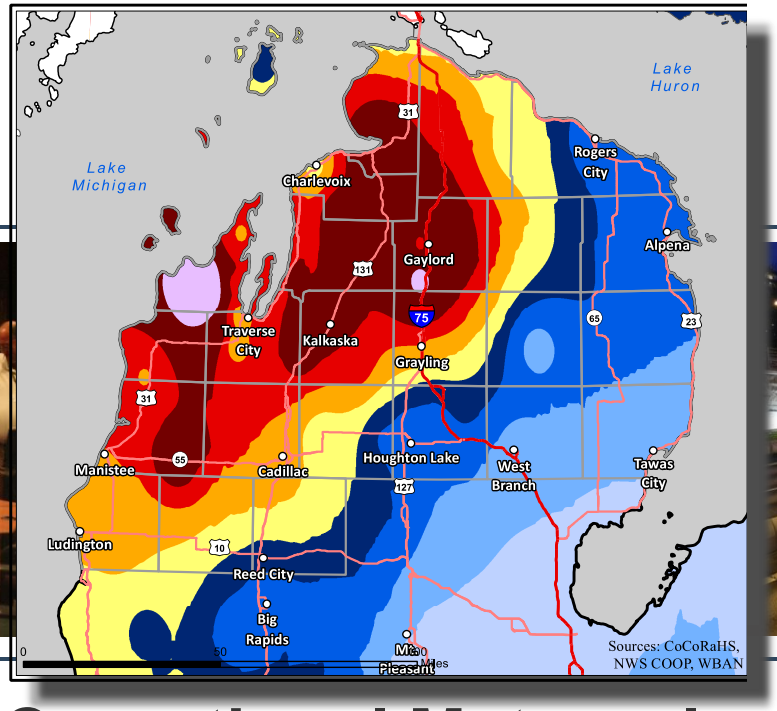
ITERIS®



Great Lakes Operational Meteorology Workshop

August 25, 2015

Grand Rapids, Michigan

-

Design Considerations for Road Weather Information Systems to Detect, Measure, and Support Forecasts for Lake Effect/Enhanced Snows

Bob Hart

Road Weather Information System (RWIS)

- Network of Environmental Sensor Stations (ESS)
- Purpose is to record and report:
  - Pavement temperature
  - Pavement condition
  - Weather conditions
  - Camera imagery of pavement & roadway environment
  - Traffic speeds & volume (optional)

Road Weather Information System (RWIS)

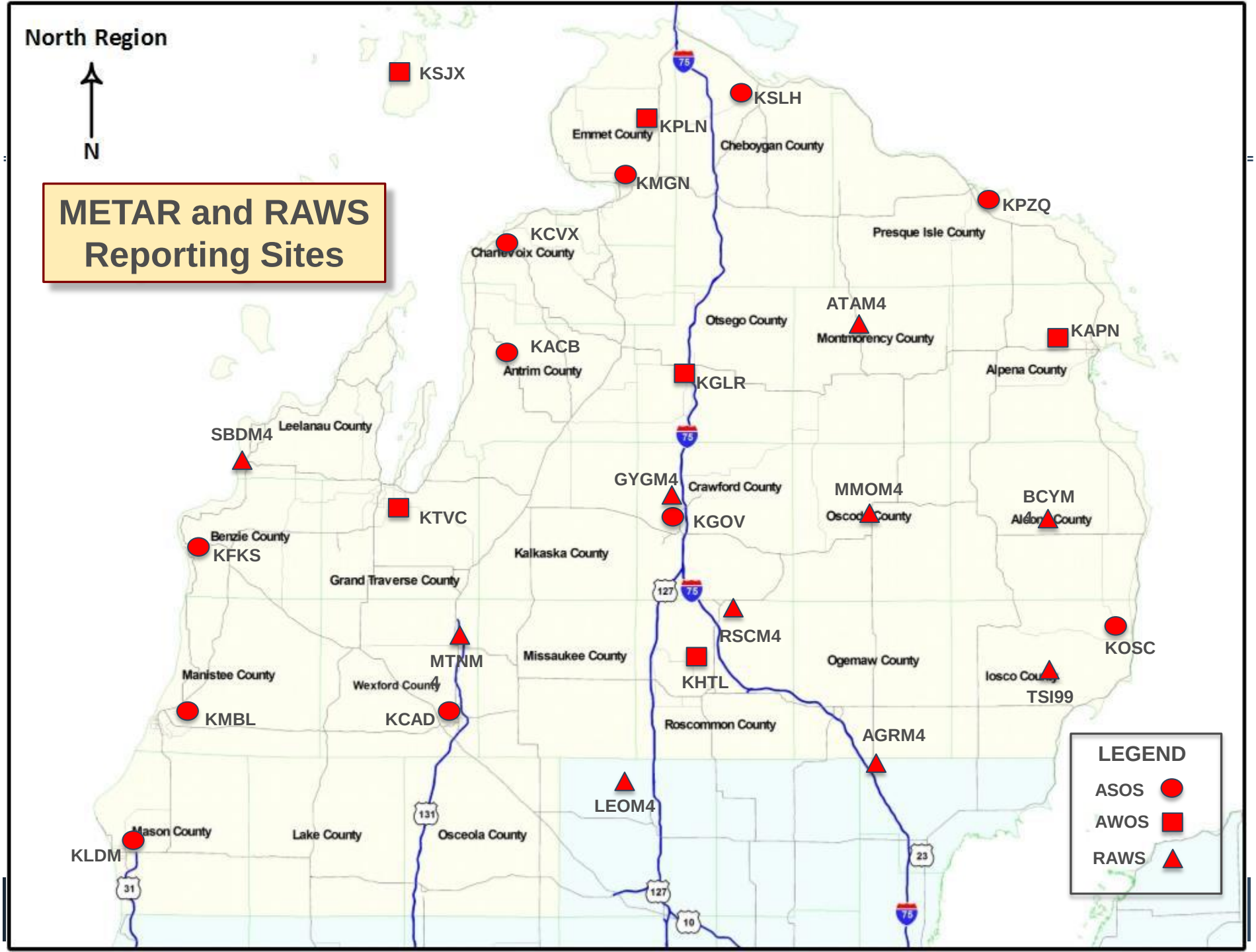
- Supports
  - DOT maintenance
  - Travelers
  - Weather service providers
    - To aid forecast products
    - To supplement analysis fields
  - Traffic management
  - Research organizations

RWIS Infrastructure

- Owner – typically state DOT
- ESS Network Implementation – typically done by DOT district or region
- Data Acquisition and Delivery
  - Managed by owner agency
  - Data collected from ESS remote processing unit using cellular or radio communications
  - Data transported to central processing center
  - Users typically access RWIS & weather data via web sites
    - Maintenance personnel & travelers

RWIS Network Design

- RWIS has been a transportation support system
- Design considerations for ESS sites
  - Evenly distributed network
    - To fairly support maintenance facilities
    - To provide representative data
  - Site selection to serve major traffic corridors
  - Critical local maintenance issues
    - Accident prone zones
    - Monitor remote areas away from maintenance facilities
    - Areas affected by local weather conditions
  - Fill gaps in existing weather networks


