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Ian P. Madin, Interim State Geologist

Modeled Pedestrian Evacuation Times at 4 Feet per Second During an XXL1 Local Tsunami Event
Seaside and Gearhart, Clatsop County, Oregon
All Bridges Intact

2015

OPEN-FILE REPORT O-15-02

Local Tsunami Evacuation Analysis of Seaside and Gearhart, Clatsop County, Oregon

By George R. Priest, Laura L. Stimely, Nathan J. Wood, Ian P. Madin, and Rudie J. Watzig

PLATE 1

This project was funded under award #NA13NWS4670013 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program.

Key

Time required after initial earthquake to reach ground outside the hazard area if walking at a rate of 4 feet/second (22 minutes/mile)

- 0-10 minutes
- 10-15 minutes
- 15-20 minutes
- 20-25 minutes
- 25-30 minutes
- 30-35 minutes
- 35-40 minutes
- 40-45 minutes
- 45+ minutes

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Building
- 17 Tsunami wave arrival time at key points (minutes)
- Safety (XXL1 inundation limit)
- Assembly Area

Note: For legibility of the evacuation modeling data, roads on this map are emphasized by extending the width 12 feet from the road edge; thus road ends appear to have a 12 ft extension that does not actually exist.

How to Use These Maps

1. **Find your location on the map and note the color of the closest street.**
2. **Look at the map legend to see how long it will take to reach an area outside the hazard area from your location if you follow the path indicated by the arrows and travel at 4 ft/second (22 minutes/mile). Remember that boundaries between neighboring EVACUATION FLOW ZONES are where it is equally efficient to follow two different routes.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat the wave to that point. Evacuation from some areas requires a speed greater than 4 ft/second**

Explanation

These maps show how long it should take to walk to ground outside the hazard area for a maximum-considered (XXL1) tsunami caused by a magnitude 9.1 Cascadia subduction zone earthquake. Black arrows on the map show the fastest routes. The color at any location gives the walking time along the route. The routes follow paths or roads everywhere except on the beach. The time is based on a walking speed of 4 feet per second (22 minutes per mile) and takes into account variations in speed from slope and type of surface (e.g., pavement versus sand).

The map also shows the estimated time of tsunami arrival where major evacuation routes reach ground outside the hazard area and at key points such as bridges. Tsunami arrival time is counted from the start of the local earthquake. When estimating your own evacuation time remember that the earthquake may shake violently for 3-5 minutes, during which time you should "drop, cover, and hold on." In addition to this delay you should consider other factors such as your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake.

Note that this evacuation modeling approach restricts evacuation to streets and trails; thus, in some cases small areas above the tsunami inundation but with no street or trail connection are ignored. If you know there is ready access to such areas, then consider these off-street routes when planning your evacuation.

See the text from this open-file report for technical information on mapping methods. See DOGAMI Special Paper 43 or DOGAMI Open-File Report O-13-19 for explanations of the tsunami scenario used for these maps.

References

Priest, G. R., Witter, R. C., Zhang, Y. J., Wang, K., Goldfinger, C., Stimely, L. L., English, J. T., Pickner, S. G., Hughes, K. L. B., Wille, T. E., and Smith, R. L., 2013, Tsunami inundation scenarios for Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-13-19, 18 p., GIS data.

