Appendix E: Plate 1

Population Density and Building Location
Clackamas County, Oregon

MULTNOMAH CO.
CLACKAMAS CO.
WASHINGTON CO.
YAMHILL CO.
MARION CO.
HOOD RIVER CO.
WASCO CO.

Milwaukie
Happy Valley
Boring
Sandy
Oregon City
Mount Hood Village
Government Camp
Wilsonville
Estacada
Canby
Molalla
Ripplebrook

99W
99E
5
26
224
213

Permanent Residents Per 20-Acre Cell

- 0 (Building(s) present, no permanent residents)
- 1–5
- 6–10
- 11–20
- 21–50
- 51–100
- 101–200
- 201–500
- 501–1,000
- 1,001–2,000

Floating structures and buildings less than 400 square feet not included in building count

0 2.5 5 10 Miles
0 4 8 16 Kilometers

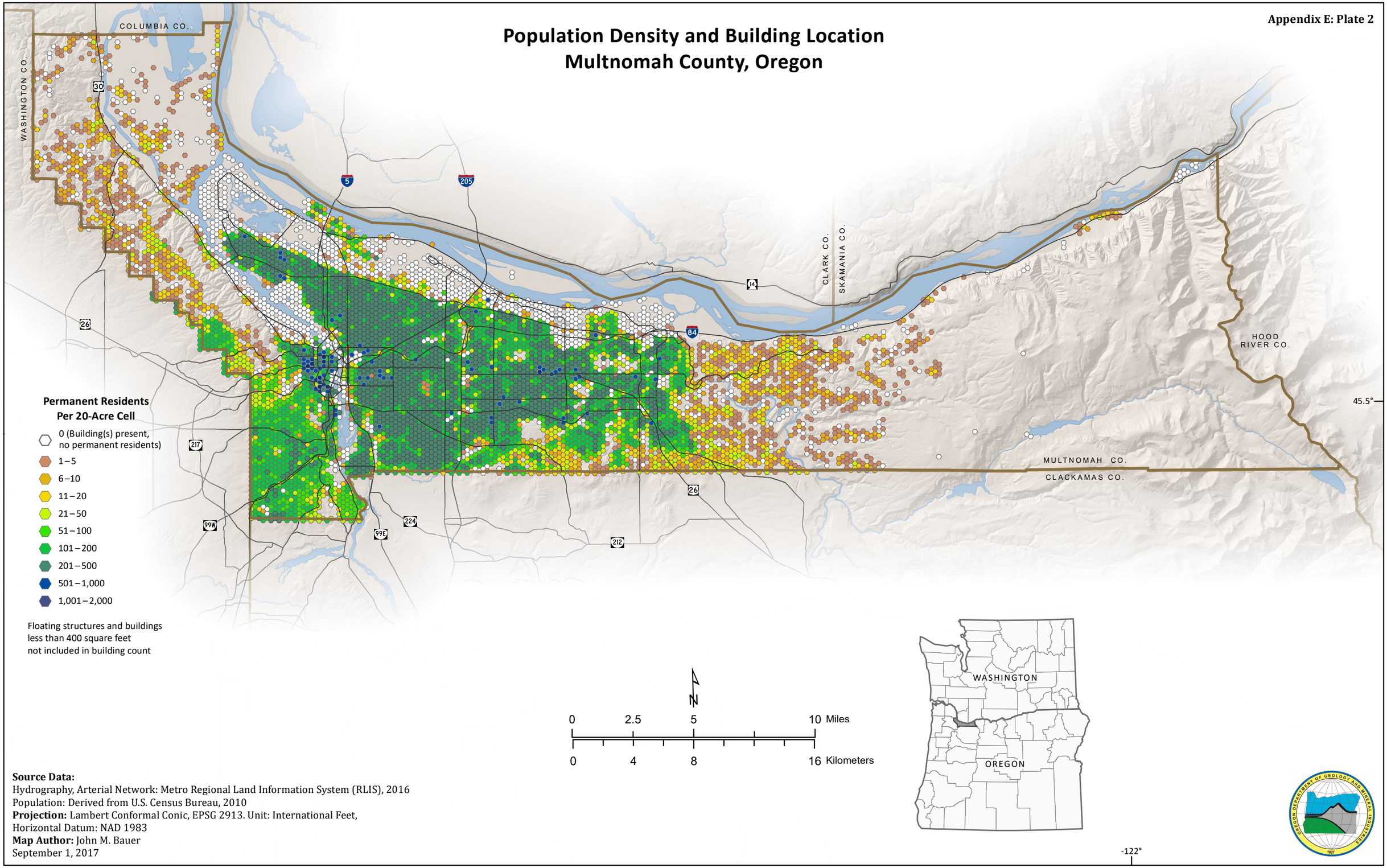
WASHINGTON
OREGON

45°
-122°

Source Data:
Hydrography, Arterial Network: Metro Regional Land Information System (RLIS), 2016
Population: Derived from U.S. Census Bureau, 2010
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet,
Horizontal Datum: NAD 1983
Map Author: John M. Bauer
September 1, 2017

Appendix E: Plate 2

Population Density and Building Location
Multnomah County, Oregon



Source Data:
Hydrography, Arterial Network: Metro Regional Land Information System (RLIS), 2016
Population: Derived from U.S. Census Bureau, 2010
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet,
Horizontal Datum: NAD 1983
Map Author: John M. Bauer
September 1, 2017