North Region
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METAR and RAWS Reporting Sites
KSJX
KSLH
KPLN
Emmet County
Cheboygan County
KMGN
KPZQ
Presque Isle County
KCVX
Charlevoix County
ATAM4
Otsego County
Montmorency County
KAPN
Alpena County
KACB
Antrim County
KGLR
SBDM4
Leelanau County
GYGM4
Crawford County
MMOM4
BCYM
KTVC
KGOV
Benzie County
KFKS
Kalkaska County
Grand Traverse County
RSCM4
KOSC
MTNM
Missaukee County
Ogemaw County
Manistee County
Wexford County
KHTL
Iosco County
TSI99
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KCAD
Roscommon County
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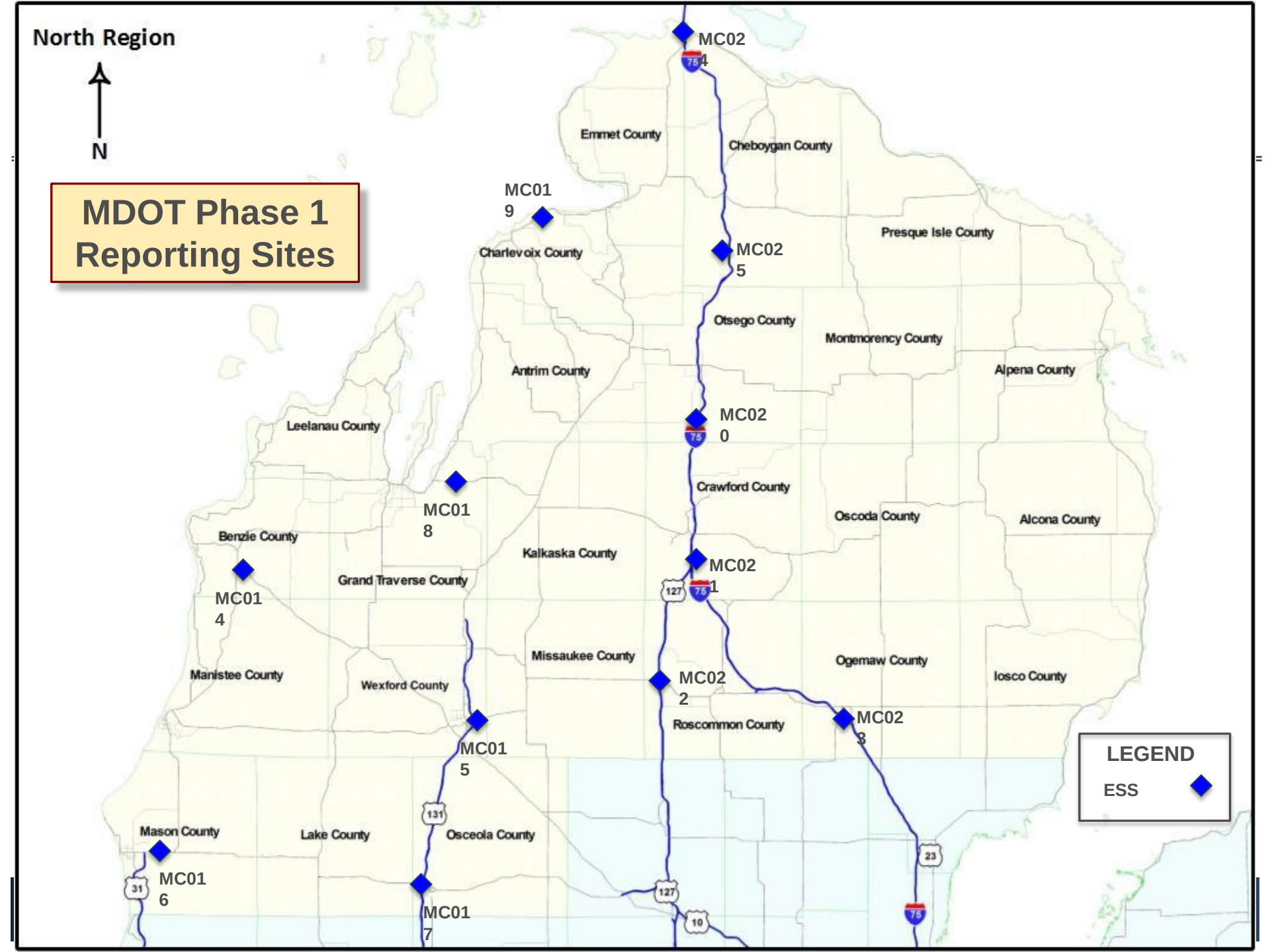
Mason County
Lake County
Osceola County
KLDM
LEGEND
ASOS
AWOS