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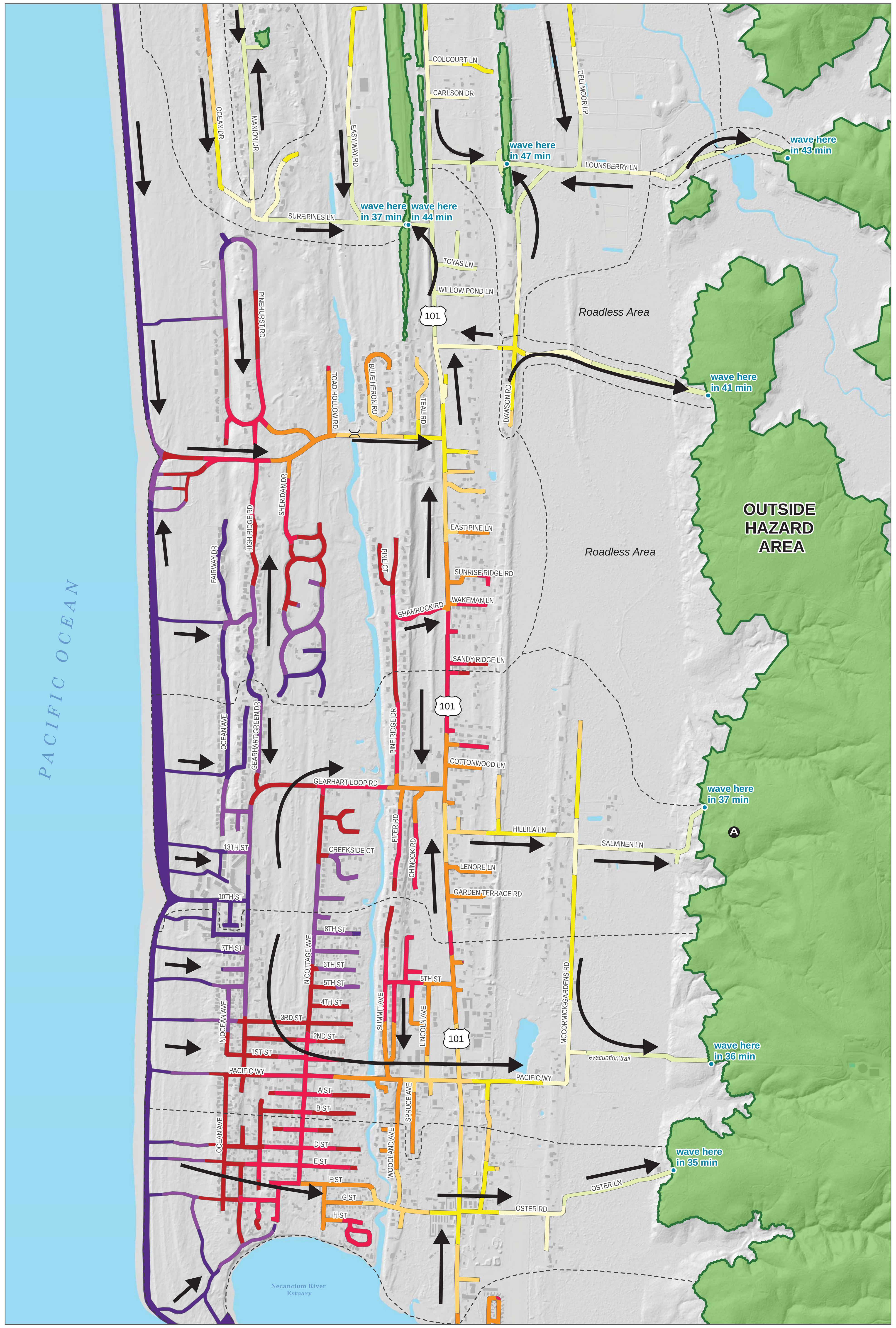
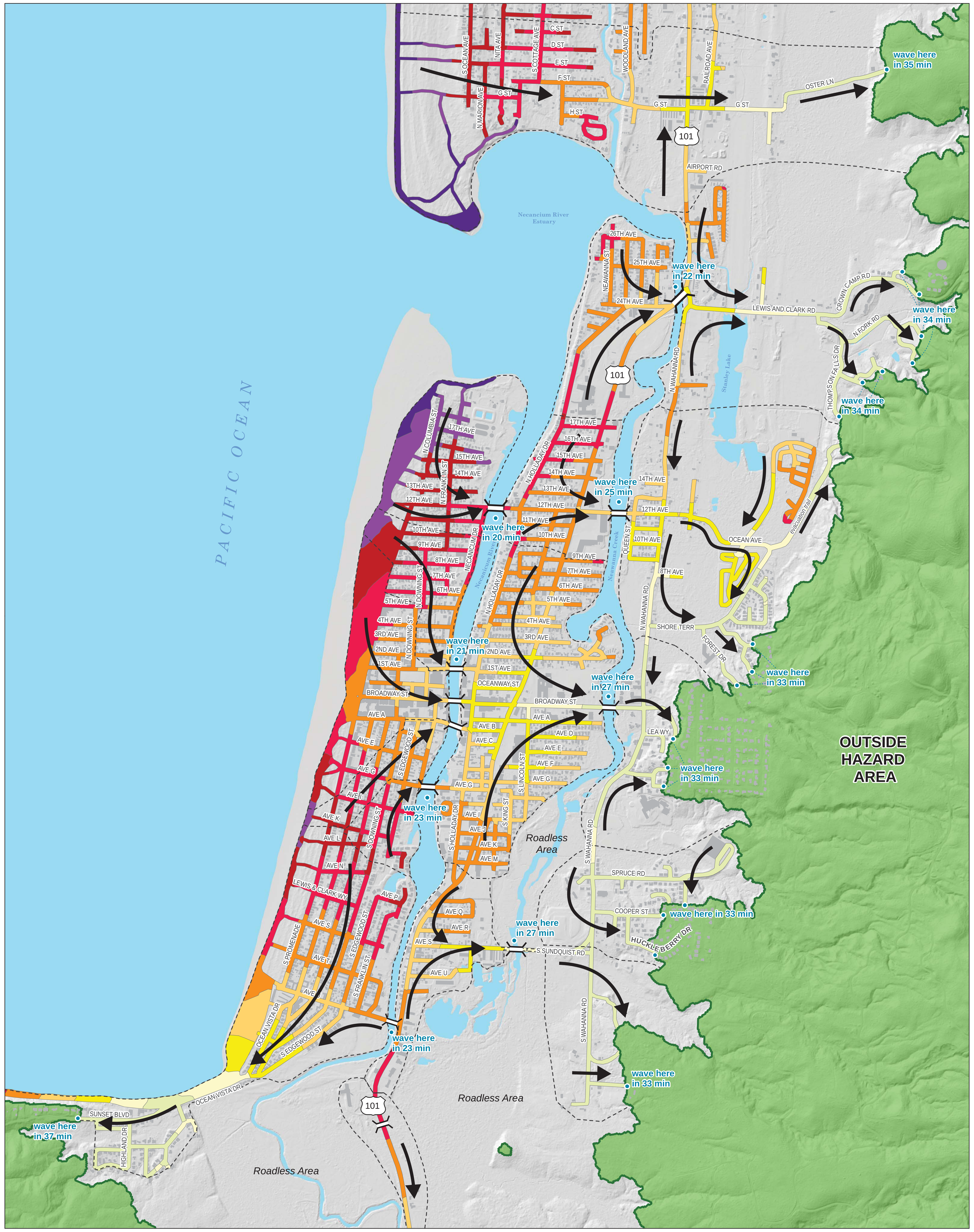
GEARHART