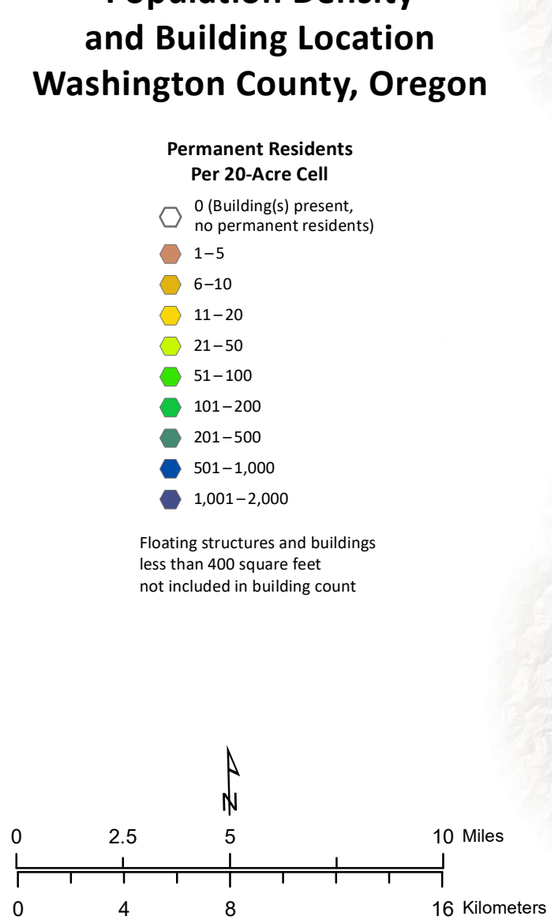
Appendix E: Plate 3

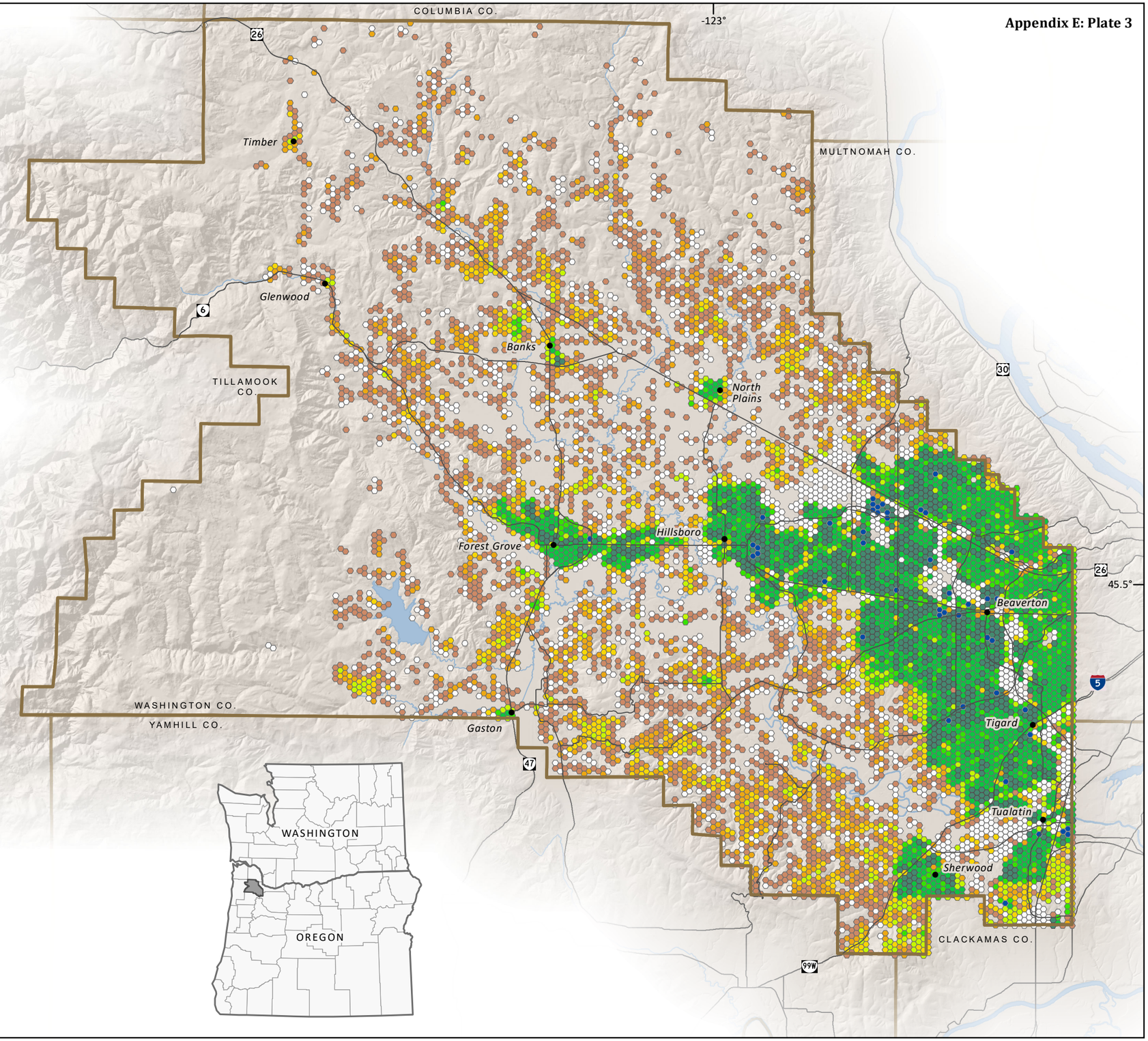
Population Density and Building Location Washington County, Oregon

Permanent Residents Per 20-Acre Cell

- 0 (Building(s) present, no permanent residents)
- 1–5
- 6–10
- 11–20
- 21–50
- 51–100
- 101–200
- 201–500
- 501–1,000
- 1,001–2,000

Floating structures and buildings less than 400 square feet not included in building count





Source Data:
Hydrography, Arterial Network: Metro Regional Land Information System (RLIS), 2016
Population: Derived from U.S. Census Bureau, 2010
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
September 1, 2017

Appendix E: Plate 4

Site Peak Ground Acceleration

Simulated Cascadia Subduction Zone Magnitude 9.0 Earthquake

-123°

45.5°

Scappoose
COLUMBIA CO.
Timber
Glenwood
Burlington
Vancouver
Cascade Locks
Tualatin Mountains
TILLAMOOK CO.
Banks
North Plains
Camas
CLARK CO.
SKAMANIA CO.
Rockcreek
Maywood Park
Cedar Mill
Forest Grove
Cornelius
Hillsboro
Wood Village
Gresham
Aloha
Beaverton
Raleigh Hills
MULTNOMAH CO.
CLACKAMAS CO.
WASHINGTON CO.
Gaston
YAMHILL CO.
Milwaukie
Happy Valley
Boring
Tigard
Sunnyside
Lake Oswego
Oak Grove
King City
Johnson City
Sandy
Brightwood
Mount Hood Village
Tualatin
Gladstone
Sherwood
Oregon City
Rhododendron
Government Camp
Wilsonville
Estacada
HOOD RIVER CO.
WASCO CO.
Canby
MARION CO.
Barlow
Molalla
Ripplebrook
Scotts Mills

Site Peak Ground Acceleration (g)

- < 0.05
- 0.05 – 0.10
- 0.10 – 0.15
- 0.15 – 0.20
- 0.20 – 0.25
- 0.25 – 0.30
- 0.30 – 0.35
- 0.35 – 0.40
- 0.40 – 0.45