RAWS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MC025
MC020
MC018
MC014
MC021
MC022
MC023
MC015
MC016
MC017
Emmet County
Cheboygan County
Charlevoix County
Presque Isle County
Otsego County
Montmorency County
Antrim County
Alpena County
Leelanau County
Crawford County
Oscoda County
Alcona County
Benzie County
Kalkaska County
Grand Traverse County
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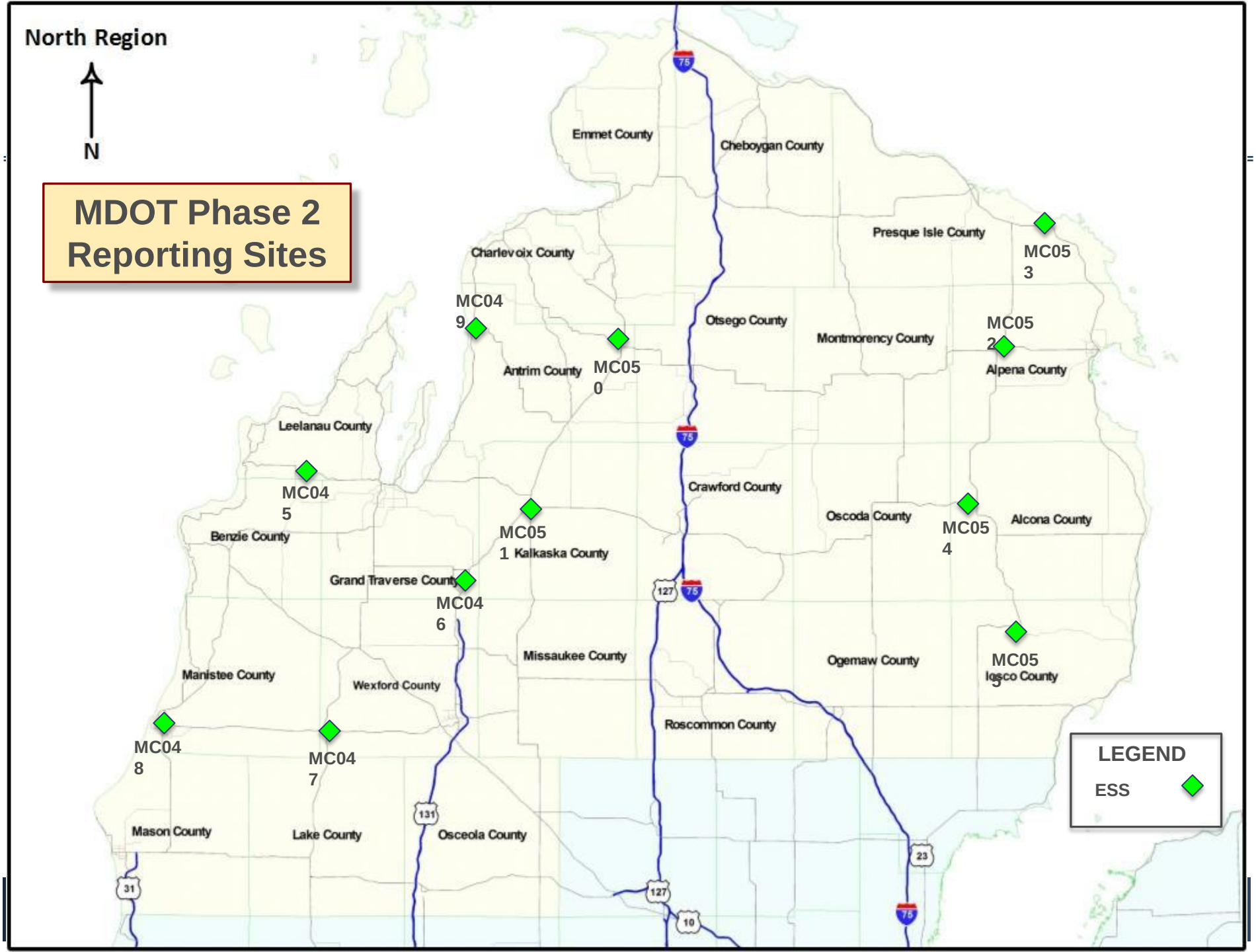
Mason County
Lake County
Osceola County
LEGEND
ESS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Charlevoix County
MC049
Otsego County
Montmorency County
MC052
Antrim County
MC050
Alpena County
Leelanau County
MC045
Crawford County
Oscoda County
MC054
Alcona County
Benzie County
MC051
Kalkaska County
Grand Traverse County
