Select an option for saving output.
* File names must be shorter than 10 characters, contain no spaces, and start with a non-numeric character.
Final output
Create new file.
File name:
my_output
Add these criteria to previous scenario output.
Previous scenario output:
File name:
Area of interest
All Michigan waters (default)
Individual lake
Lake Erie
Lake Huron
Lake Michigan
Lake Superior
Your own area of interest
Individual variable output
Save the output for individual variables (the files will be saved in the same folder.)
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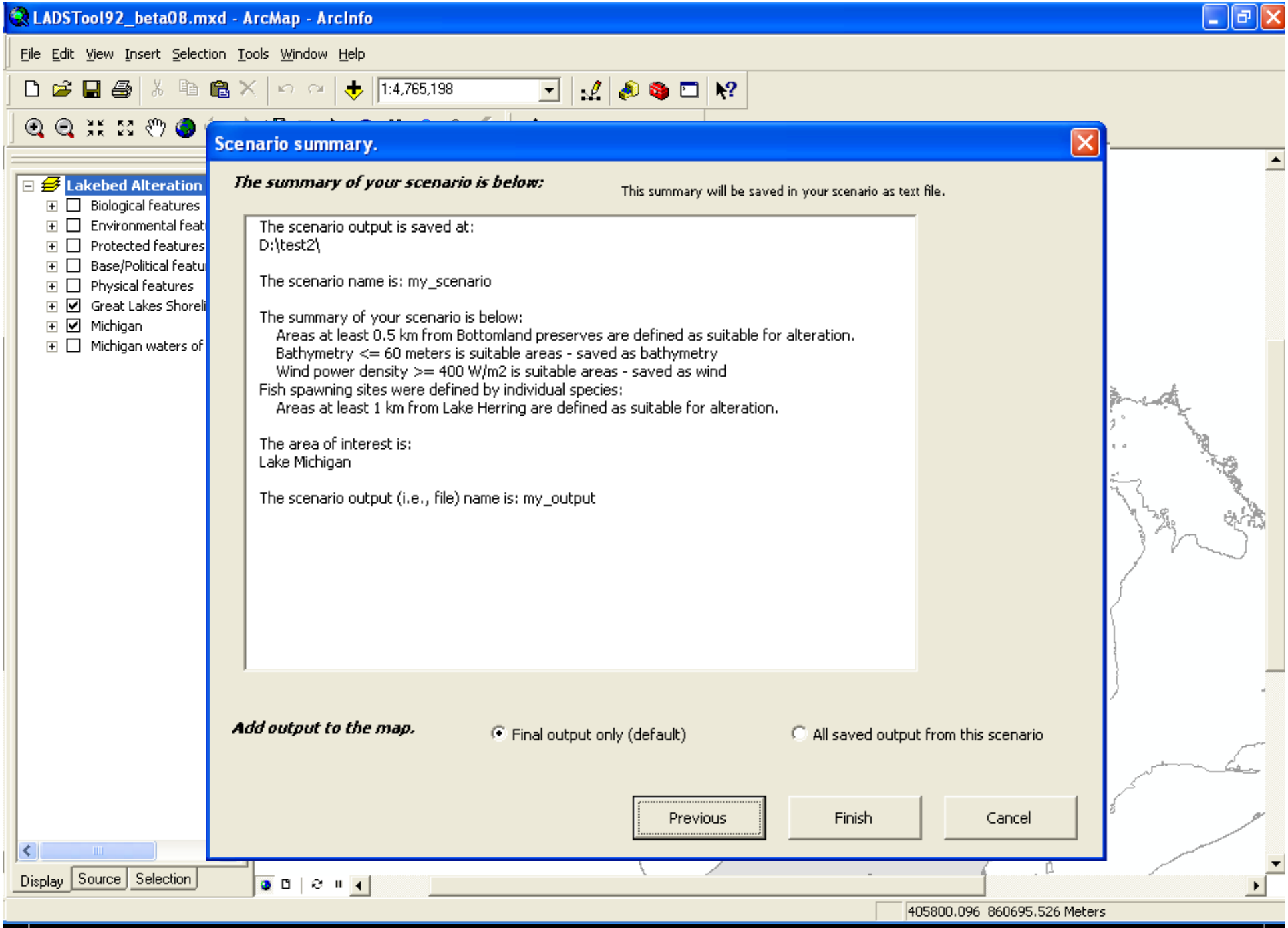
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Display Source Selection
Scenario summary.
The summary of your scenario is below:
This summary will be saved in your scenario as text file.