N

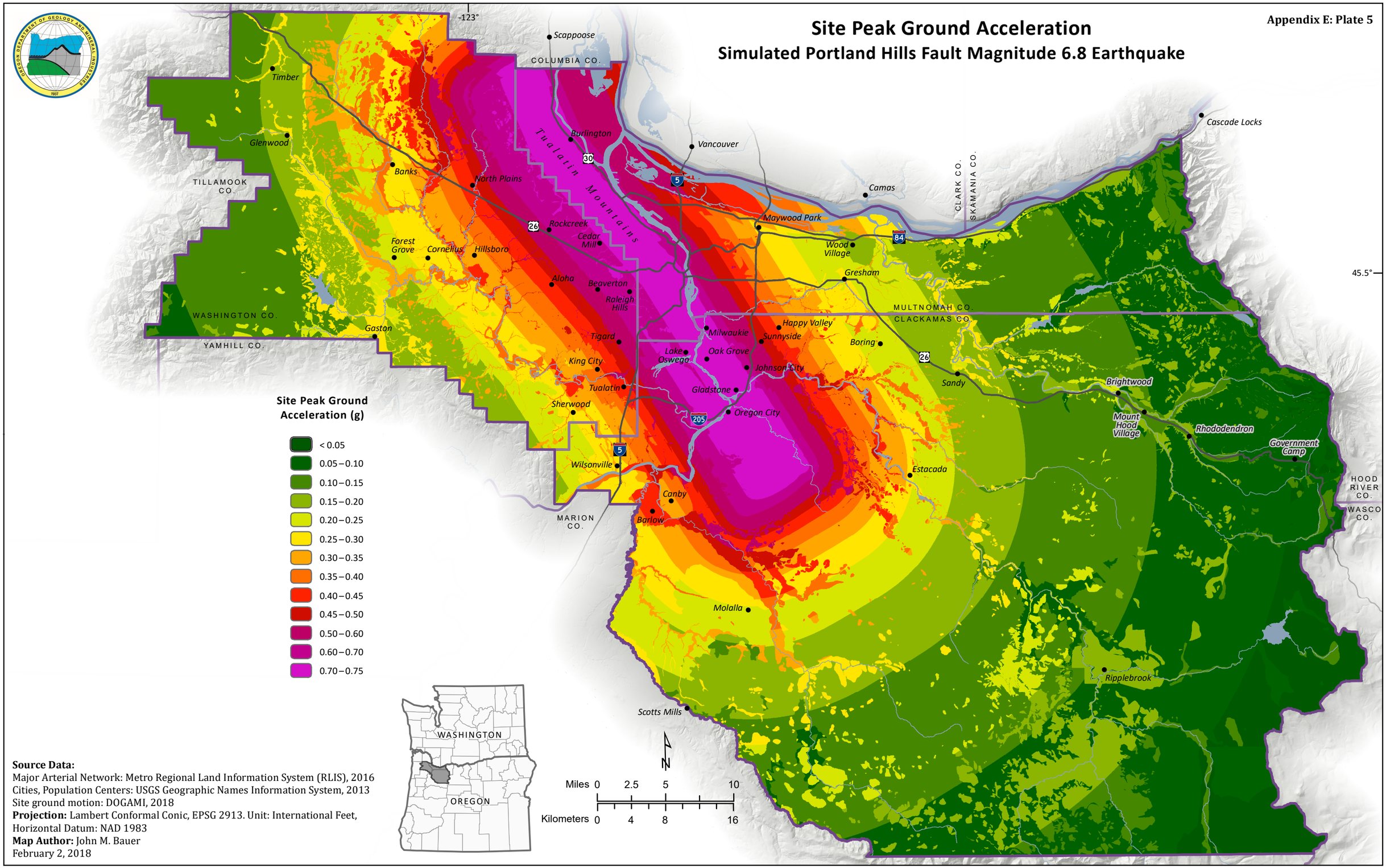
Miles 0 2.5 5 10

Kilometers 0 4 8 16

Source Data:
Major Arterial Network: Metro Regional Land Information System (RLIS), 2016
Cities, Population Centers: USGS Geographic Names Information System, 2013
Site ground motion: DOGAMI, 2018
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 2, 2018

Appendix E: Plate 5

Site Peak Ground Acceleration
Simulated Portland Hills Fault Magnitude 6.8 Earthquake

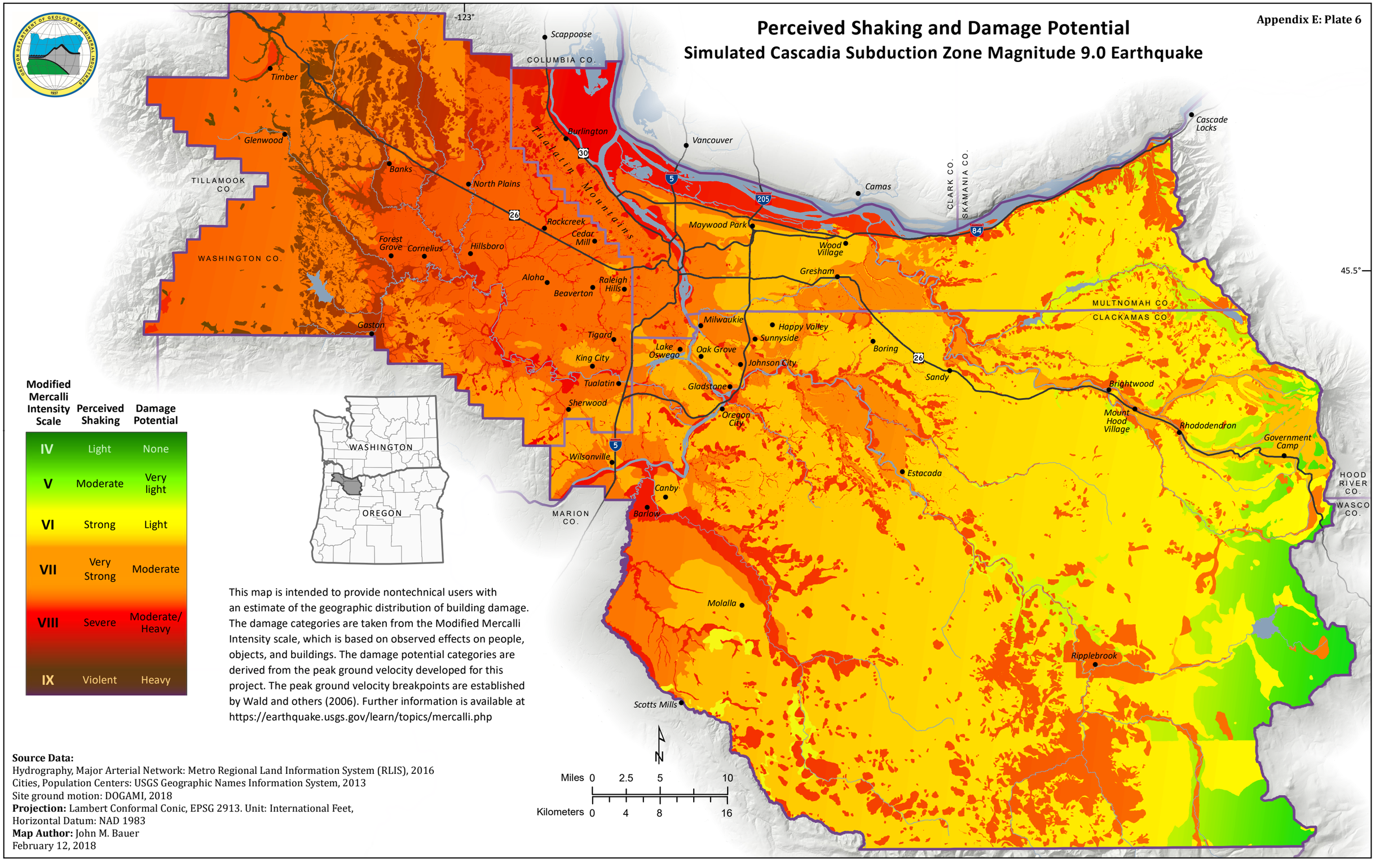


Source Data:
Major Arterial Network: Metro Regional Land Information System (RLIS), 2016
Cities, Population Centers: USGS Geographic Names Information System, 2013
Site ground motion: DOGAMI, 2018
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 2, 2018