MC046
Missaukee County
Ogemaw County
MC055
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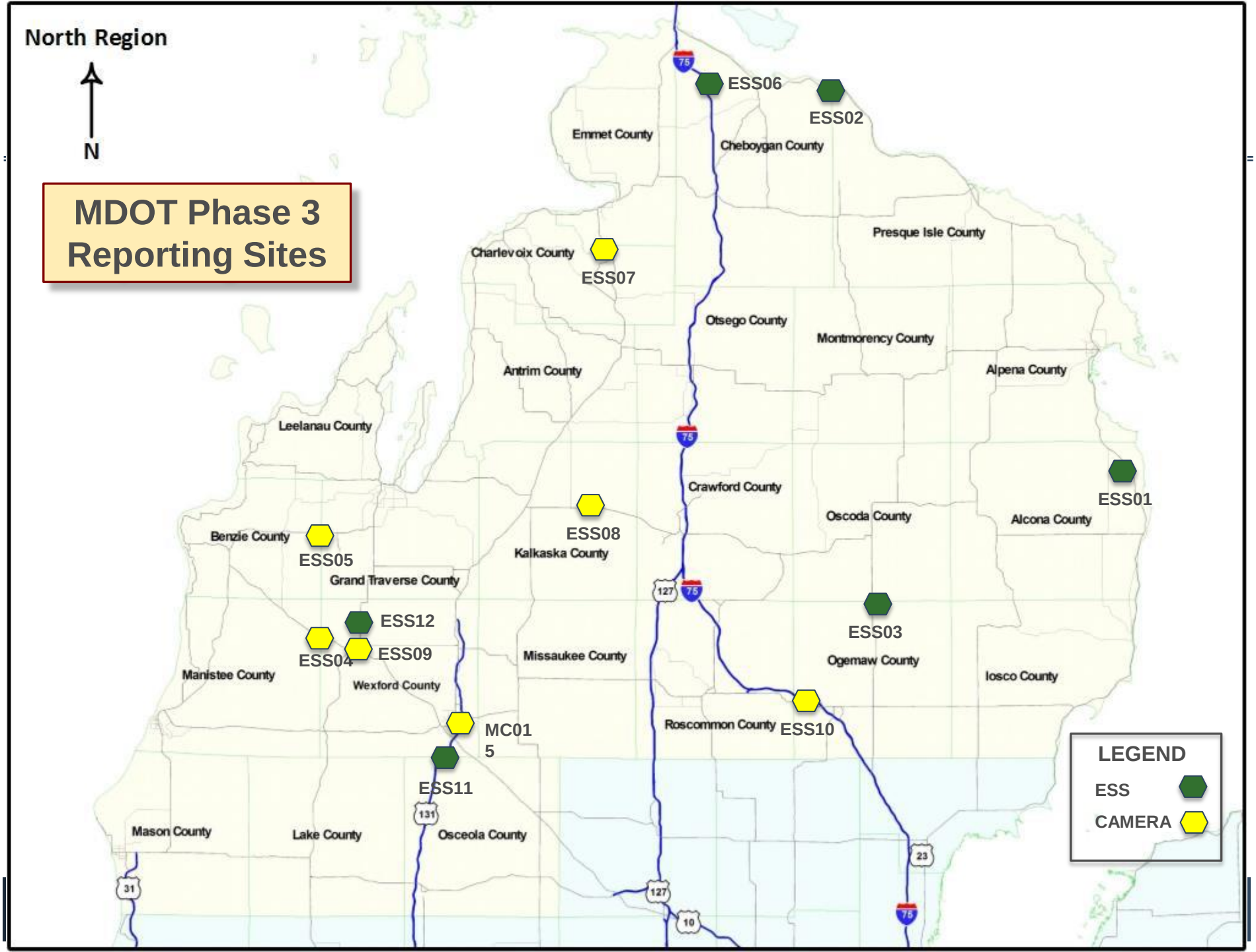
MC047
Mason County
Lake County
Osceola County
LEGEND
ESS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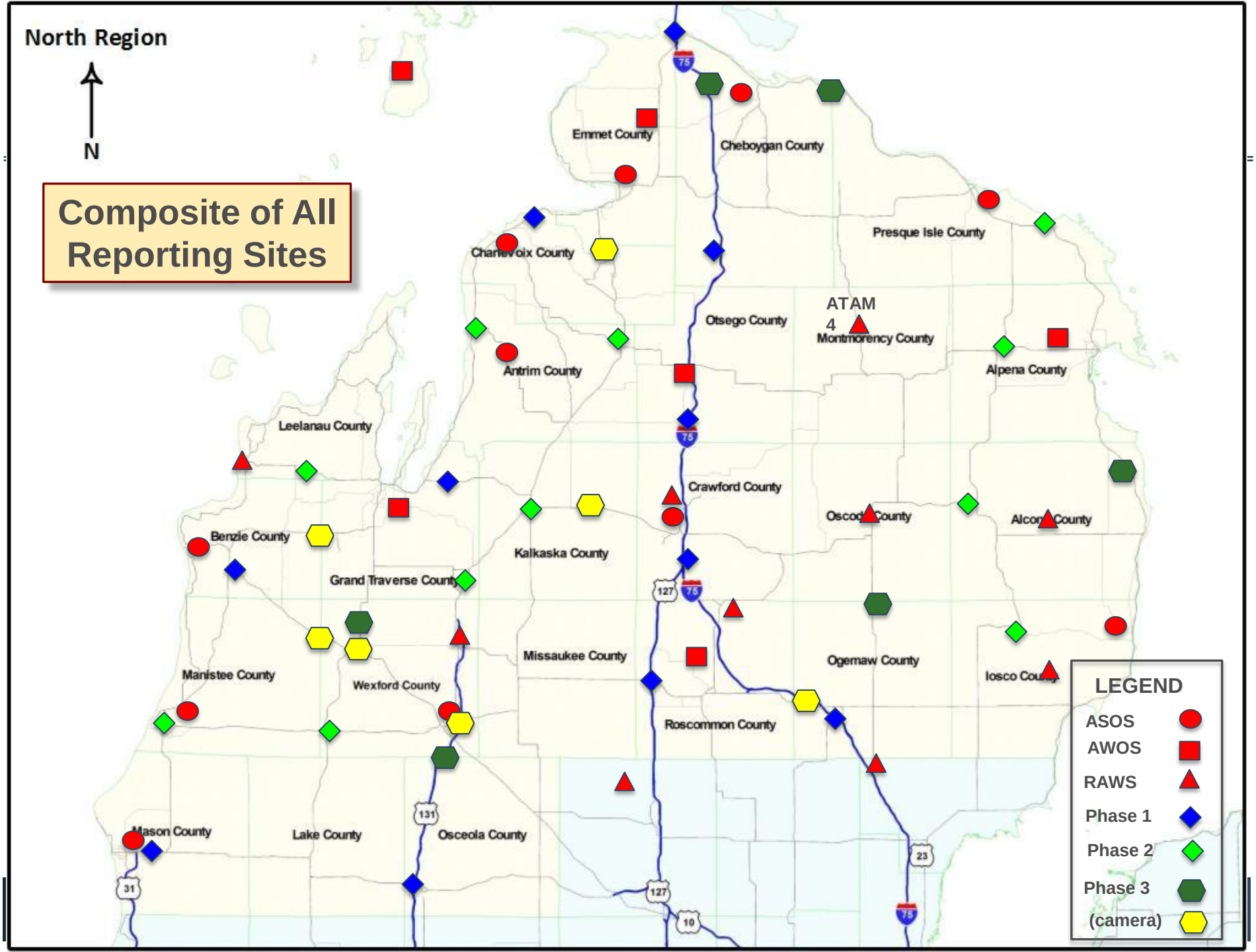
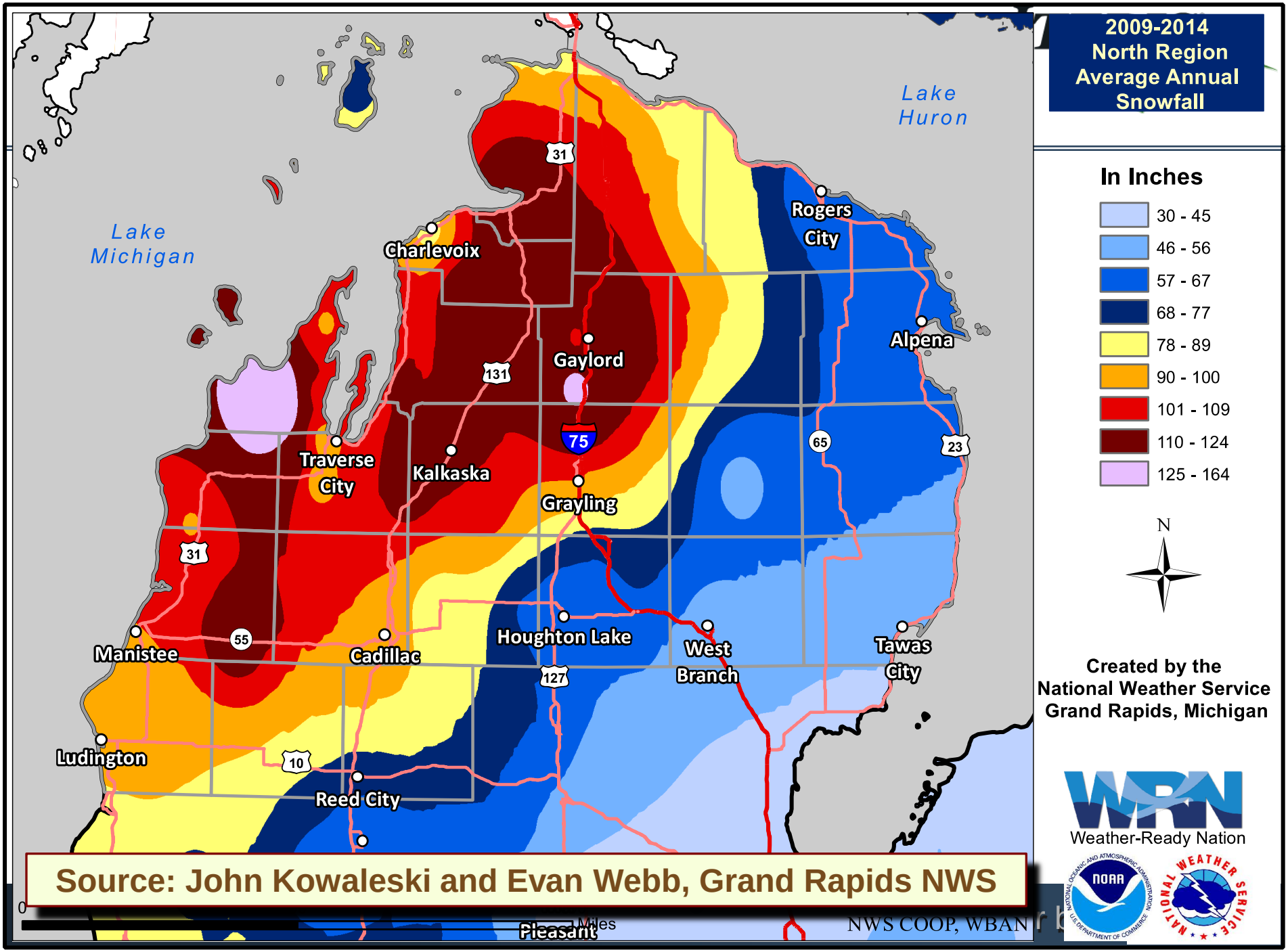
Presque Isle County
Charlevoix County
ESS07
Otsego County
Montmorency County
Antrim County
Alpena County
Leelanau County
Crawford County
ESS01
ESS08
Oscoda County
Alcona County
Benzie County
ESS05
Kalkaska County
Grand Traverse County
ESS12
ESS03
ESS04
ESS09
Missaukee County
Ogemaw County
Manistee County
Iosco County
Wexford County
Roscommon County
ESS10
MC01
5
ESS11
Mason County
Lake County
Osceola County
LEGEND
ESS
CAMERA