SEASIDE



Source Data:
These maps is based on hydrodynamic tsunami modeling by Joseph Zhang, Oregon Health and Science University, Portland, Oregon. Model data input were created by John T. English and George R. Priest, DOGAMI. Tsunami arrival time scenarios and evacuation difficulty analyses were conducted by George R. Priest, Rudie J. Watzig, and Ian P. Madin, DOGAMI.

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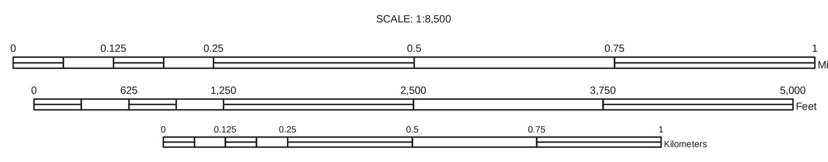
Lidar data are from DOGAMI Lidar Data Quadrangles LDQ-2011-45123-H8-Tillamook Head and LDQ-2011-46123-A8-Gearhart.

Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map



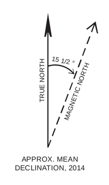


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PLATE 2

This project was funded under award #NA13NWS4670013 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program.

Key

Time required after initial earthquake to reach ground outside the hazard area if walking at a rate of 4 feet/second (22 minutes/mile)

- 0-10 minutes
- 10-15 minutes
- 15-20 minutes
- 20-25 minutes
- 25-30 minutes
- 30-35 minutes
- 35-40 minutes
- 40-45 minutes
- 45+ minutes

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Building
- 17 Tsunami wave arrival time at key points (minutes)
- Safety (XXL1 inundation limit)
- A Assembly Area

Note: For legibility of the evacuation modeling data, roads on this map are emphasized by extending the width 12 feet from the road edge; thus road ends appear to have a 12 ft extension that does not actually exist.

How to Use These Maps

1. **Find your location on the map and note the color of the closest street.**
2. **Look at the map legend to see how long it will take to reach an area outside the hazard area from your location if you follow the path indicated by the arrows and travel at 4 ft/second (22 minutes/mile). Remember that EVACUATION FLOW ZONE boundaries are where it is equally efficient to follow two different routes to safety.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat the wave to that point. Evacuation from some areas requires a speed greater than 4 ft/second**

Explanation

These maps show how long it should take to walk to ground outside the hazard area for a large (L1) tsunami caused by a magnitude 9.0 Cascadia subduction zone earthquake. Black arrows on the map show the fastest routes. The color at any location gives the walking time along the route. The routes follow paths or roads everywhere except on the beach. The time is based on a walking speed of 4 feet per second (22 minutes per mile) and takes into account variations in speed from slope and type of surface (e.g., pavement versus sand).

The map also shows the estimated time of tsunami arrival where major evacuation routes reach ground outside the hazard area and at key points such as bridges. Tsunami arrival time is counted from the start of the local earthquake. When estimating your own evacuation time remember that the earthquake may shake violently for 3-5 minutes, during which time you should "drop, cover, and hold on." In addition to this delay you should consider other factors such as your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake.

Note that this evacuation modeling approach restricts evacuation to streets and trails; thus, in some cases small areas above the tsunami inundation but with no street or trail connection are ignored. If you know there is ready access to such areas, then consider these off-street routes when planning your evacuation.

See the text from this open-file report for technical information on mapping methods. See DOGAMI Special Paper 43 or DOGAMI Open-File Report O-13-19 for explanations of the tsunami scenario used for these maps.