Appendix E: Plate 6

Perceived Shaking and Damage Potential

Simulated Cascadia Subduction Zone Magnitude 9.0 Earthquake



Modified Mercalli Intensity Scale	Perceived Shaking	Damage Potential
IV	Light	None
V	Moderate	Very light
VI	Strong	Light
VII	Very Strong	Moderate
VIII	Severe	Moderate/ Heavy
IX	Violent	Heavy

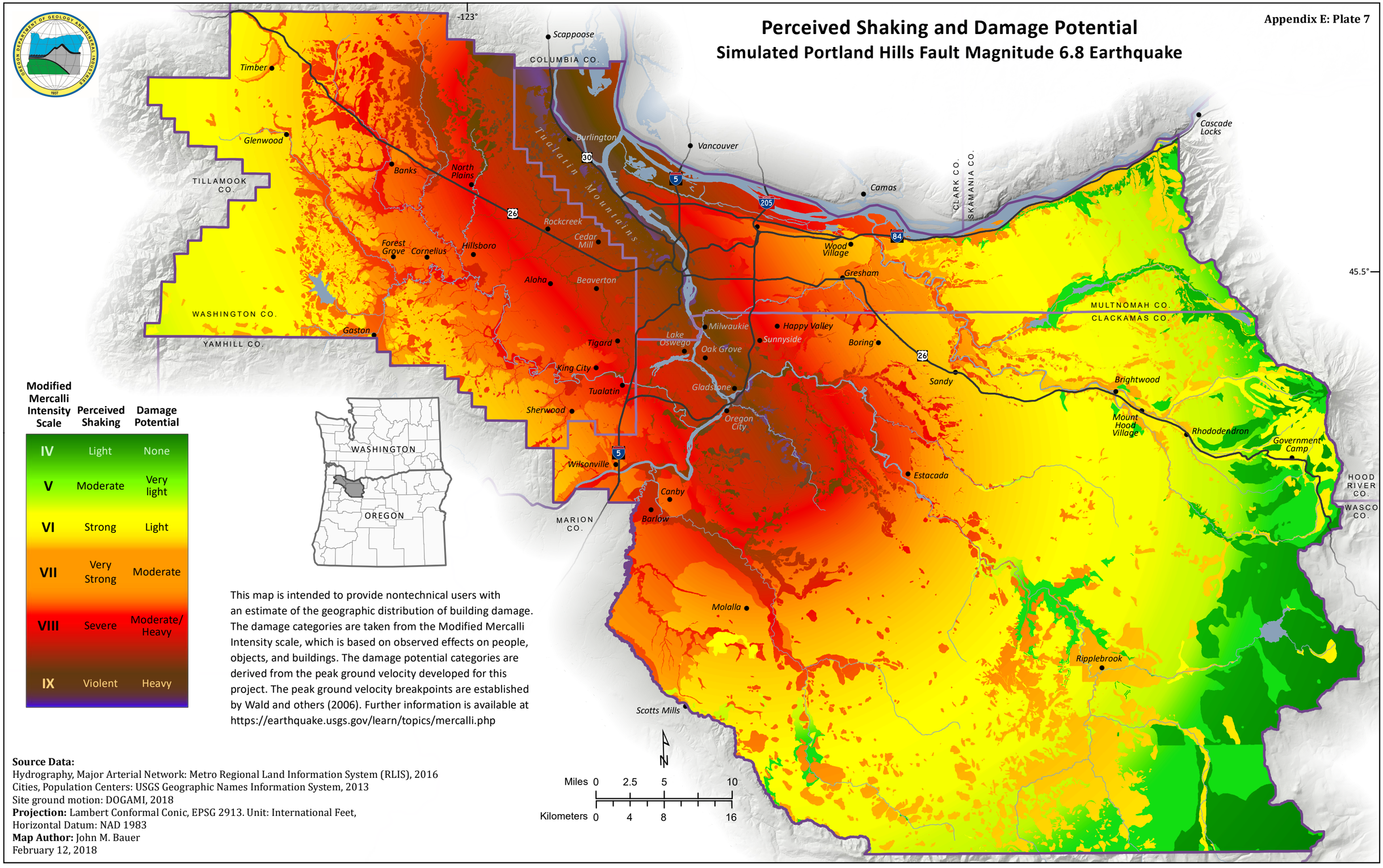
This map is intended to provide nontechnical users with an estimate of the geographic distribution of building damage. The damage categories are taken from the Modified Mercalli Intensity scale, which is based on observed effects on people, objects, and buildings. The damage potential categories are derived from the peak ground velocity developed for this project. The peak ground velocity breakpoints are established by Wald and others (2006). Further information is available at https://earthquake.usgs.gov/learn/topics/mercalli.php

Source Data:
Hydrography, Major Arterial Network: Metro Regional Land Information System (RLIS), 2016
Cities, Population Centers: USGS Geographic Names Information System, 2013
Site ground motion: DOGAMI, 2018
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet,
Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 12, 2018

Appendix E: Plate 7

Perceived Shaking and Damage Potential

Simulated Portland Hills Fault Magnitude 6.8 Earthquake



Modified Mercalli Intensity Scale	Perceived Shaking	Damage Potential
IV	Light	None
V	Moderate	Very light
VI	Strong	Light
VII	Very Strong	Moderate
VIII	Severe	Moderate/ Heavy
IX	Violent	Heavy

This map is intended to provide nontechnical users with an estimate of the geographic distribution of building damage. The damage categories are taken from the Modified Mercalli Intensity scale, which is based on observed effects on people, objects, and buildings. The damage potential categories are derived from the peak ground velocity developed for this project. The peak ground velocity breakpoints are established by Wald and others (2006). Further information is available at https://earthquake.usgs.gov/learn/topics/mercalli.php

Source Data:
Hydrography, Major Arterial Network: Metro Regional Land Information System (RLIS), 2016
Cities, Population Centers: USGS Geographic Names Information System, 2013
Site ground motion: DOGAMI, 2018
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet,
Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 12, 2018

Appendix E: Plate 8

Potential Permanent Ground Deformation Due to Earthquake-Induced Landslides or Liquefaction Lateral Spreading

Cascadia Subduction Zone Magnitude 9.0 Earthquake

Wet (Saturated) Soil Scenario

-123°

45.5°

Scappoose
COLUMBIA CO.
Timber
Glenwood
Burlington
Cascade Locks
Banks
North Plains
TILLAMOOK CO.
Camas
CLARK CO.
SKAMANIA CO.
Forest Grove
Hillsboro
Cedar Mill
Wood Village
Aloha
Gresham
MULTNOMAH CO.
CLACKAMAS CO.
WASHINGTON CO.
Gaston
Milwaukie
Sunnyside
Boring
YAMHILL CO.
Tigard
Lake Oswego
King City
Sandy
Tualatin
Oregon City
Sherwood
Rhododendron
Government Camp
Wilsonville
Estacada
HOOD RIVER CO.
Canby
WASCO CO.
MARION CO.
Molalla