North Region
N
Composite of All Reporting Sites
Emmet County
Cheboygan County
Presque Isle County
Charlevoix County
Otsego County
ATAM
4
Montmorency County
Alpena County
Antrim County
Leelanau County
Crawford County
Benzie County
Kalkaska County
Grand Traverse County
Missaukee County
Ogemaw County
Manistee County
Wexford County
Roscommon County
Mason County
Lake County
Osceola County
LEGEND
ASOS
AWOS
RAWS
Phase 1
Phase 2
Phase 3
(camera)


2009-2014
North Region
Average Annual
Snowfall
In Inches
30 - 45
46 - 56
57 - 67
68 - 77
78 - 89
90 - 100
101 - 109
110 - 124
125 - 164
N
Lake
Michigan
Lake
Huron
Charlevoix
Rogers
City
Alpena
Gaylord
Traverse
City
Kalkaska
Grayling
Manistee
Cadillac
Houghton Lake
West
Branch
Tawas
City
Ludington
Reed City
Pleasant
31
131
75
65
23
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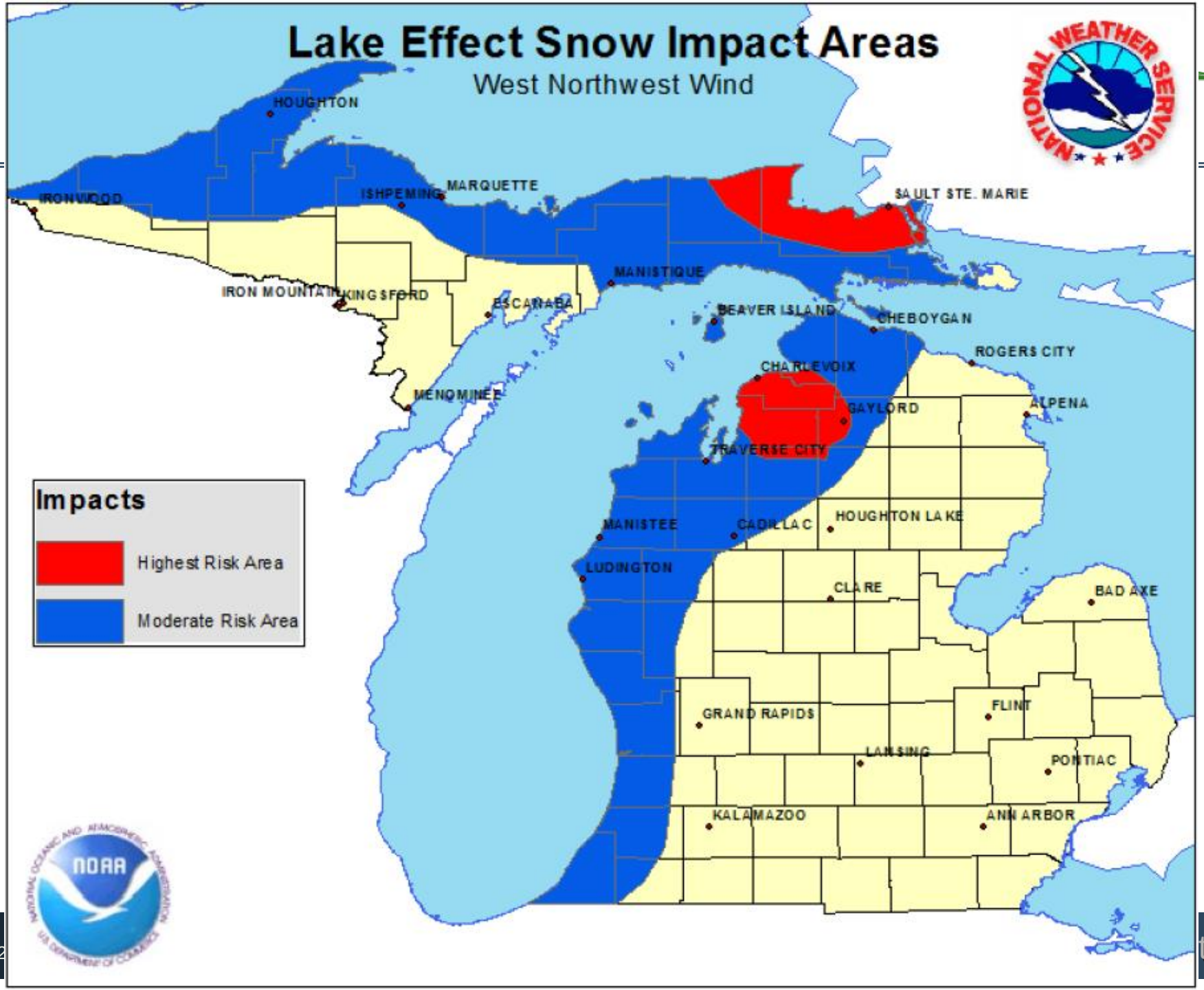
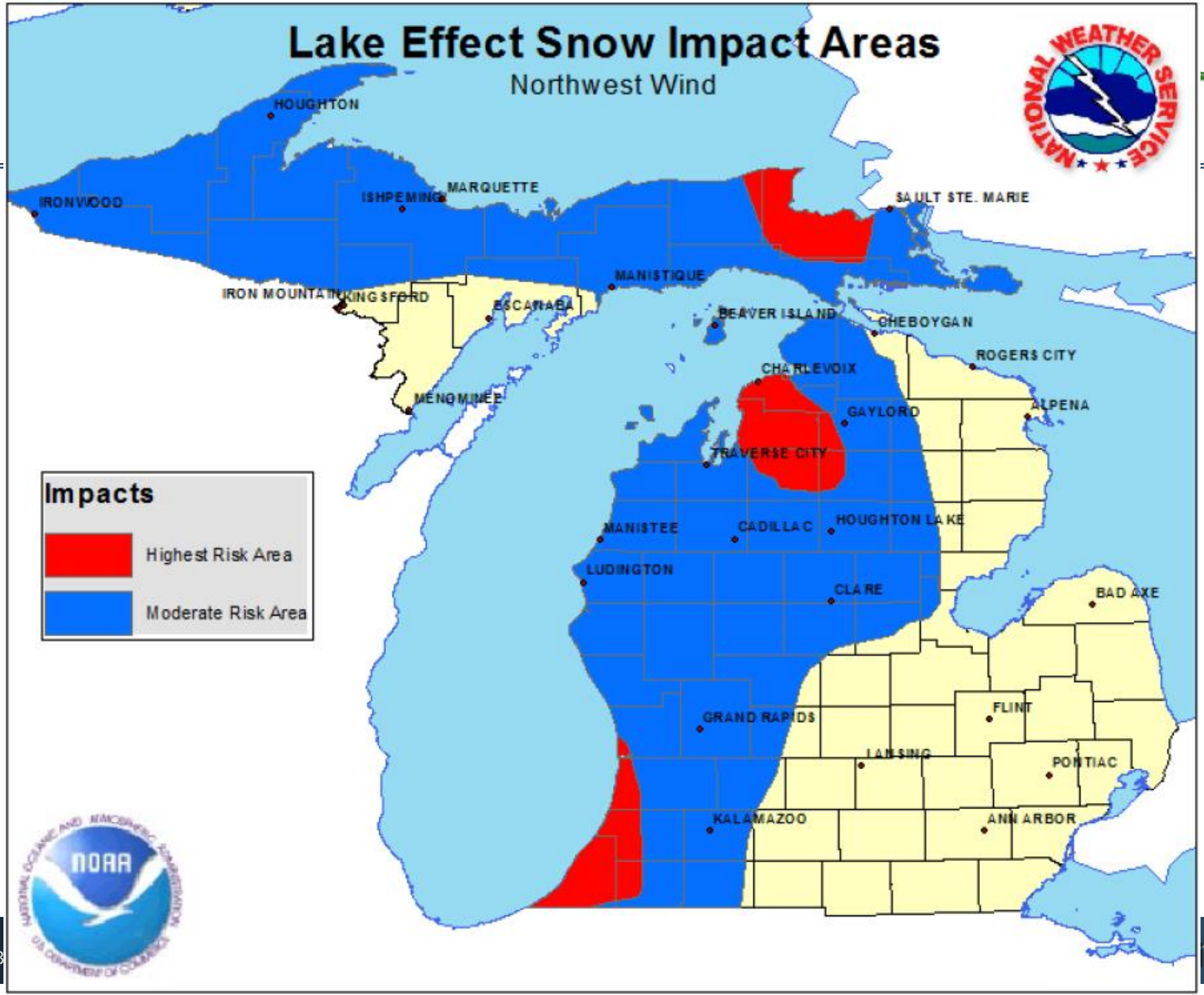
127
10
Created by the
National Weather Service
Grand Rapids, Michigan
Source: John Kowaleski and Evan Webb, Grand Rapids NWS
0
Miles
NWS COOP, WBAN
Weather-Ready Nation
NOAA
NATIONAL WEATHER SERVICE