The scenario output is saved at:
D:\test2\
The scenario name is: my_scenario
The summary of your scenario is below:
Areas at least 0.5 km from Bottomland preserves are defined as suitable for alteration.
Bathymetry <= 60 meters is suitable areas - saved as bathymetry
Wind power density >= 400 W/m2 is suitable areas - saved as wind
Fish spawning sites were defined by individual species:
Areas at least 1 km from Lake Herring are defined as suitable for alteration.
The area of interest is:
Lake Michigan
The scenario output (i.e., file) name is: my_output
Add output to the map.
Final output only (default)
All saved output from this scenario
Previous
Finish
Cancel
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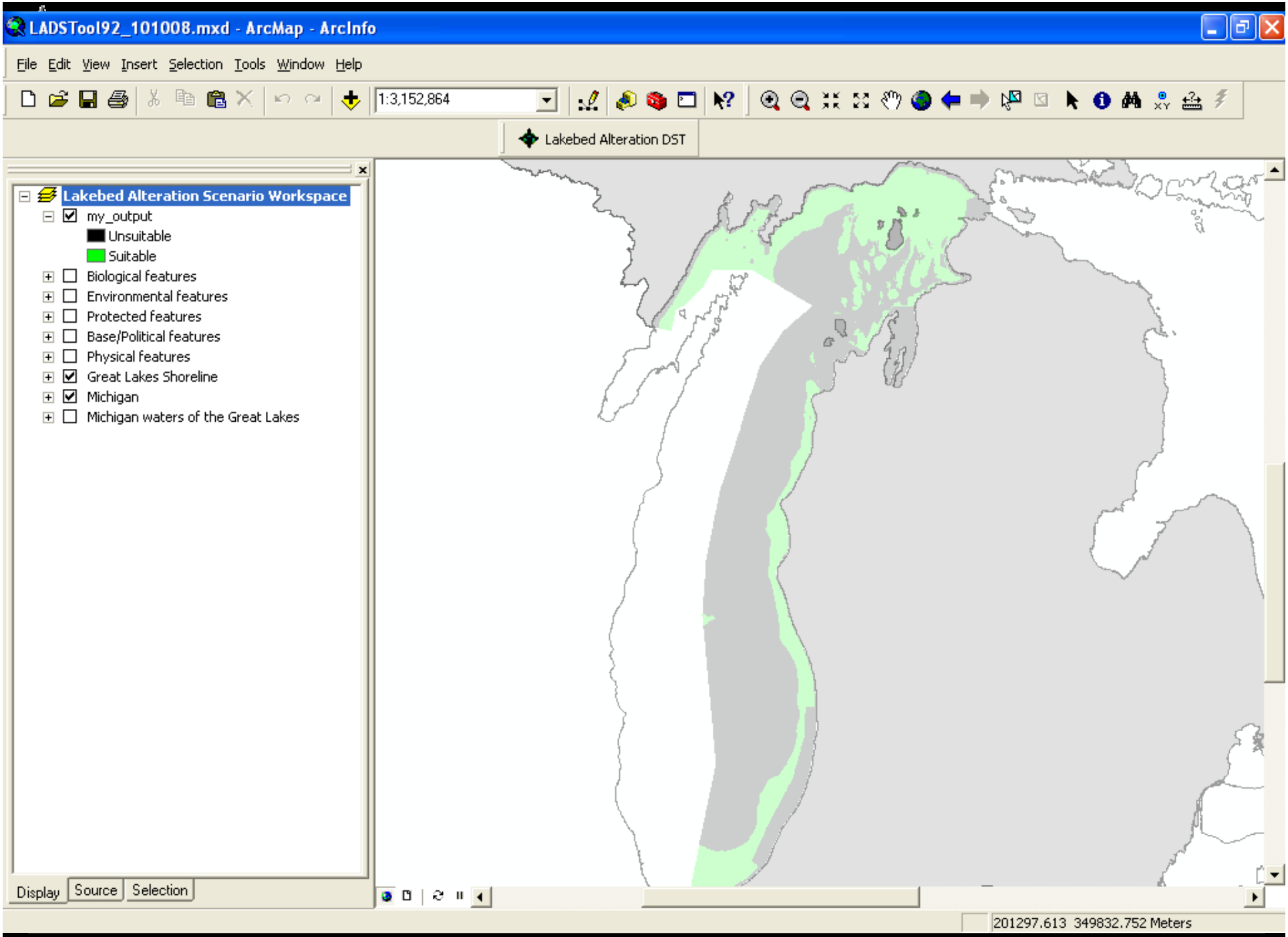