Permanent Ground Deformation

- None
- Low (0–10 cm; 0–4 inches)
- Moderate (10–30 cm; 4–12 inches)
- High (30–100 cm; 12–39 inches)
- Very High (100–1180 cm; 39–173 inches)

Miles 0 2.5 5 10

Kilometers 0 4 8 16

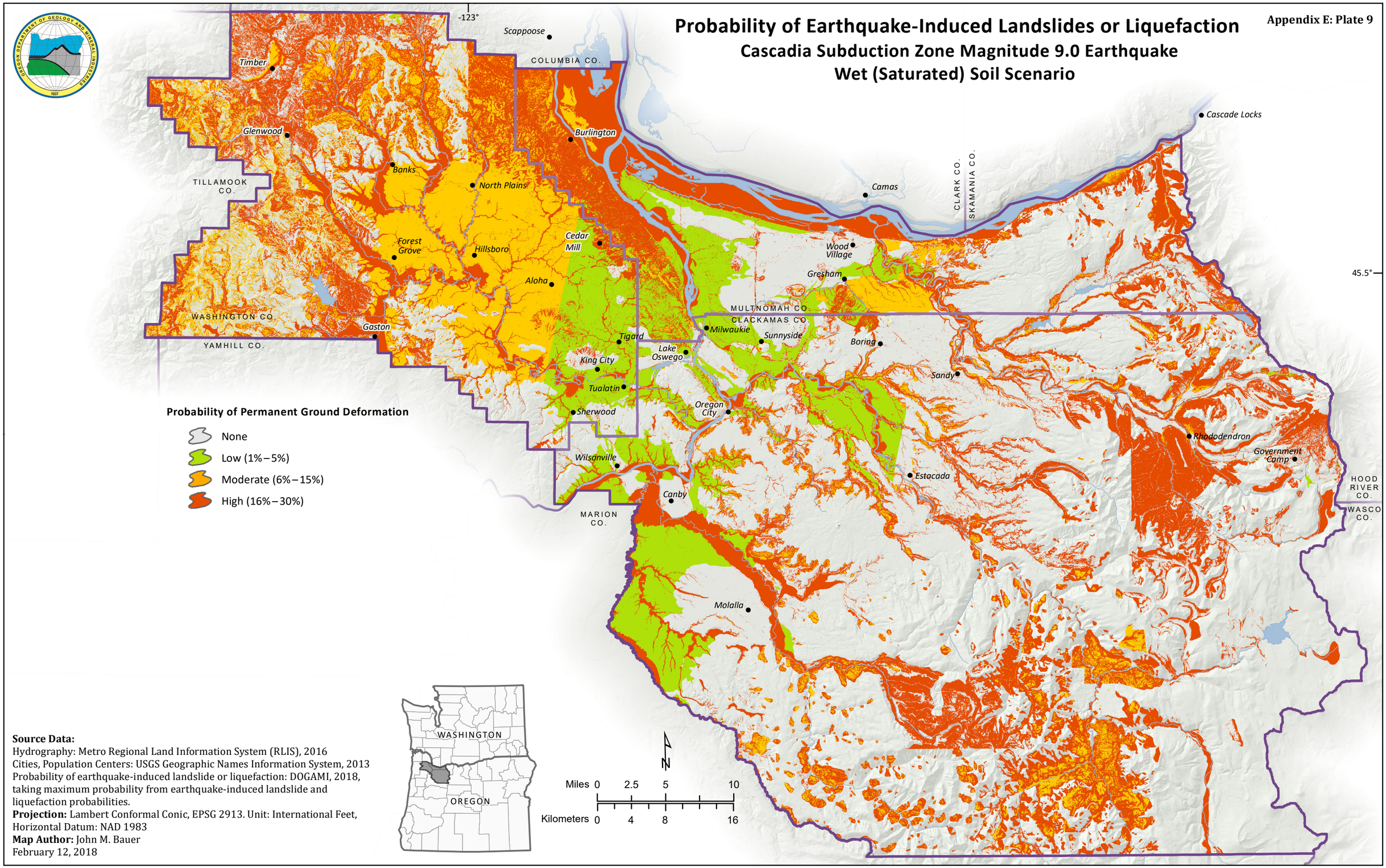
Source Data:
Hydrography: Metro Regional Land Information System (RLIS), 2016
Cities, Population Centers: USGS Geographic Names Information System, 2013
Probability of earthquake-induced landslide or liquefaction: DOGAMI, 2018, taking maximum ground deformation from earthquake-induced landslide and liquefaction lateral spreading.
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 12, 2018

Appendix E: Plate 9

Probability of Earthquake-Induced Landslides or Liquefaction

Cascadia Subduction Zone Magnitude 9.0 Earthquake

Wet (Saturated) Soil Scenario



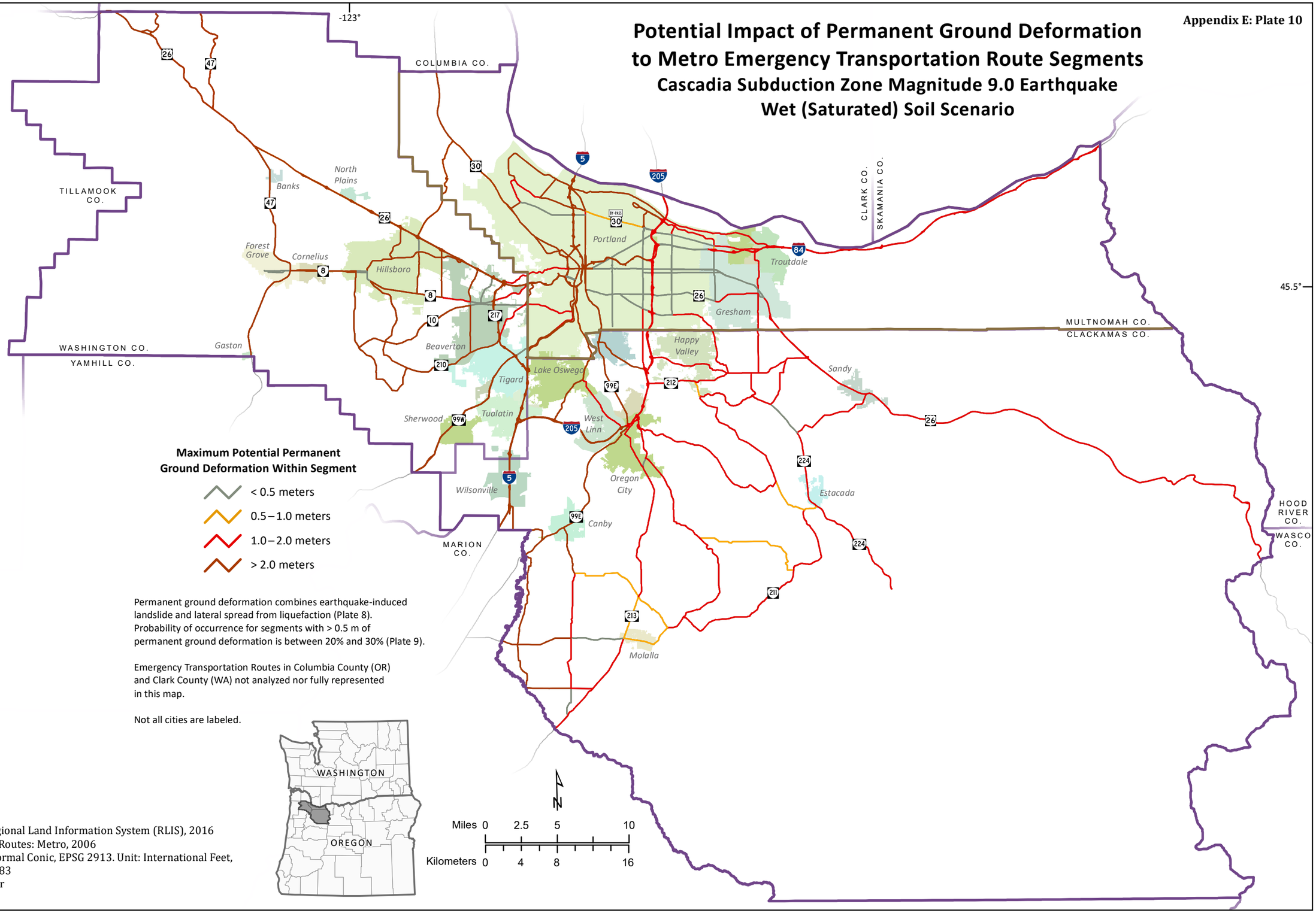
Source Data:
Hydrography: Metro Regional Land Information System (RLIS), 2016
Cities, Population Centers: USGS Geographic Names Information System, 2013
Probability of earthquake-induced landslide or liquefaction: DOGAMI, 2018, taking maximum probability from earthquake-induced landslide and liquefaction probabilities.
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 12, 2018