Lake Effect Snow Impact Areas
West Northwest Wind
NATIONAL WEATHER SERVICE
HOUGHTON
IRONWOOD
ISHPEMING
MARQUETTE
SAULT STE. MARIE
IRON MOUNTAIN
KINGSFORD
ESCANABA
MANISTIQUE
BEAVER ISLAND
CHEBOYGAN
ROGERS CITY
CHARLEVOIX
MENOMINEE
GAYLORD
ALPENA
TRAVERSE CITY
MANISTEE
CADILLAC
HOUGHTON LAKE
LUDINGTON
CLARE
BAD AXE
GRAND RAPIDS
FLINT
LANSING
PONTIAC
KALAMAZOO
ANN ARBOR
Impacts
Highest Risk Area
Moderate Risk Area
NOAA


Lake Effect Snow Impact Areas
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ESCANABA
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MENOMINEE
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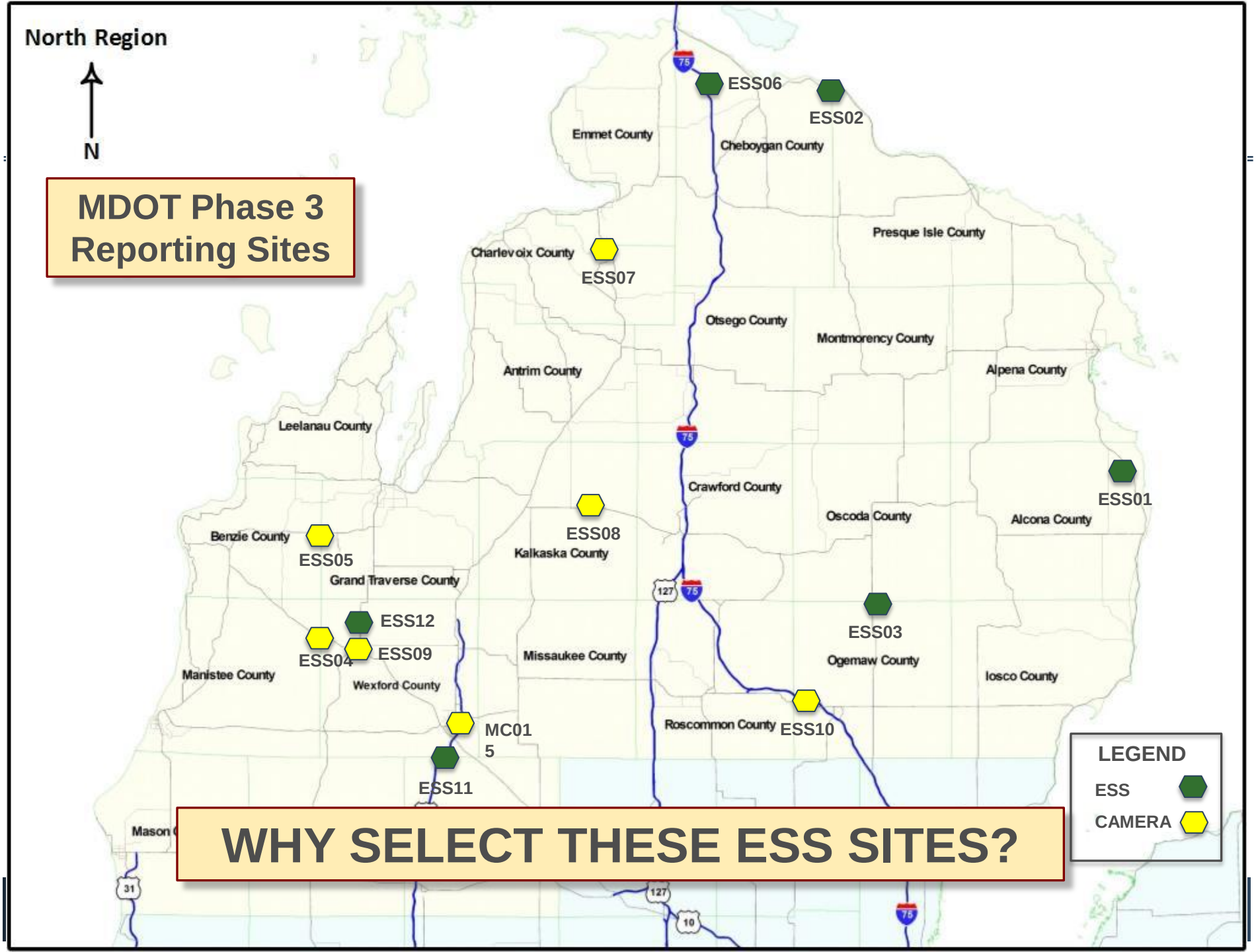
ANN ARBOR


North Region
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Missaukee County
Ogemaw County
Manistee County
Iosco County
Wexford County
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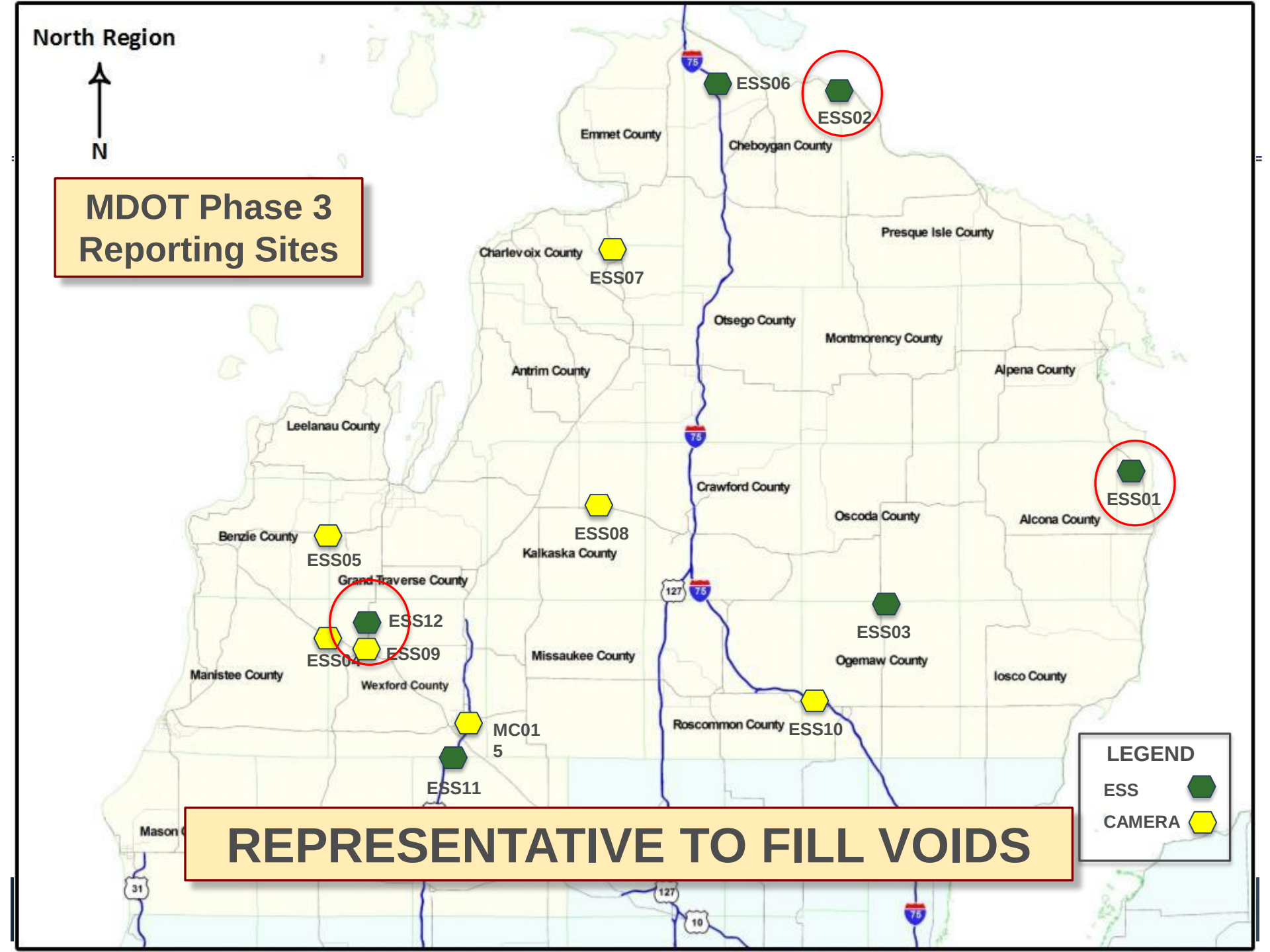
ESS11
Mason
WHY SELECT THESE ESS SITES?
LEGEND
ESS
CAMERA