References

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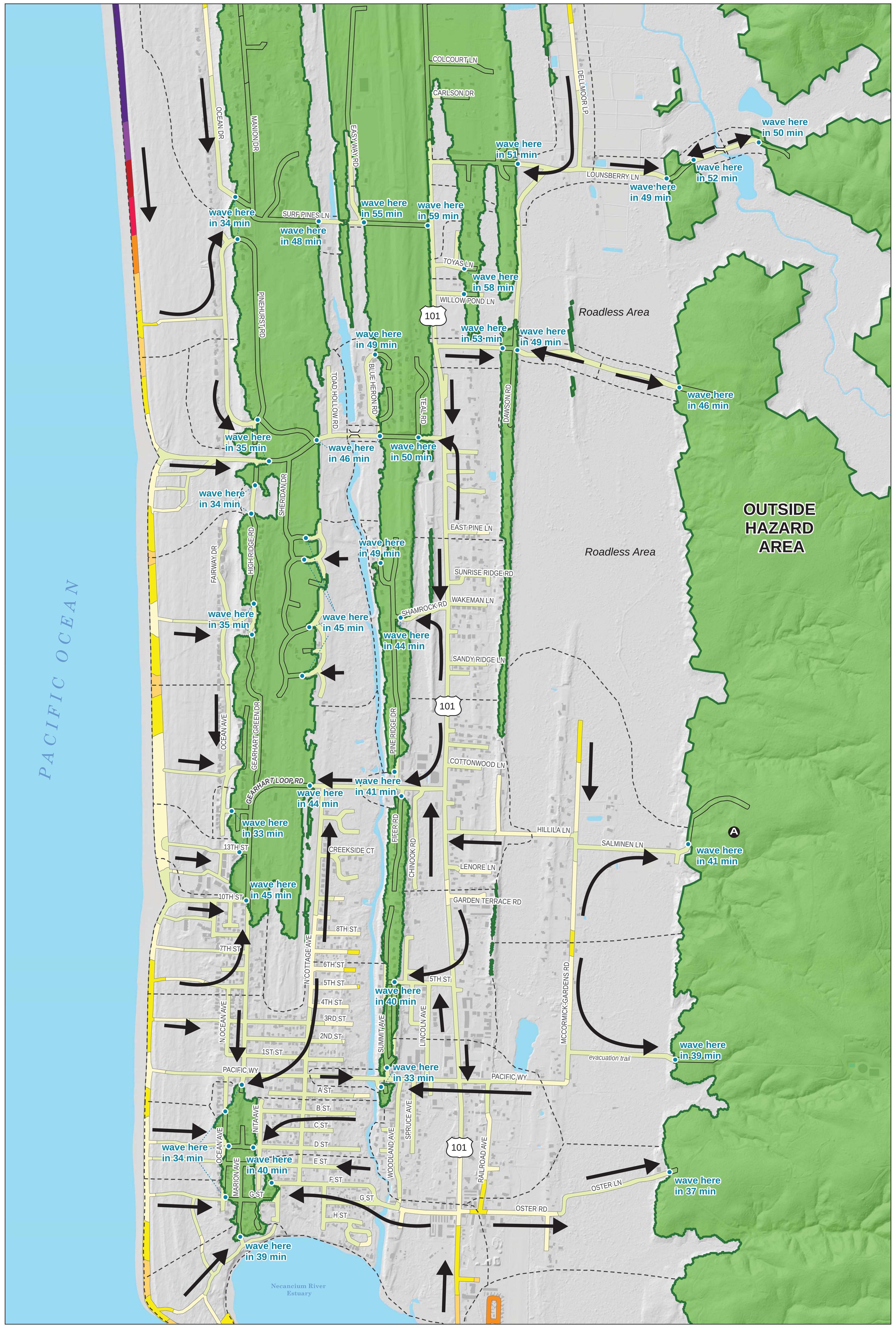
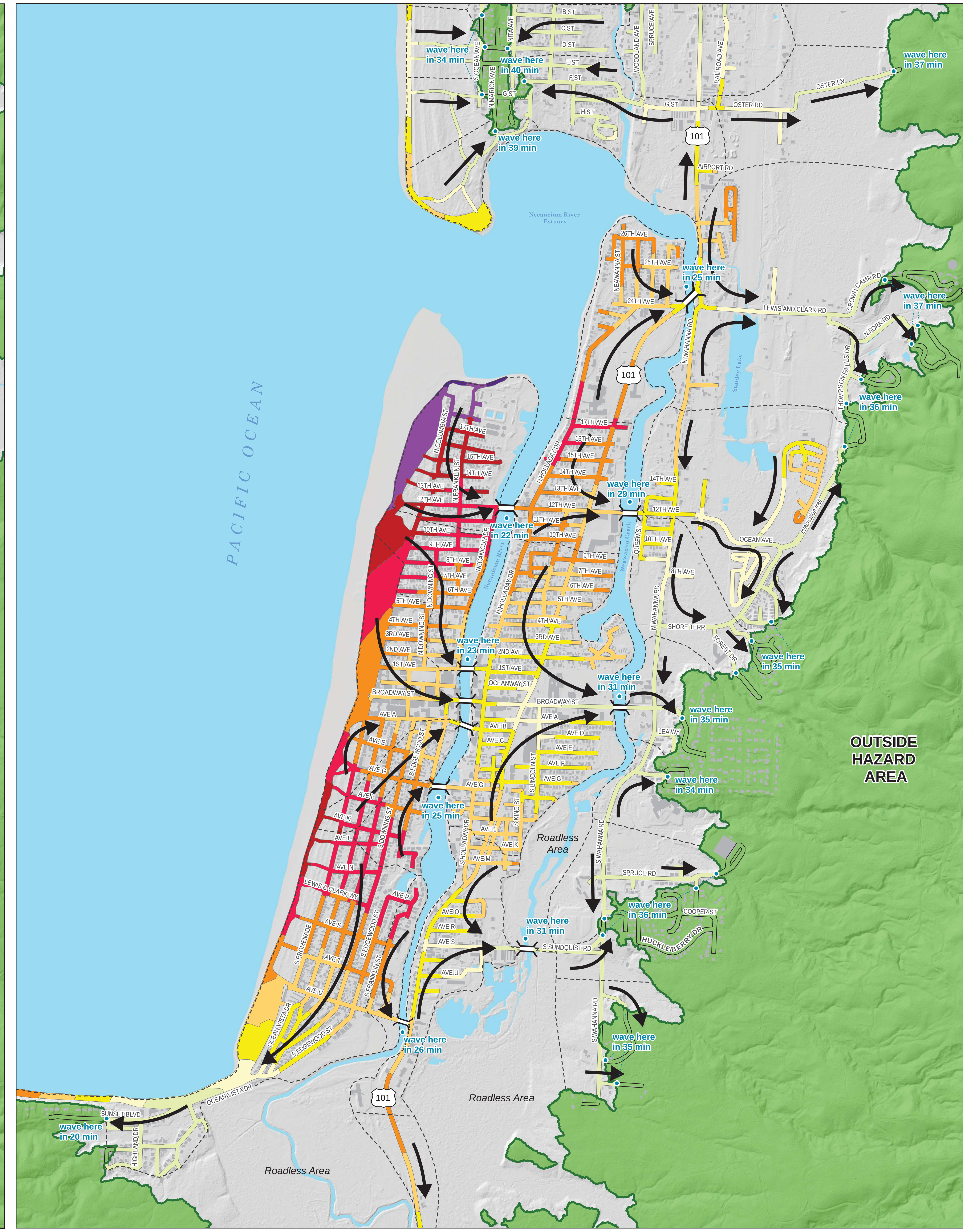
GEARHART