Appendix E: Plate 10

Potential Impact of Permanent Ground Deformation to Metro Emergency Transportation Route Segments

Cascadia Subduction Zone Magnitude 9.0 Earthquake

Wet (Saturated) Soil Scenario



Permanent ground deformation combines earthquake-induced landslide and lateral spread from liquefaction (Plate 8). Probability of occurrence for segments with > 0.5 m of permanent ground deformation is between 20% and 30% (Plate 9).

Emergency Transportation Routes in Columbia County (OR) and Clark County (WA) not analyzed nor fully represented in this map.

Not all cities are labeled.

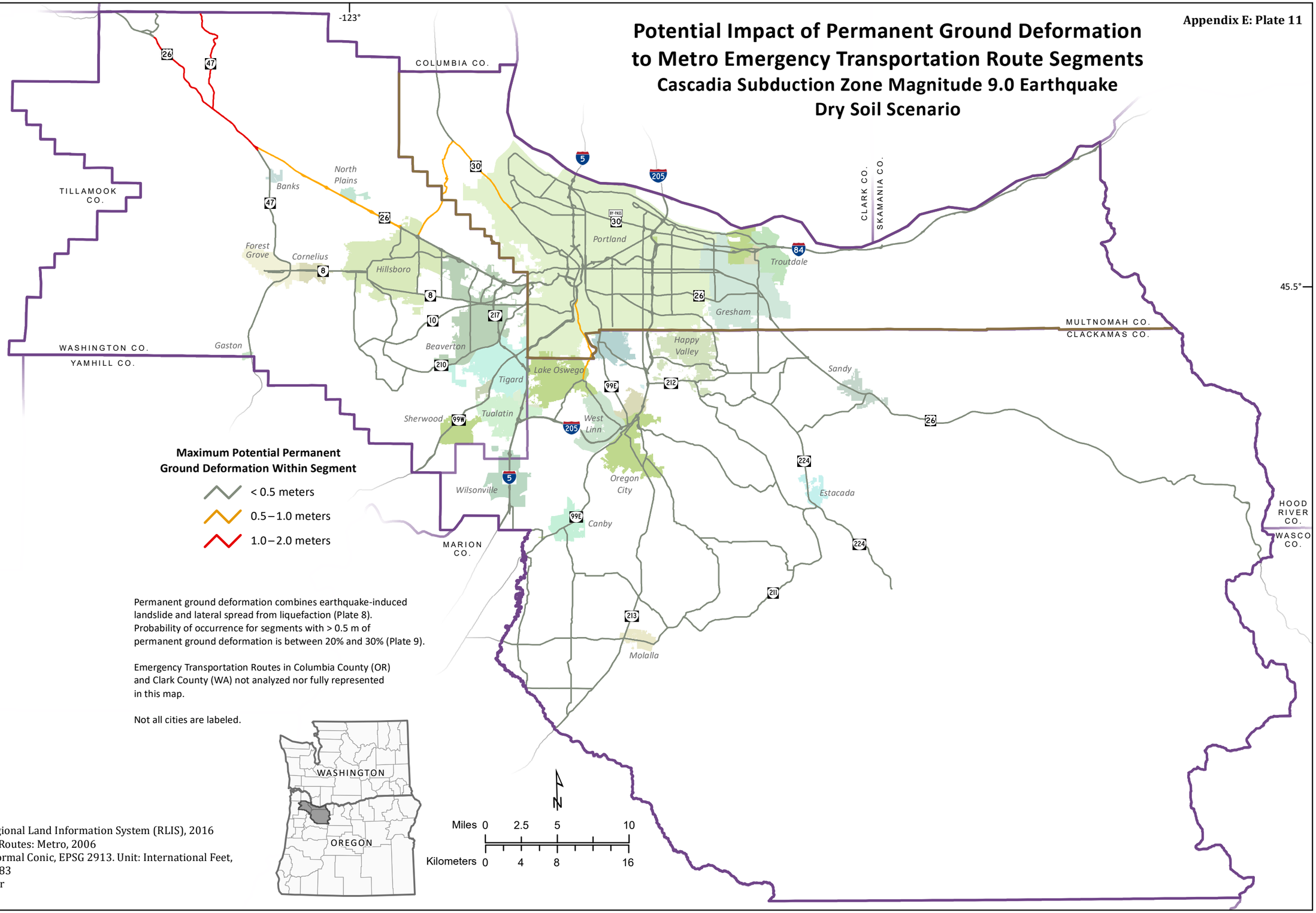
Source Data:
City boundaries: Metro Regional Land Information System (RLIS), 2016
Emergency Transporation Routes: Metro, 2006
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
September 1, 2017

Appendix E: Plate 11

Potential Impact of Permanent Ground Deformation to Metro Emergency Transportation Route Segments

Cascadia Subduction Zone Magnitude 9.0 Earthquake

Dry Soil Scenario



Permanent ground deformation combines earthquake-induced landslide and lateral spread from liquefaction (Plate 8). Probability of occurrence for segments with > 0.5 m of permanent ground deformation is between 20% and 30% (Plate 9).

Emergency Transportation Routes in Columbia County (OR) and Clark County (WA) not analyzed nor fully represented in this map.