North Region
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LEGEND
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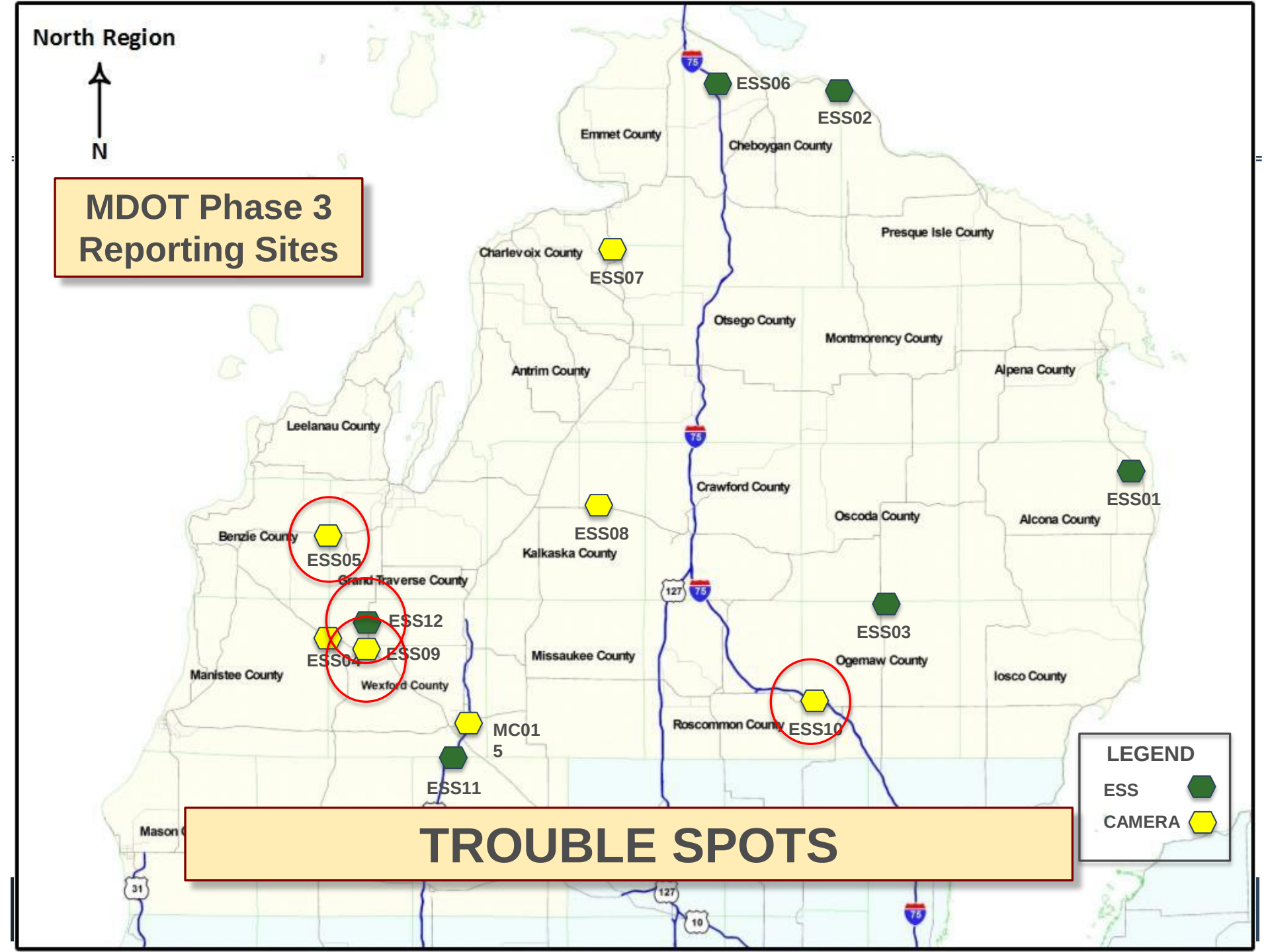
CAMERA
REPRESENTATIVE TO FILL VOIDS