SEASIDE



Source Data:
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Lidar data are from DOGAMI Lidar Data Quadrangles LDQ-2011-45123-H8-Tillamook Head and LDQ-2011-46123-A8-Gearhart.

Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map

SCALE 1:9,600

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Modeled Pedestrian Evacuation Times at 4 Feet per Second During an L1 Local Tsunami Event, Seaside, Clatsop County, Oregon: Avenue U and Avenue G Bridges Removed

2015

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Local Tsunami Evacuation Analysis of Seaside and Gearhart, Clatsop County, Oregon

By George R. Priest, Laura L. Stimely, Nathan J. Wood, Ian P. Madin, and Rudie J. Watzig

PLATE 3

This project was funded under award #NA13NWS4670013 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program.

Key

Time required after initial earthquake to reach ground outside the hazard area if walking at a rate of 4 feet/second (22 minutes/mile)

- 0-10 minutes
- 10-15 minutes
- 15-20 minutes
- 20-25 minutes
- 25-30 minutes
- 30-35 minutes
- 35-40 minutes
- 40-45 minutes
- 45+ minutes

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Bridge out
- Building
- 17 Tsunami wave arrival time at key points (minutes)
- Safety (L1 inundation limit)
- A Assembly Area

Note: For legibility of the evacuation modeling data, roads on this map are emphasized by extending the width 12 feet from the road edge; thus road ends appear to have a 12 ft extension that does not actually exist.

How to Use This Map

1. **Find your location on the map and note the color of the closest street.**
2. **Look at the map legend to see how long it will take to reach an area outside the hazard area from your location if you follow the path indicated by the arrows and travel at 4 ft/second (22 minutes/mile). Remember that EVACUATION FLOW ZONE boundaries are where it is equally efficient to follow two different routes to safety.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat**

Explanation

This map shows how long it should take to walk to ground outside the hazard area for a large (L1) tsunami caused by a magnitude 9.0 Cascadia subduction zone earthquake if the Avenue U and Avenue G bridges collapse during the earthquake. Black arrows on the map show the fastest routes. The color at any location gives the walking time along the route. The routes follow paths or roads everywhere except the on beach. The time is based on a walking speed of 4 feet per second (22 minutes per mile) and takes into account variations in speed from slope and type of surface (e.g., pavement versus sand).