Not all cities are labeled.

Source Data:
City boundaries: Metro Regional Land Information System (RLIS), 2016
Emergency Transporation Routes: Metro, 2006
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
September 1, 2017

Appendix E: Plate 12

Potential Impact of Permanent Ground Deformation to Metro Emergency Transportation Routes

Cascadia Subduction Zone Magnitude 9.0 Earthquake

Wet (Saturated) Soil Scenario

-123°

45.5°

COLUMBIA CO.

TILLAMOOK CO.

WASHINGTON CO.

YAMHILL CO.

CLARK CO.

SKAMANIA CO.

MULTNOMAH CO.

CLACKAMAS CO.

MARION CO.

HOOD RIVER CO.

WASCO CO.

Banks

North Plains

Forest Grove

Cornelius

Hillsboro

Gaston

Portland

Troutdale

Gresham

Beaverton

Milwaukie

Happy Valley

Tigard

Lake Oswego

King City

Tualatin

Sherwood

West Linn

Oregon City

Gladstone

Sandy

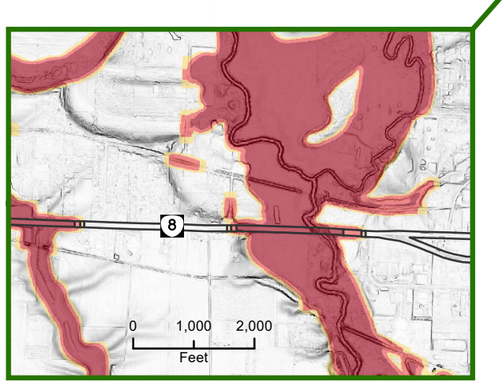
Wilsonville

Estacada

Canby

Molalla

47 26 30 8 10 205 210 99E 212 224 211 213 5



Closeup, Oregon Highway 8, showing potential permanent ground deformation (same color scale as main map)

Miles 0 2.5 5 10

Kilometers 0 4 8 16

Potential Permanent Ground Deformation

- < 0.5 meters
- 0.5 – 1.0 meters
- 1.0 – 2.0 meters
- > 2.0 meters

Permanent ground deformation takes the maximum of earthquake-induced landslide and lateral spread from liquefaction (Plate 8).

Probability of occurrence for road areas with > 0.5 m permanent ground deformation is between 20% and 30% (Plate 9).

Emergency Transportation Routes in Columbia County (OR) and Clark County (WA) not analyzed nor fully represented in this map.

Highway labels are placed on areas with minimal to no ground deformation (< 0.5 m).

Not all cities are labeled.

Source Data:
Emergency Transporation Routes: Metro, 2006
Cities: Metro Regional Land Information System (RLIS), May 2017
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet.
Horizontal Datum: NAD 1983
Map Author: John M. Bauer
September 1, 2017

Appendix E: Plate 13

Potential Impact of Permanent Ground Deformation to Electrical Transmission Structures

Cascadia Subduction Zone Magnitude 9.0 Earthquake, Wet (Saturated) Soil Scenario

-123°

45.5°

COLUMBIA CO.

TILLAMOOK CO.

WASHINGTON CO.

YAMHILL CO.

MARION CO.

CLARK CO.

SKAMANIA CO.

MULTNOMAH CO.

CLACKAMAS CO.

HOOD RIVER CO.

WASCO CO.

Potential Permanent Ground Deformation at Electrical Transmission Pole/Tower

- < 1.0 meter
- 1.0 – 2.0 meters
- > 2.0 meters

Substation

Transmission Line Corridor (outside of study area)

Permanent ground deformation at the pole/tower site takes the maximum of earthquake-induced landslide and lateral spread from liquefaction (Plate 8). Probability of occurrence for structures with > 1 meter permanent ground deformation is between 20% and 30% (Plate 9).

Miles 0 2.5 5 10

Kilometers 0 4 8 16

Source Data:
Hydrography: Metro Regional Land Information System (RLIS), 2016
Transmission Structures: Compiled by DOGAMI, 2017
Substations and Transmission Line Corridors: Dept. of Homeland Security Homeland Infrastructure Foundation-Level Data (HIFLD), 2017
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
September 1, 2017

Appendix E: Plate 14

MULTNOMAH CO.

CLACKAMAS CO.

WASHINGTON CO.

YAMHILL CO.

MARION CO.

HOOD RIVER CO.

WASCO CO.

Injuries Requiring Hositalization per Neighborhood Unit

- 0 – 1
- 2 – 5
- 6 – 10
- 11 – 20
- 21 – 50
- H Hospital

Hospitals outside of Clackamas County not shown.
"Injuries requiring hospitalization" combines Hazus casualty levels 2 and 3.

N

0 2.5 5 10 Miles

0 4 8 16 Kilometers

Injuries Requiring Hospitalization
Clackamas County, Oregon
Cascadia Subduction Zone Magnitude 9.0 Earthquake
Wet (Saturated) Soil Conditions, Daytime ("2 PM") Scenario