North Region
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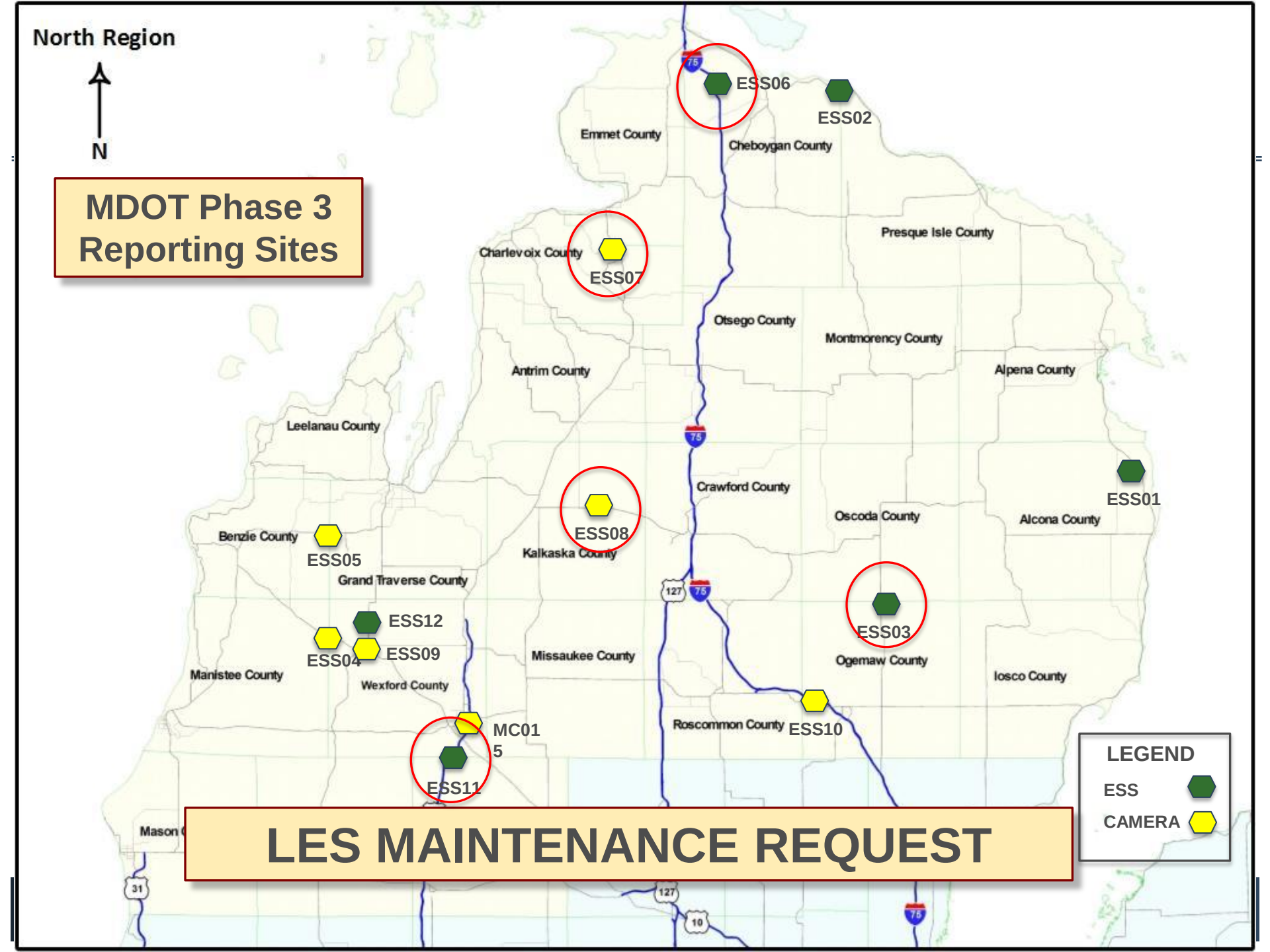
Mason
LEGEND
ESS
CAMERA
TROUBLE SPOTS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Grand Traverse County
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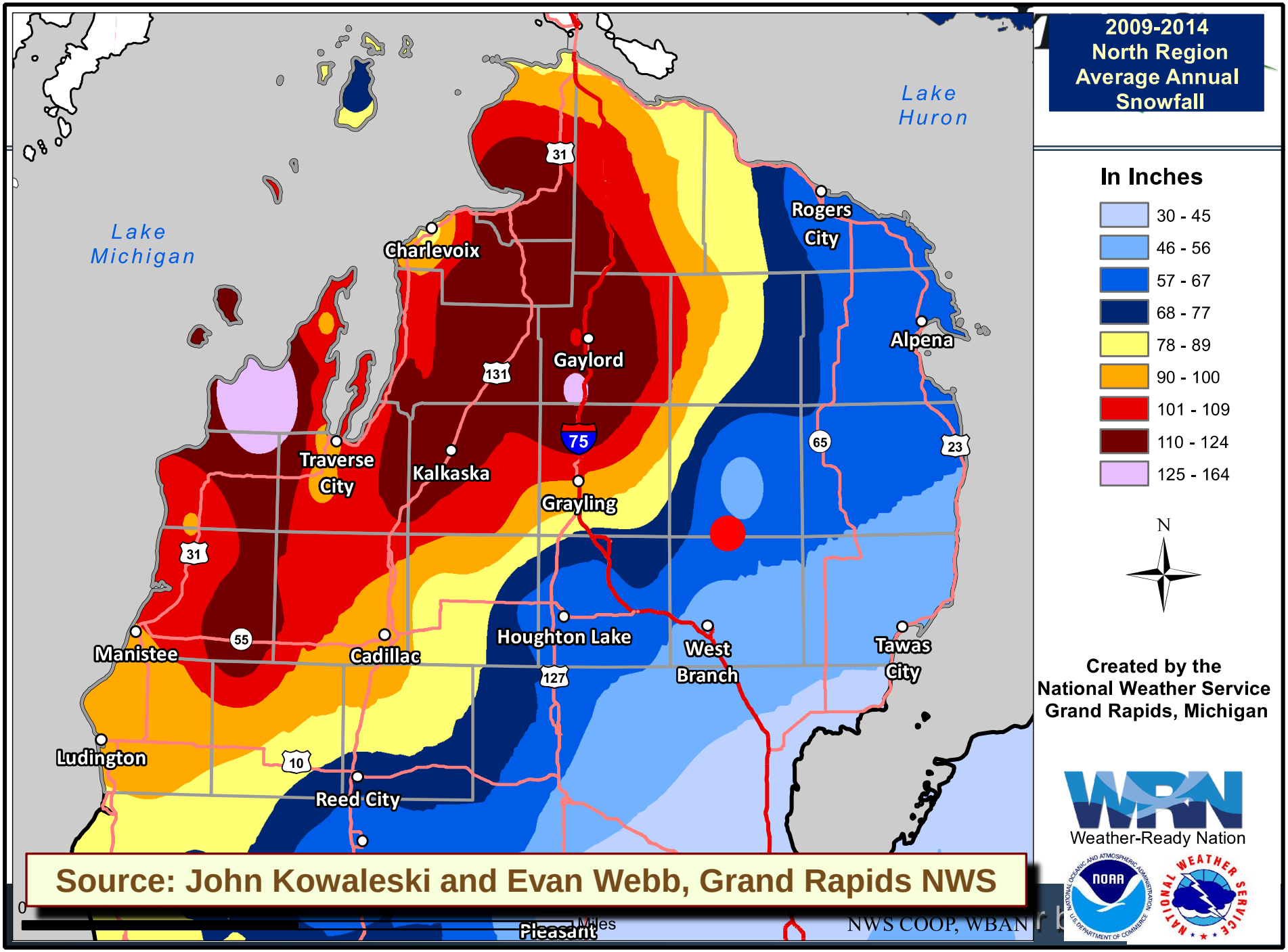
Missaukee County
Ogemaw County
Manistee County
Wexford County
Iosco County
MC01
5
Roscommon County
ESS10
ESS11
Mason
LES MAINTENANCE REQUEST
LEGEND
ESS
CAMERA

LAKE EFFECT SNOW SITES

- ESS06 – I-75 & Levering Road
  - Break point in rise from Lake Michigan (577’) to 800’ plateau extending south for 40 miles
- ESS07 – US-131 8 miles south of Petoskey
  - 1 mile long hill climbing from 780’ to 915’
- ESS08 - M-72 10 east if Kalkaska
  - West edge of N/S moraine 170 feet above the Boardman River drainage plain
- ESS11 – US-131 @ Wexford SCL
  - On upslope from 1200’ to 1400’ into Cadillac highlands
  - Westerly flow funneled up the Pine River basin

LAKE EFFECT SNOW SITES

- ESS03 – M-33 @ Loon Lake
  - Morainal dome that is 200+ feet higher than surrounding plateau
  - Affected by northwest LES flow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101 - 109
110 - 124
125 - 164
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Michigan
Lake
Huron
Charlevoix
Rogers
City
Alpena
Gaylord
Traverse
City
Kalkaska
Grayling
Manistee
Cadillac
Houghton Lake
West
Branch
Tawas
City
Ludington
Reed City
Pleasant
31
131
75
65
23
55
127
10
Created by the
National Weather Service
Grand Rapids, Michigan
Weather-Ready Nation
Source: John Kowaleski and Evan Webb, Grand Rapids NWS
0
Miles
NWS COOP, WBAN

LAKE EFFECT SNOW SITES

- Key Criteria for Determining LES Sites
  - Experience of MDOT winter maintenance personnel
  - Routine travelers
  - Highway patrol

PRIMARY LES MONITORING TOOLS

- Cameras
  - Multiple views
    - Road surface
    - Views along highway
  - This is MDOT preferred resource
- Present weather sensor
  - Precipitation type
  - Precipitation rate
  - Visibility
  - Most effective sensor is the WIVIS sensor (equivalent to the LEDWI)
- Other support
  - Temp/RH and winds

QUESTIONS?

Thank you,

Bob Hart

rdh@iteris.com