The map also shows the estimated time of tsunami arrival where major evacuation routes reach ground outside the hazard area and at key points such as bridges. Tsunami arrival time is counted from the start of the local earthquake. When estimating your own evacuation time remember that the earthquake may shake violently for 3-5 minutes, during which time you should "drop, cover, and hold on." In addition to this delay you should consider other factors such as your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake.

Note that this evacuation modeling approach restricts evacuation to streets and trails; thus, in some cases small areas above the tsunami inundation with no street or trail connection are ignored. If you know there is ready access to such areas, then consider these off-street routes when planning your evacuation.

See the text from this open-file report for technical information on mapping methods. See DOGAMI Special Paper 43 or DOGAMI Open-File Report O-13-19 for explanations of the tsunami scenario used for these maps.

References

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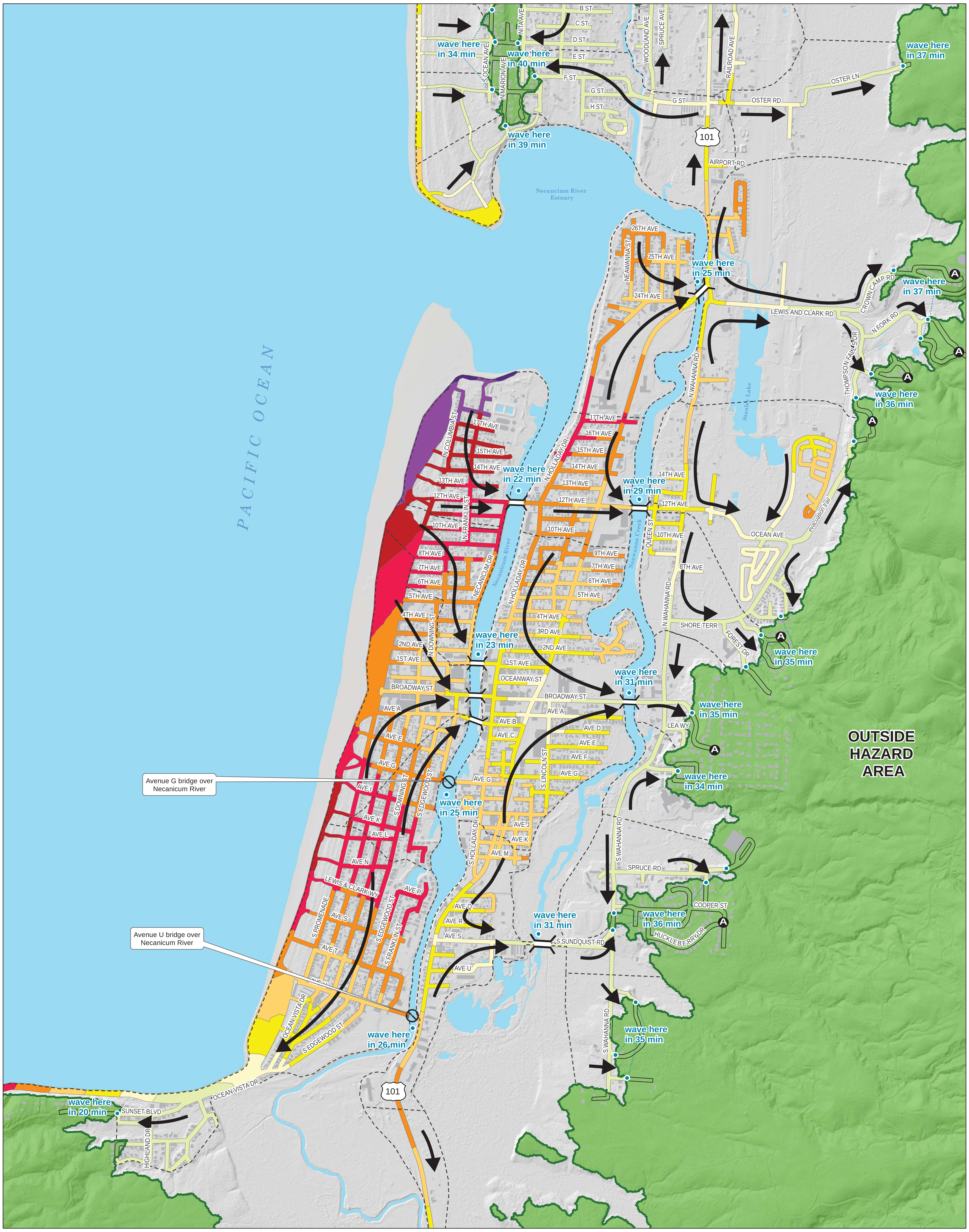