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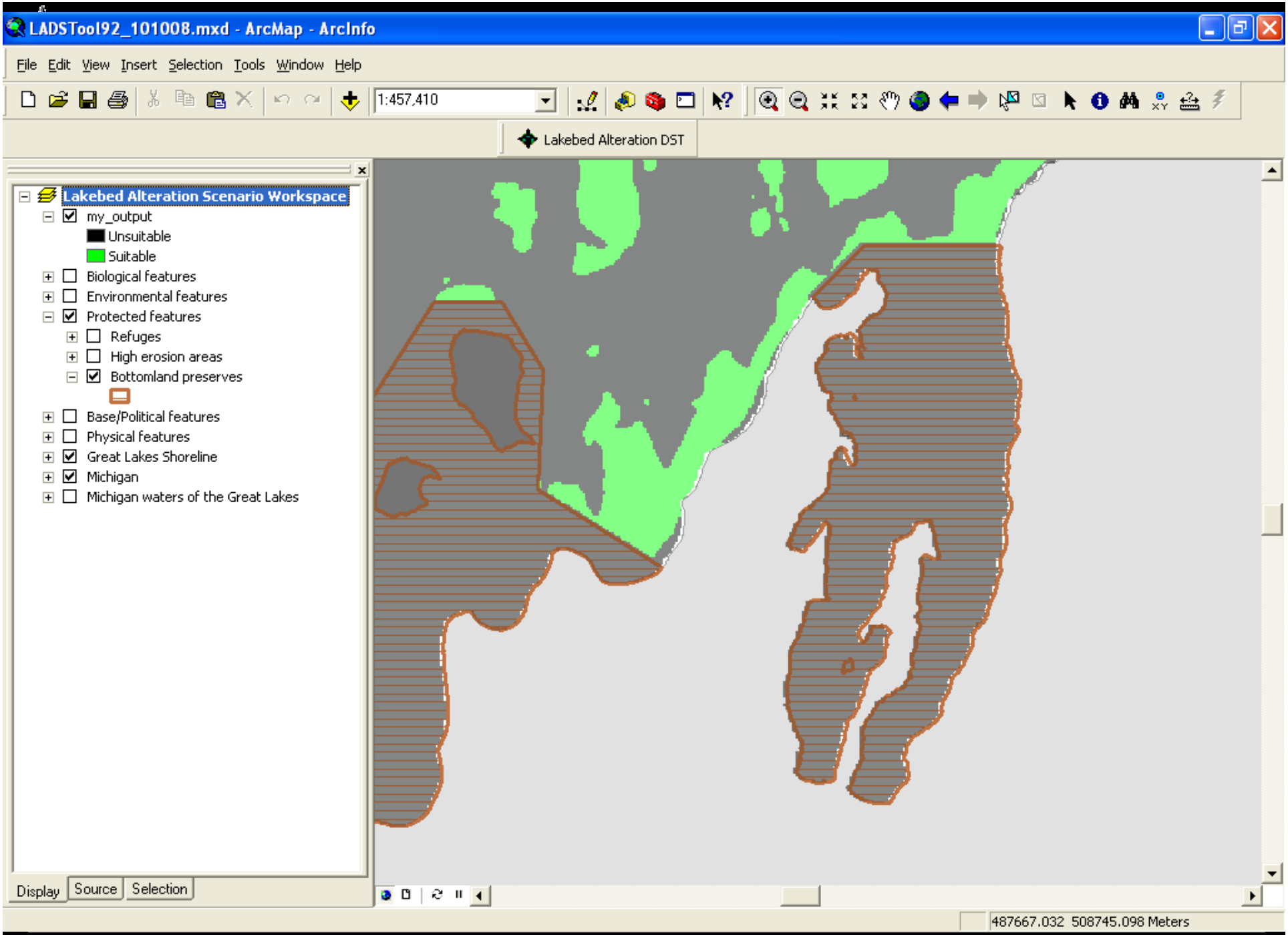
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High erosion areas
Bottomland preserves
Base/Political features
Physical features
Great Lakes Shoreline
Michigan
Michigan waters of the Great Lakes
Display
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Summary

- Strengths
  - Data visualization
  - Simplicity of tool
  - Efficient analysis
- Considerations
  - Tool efficiency vs Space requirements
  - Tool flexibility vs GIS knowledge

Future Direction

- Add sophistication to the tool.
    - e.g., a weighting mechanism
- Incorporate additional data.
    - e.g., Consent Decree, shipwrecks, ice coverage, trolling lanes
- Make tool more comprehensive.
    - e.g., hold workshops to clearly identify needs and values

Status

- First beta version was distributed in October 2008
- Project duration: 1 January 2008—31 March 2009
- Seeking support for next version with weighting mechanism.

Thank you to…

…the Michigan DEQ.

…for your attention.

Questions? Comments?

Contact Minako Kimura at mkimura@umich.edu
or Christine Geddes at cgeddes@umich.edu