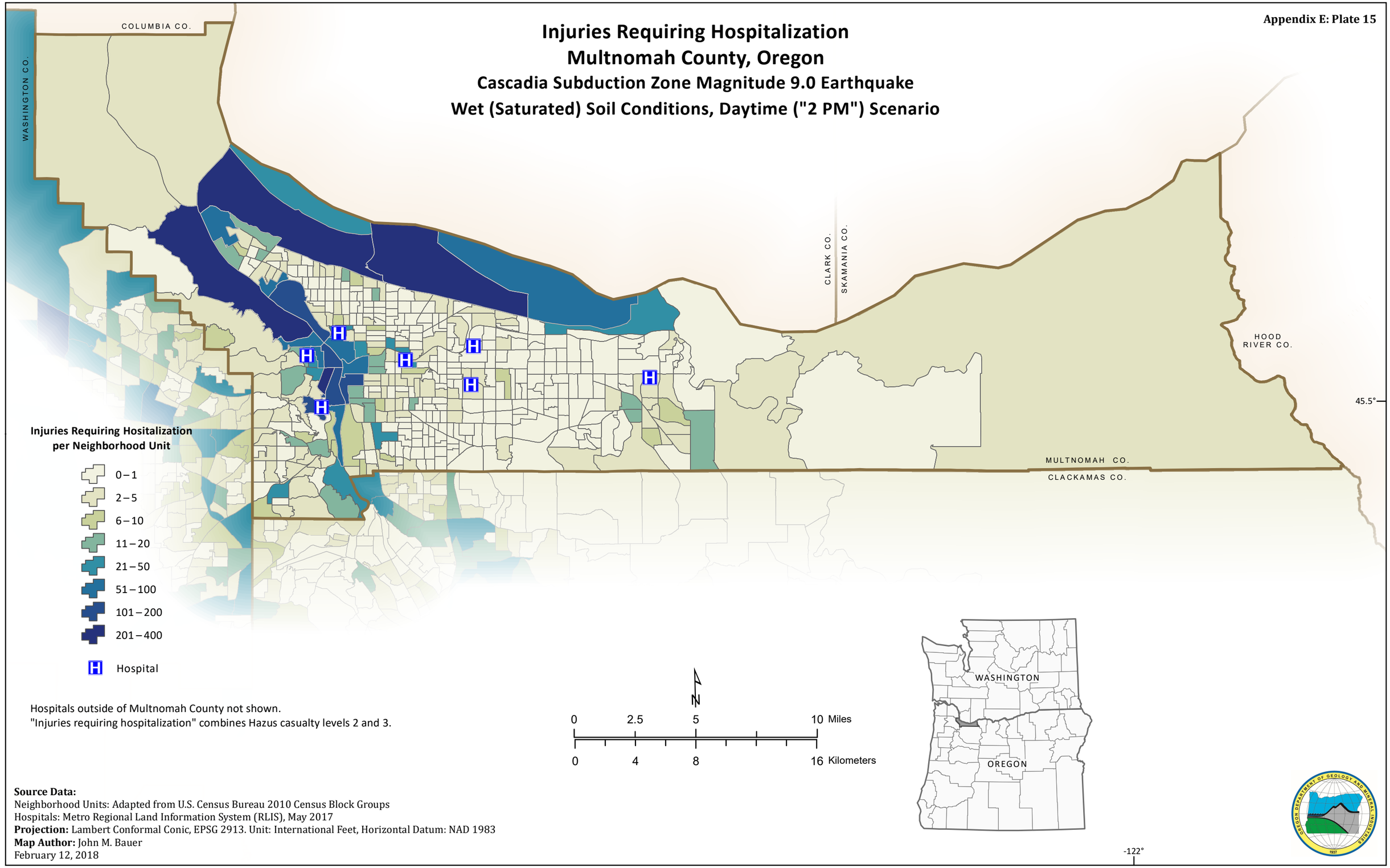
45°

-122°

Source Data:
Neighborhood Units: Adapted from U.S. Census Bureau 2010 Census Block Groups
Hospitals: Metro Regional Land Information System (RLIS), May 2017
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 12, 2018

Appendix E: Plate 15

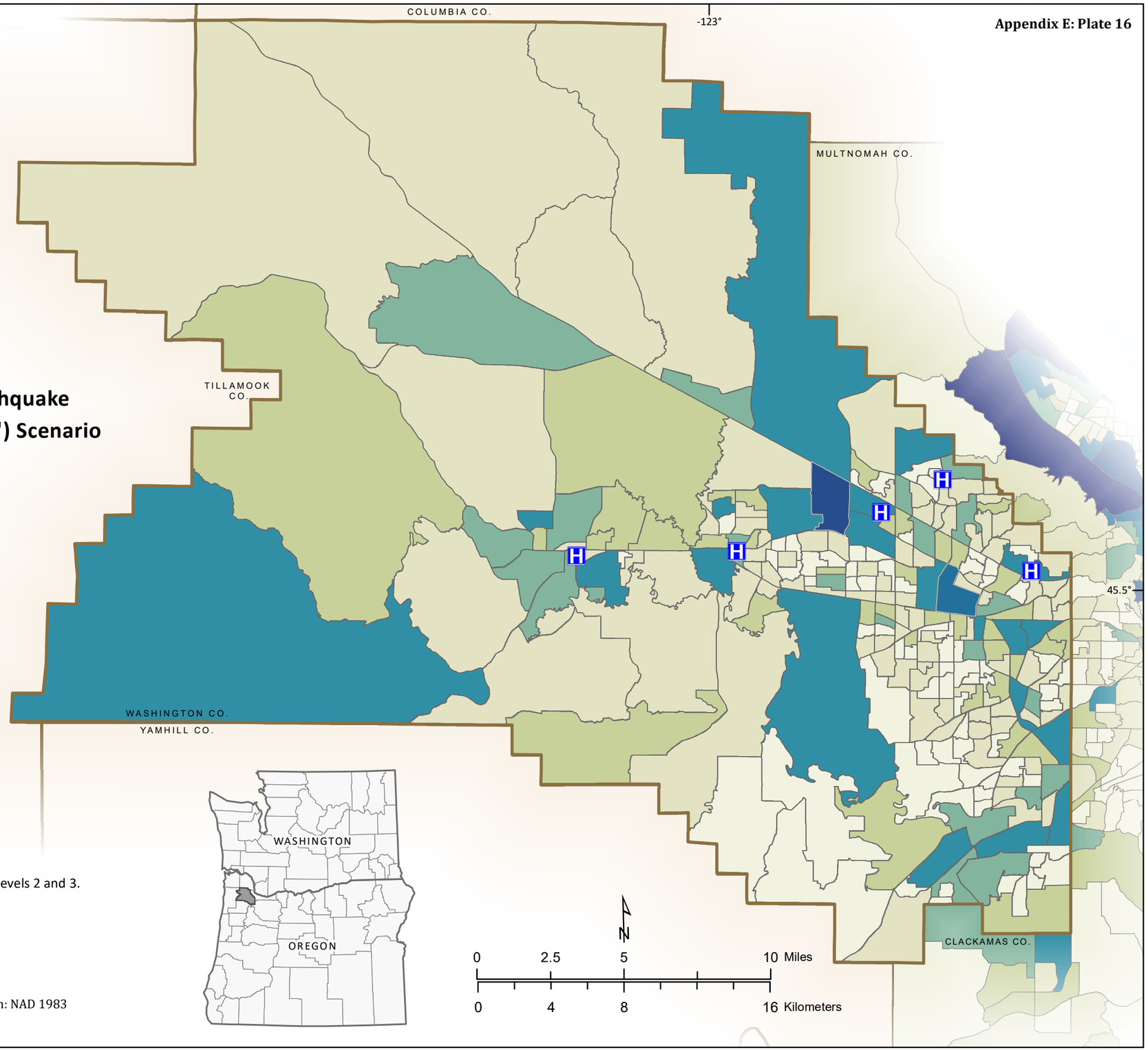
Injuries Requiring Hospitalization
Multnomah County, Oregon
Cascadia Subduction Zone Magnitude 9.0 Earthquake
Wet (Saturated) Soil Conditions, Daytime ("2 PM") Scenario



Source Data:
Neighborhood Units: Adapted from U.S. Census Bureau 2010 Census Block Groups
Hospitals: Metro Regional Land Information System (RLIS), May 2017
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 12, 2018

Appendix E: Plate 16

Injuries Requiring Hospitalization
Washington County, Oregon
Cascadia Subduction Zone Magnitude 9.0 Earthquake
Wet (Saturated) Soil Conditions, Daytime ("2 PM") Scenario



Hospitals outside of Washington County not shown.
"Injuries requiring hospitalization" combines Hazus casualty levels 2 and 3.

Source Data:
Neighborhood Units: Adapted from U.S. Census Bureau 2010 Census Block Groups
Hospitals: Metro Regional Land Information System (RLIS), May 2017
Projection: Lambert Conformal Conic, EPSG 2913. Unit: International Feet, Horizontal Datum: NAD 1983
Map Author: John M. Bauer
February 12, 2018