Source Data:
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Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map

SCALE 1:8,500

0 0.125 0.25 0.5 0.75 1 Miles

0 625 1,250 2,500 3,750 5,000 Feet

0 0.125 0.25 0.5 0.75 1 Kilometers

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Modeled Pedestrian Evacuation Times at 4 Feet per Second During an L1 Local Tsunami Event, Seaside, Clatsop County, Oregon: Avenue A, West Broadway, and Highway 101 Bridges Removed

2015

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Local Tsunami Evacuation Analysis of Seaside and Gearhart, Clatsop County, Oregon

By George R. Priest, Laura L. Stimely, Nathan J. Wood, Ian P. Madin, and Rudie J. Watzig

PLATE 4

This project was funded under award #NA13NWS4670013 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program.

Key

Time required after initial earthquake to reach ground outside the hazard area if walking at a rate of 4 feet/second (22 minutes/mile)

- 0-10 minutes
- 10-15 minutes
- 15-20 minutes
- 20-25 minutes
- 25-30 minutes
- 30-35 minutes
- 35-40 minutes
- 40-45 minutes
- 45+ minutes

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Bridge out
- Building
- 17 Tsunami wave arrival time at key points (minutes)
- Safety (L1 inundation limit)
- Assembly Area

Note: For legibility of the evacuation modeling data, roads on this map are emphasized by extending the width 12 feet from the road edge; thus road ends appear to have a 12 ft extension that does not actually exist.

How to Use This Map

1. **Find your location on the map and note the color of the closest street.**
2. **Look at the map legend to see how long it will take to reach an area outside the hazard area from your location if you follow the path indicated by the arrows and travel at 4 ft/second (22 minutes/mile). Remember that boundaries between neighboring EVACUATION FLOW ZONES are where it is equally efficient to follow two different routes.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat**

Explanation

This map shows how long it should take to walk to ground outside the hazard area for a large (L1) tsunami caused by a magnitude 9.0 Cascadia subduction zone earthquake if the Avenue A, West Broadway, and Highway 101 bridges collapse during the earthquake. Black arrows on the map show the fastest routes. The color at any location gives the walking time along the route. The routes follow paths or roads everywhere except the on beach. The time is based on a walking speed of 4 feet per second (22 minutes per mile) and takes into account variations in speed from slope and type of surface (e.g., pavement versus sand).

The map also shows the estimated time of tsunami arrival where major evacuation routes reach ground outside the hazard area and at key points such as bridges. Tsunami arrival time is counted from the start of the local earthquake. When estimating your own evacuation time remember that the earthquake may shake violently for 3-5 minutes, during which time you should "drop, cover, and hold on." In addition to this delay you should consider other factors such as your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake.

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References

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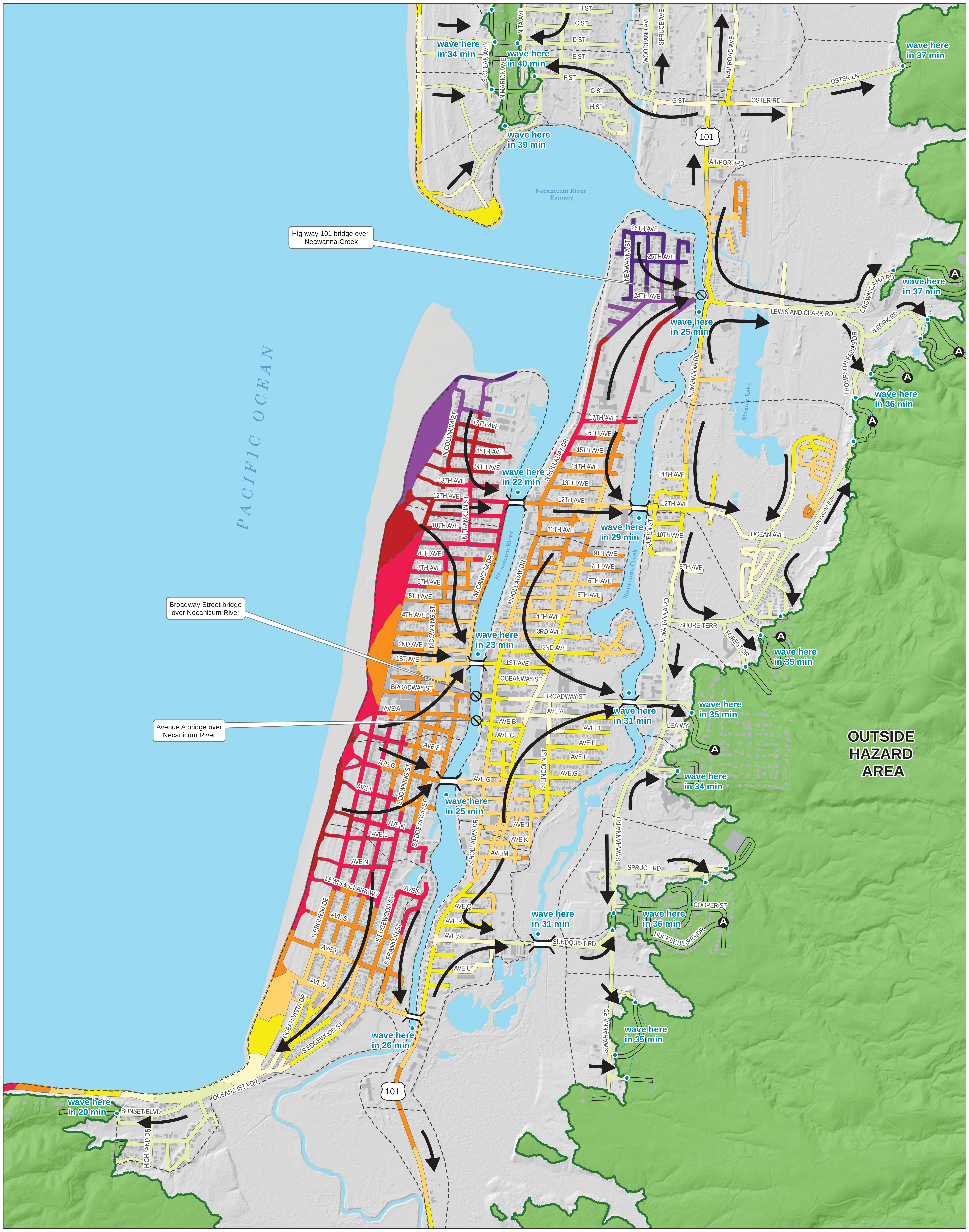

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Lidar data are from DOGAMI Lidar Data Quadrangles LDQ-2011-45123-H8-Tillamook Head and LDQ-2011-46123-A8-Gearhart.

Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map

SCALE 1:8,500

0 0.125 0.25 0.5 0.75 1 Miles

0 625 1,250 2,500 3,750 5,000 Feet

0 0.125 0.25 0.5 0.75 1 Kilometers

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Modeled Pedestrian Evacuation Times at 4 Feet per Second During an L1 Local Tsunami Event, Seaside, Clatsop County, Oregon: Hypothetical Vertical Evacuation Structure at Convention Center All Bridges Intact

2015

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Local Tsunami Evacuation Analysis of Seaside and Gearhart, Clatsop County, Oregon

By George R. Priest, Laura L. Stimely, Nathan J. Wood, Ian P. Madin, and Rudie J. Watzig

PLATE 5

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Key

Time required after initial earthquake to reach ground outside the hazard area if walking at a rate of 4 feet/second (22 minutes/mile)

- 0-10 minutes
- 10-15 minutes
- 15-20 minutes
- 20-25 minutes
- 25-30 minutes
- 30-35 minutes
- 35-40 minutes
- 40-45 minutes
- 45+ minutes

- Location of hypothetical vertical evacuation structure
- Evacuation Flow Zone
- Evacuation route
- Bridge
- Building
- 17 Tsunami wave arrival time at key points (minutes)
- Safety (L1 inundation limit)
- Assembly Area

Note: For legibility of the evacuation modeling data, roads on this map are emphasized by extending the width 12 feet from the road edge; thus road ends appear to have a 12 ft extension that does not actually exist.

How to Use This Map

1. **Find your location on the map and note the color of the closest street.**
2. **Look at the map legend to see how long it will take to reach an area outside the hazard area from your location if you follow the path indicated by the arrows and travel at 4 ft/second (22 minutes/mile). Remember that EVACUATION FLOW ZONE boundaries are where it is equally efficient to follow two different routes to safety.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat**

Explanation

This map shows how long it should take to walk to a hypothetical vertical evacuation structure near the Seaside Convention Center or to ground outside the hazard area for a large (L1) tsunami caused by a magnitude 9.0 Cascadia subduction zone earthquake. Black arrows on the map show the fastest routes. The color at any location gives the walking time along the route. The routes follow paths or roads everywhere except the on beach. The time is based on a walking speed of 4 feet per second (22 minutes per mile) and takes into account variations in speed from slope and type of surface (e.g., pavement versus sand).

The map also shows the estimated time of tsunami arrival where major evacuation routes reach ground outside the hazard area and at key points such as bridges. Tsunami arrival time is counted from the start of the local earthquake. When estimating your own evacuation time remember that the earthquake may shake violently for 3-5 minutes, during which time you should "drop, cover, and hold on." In addition to this delay you should consider other factors such as your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake.

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References

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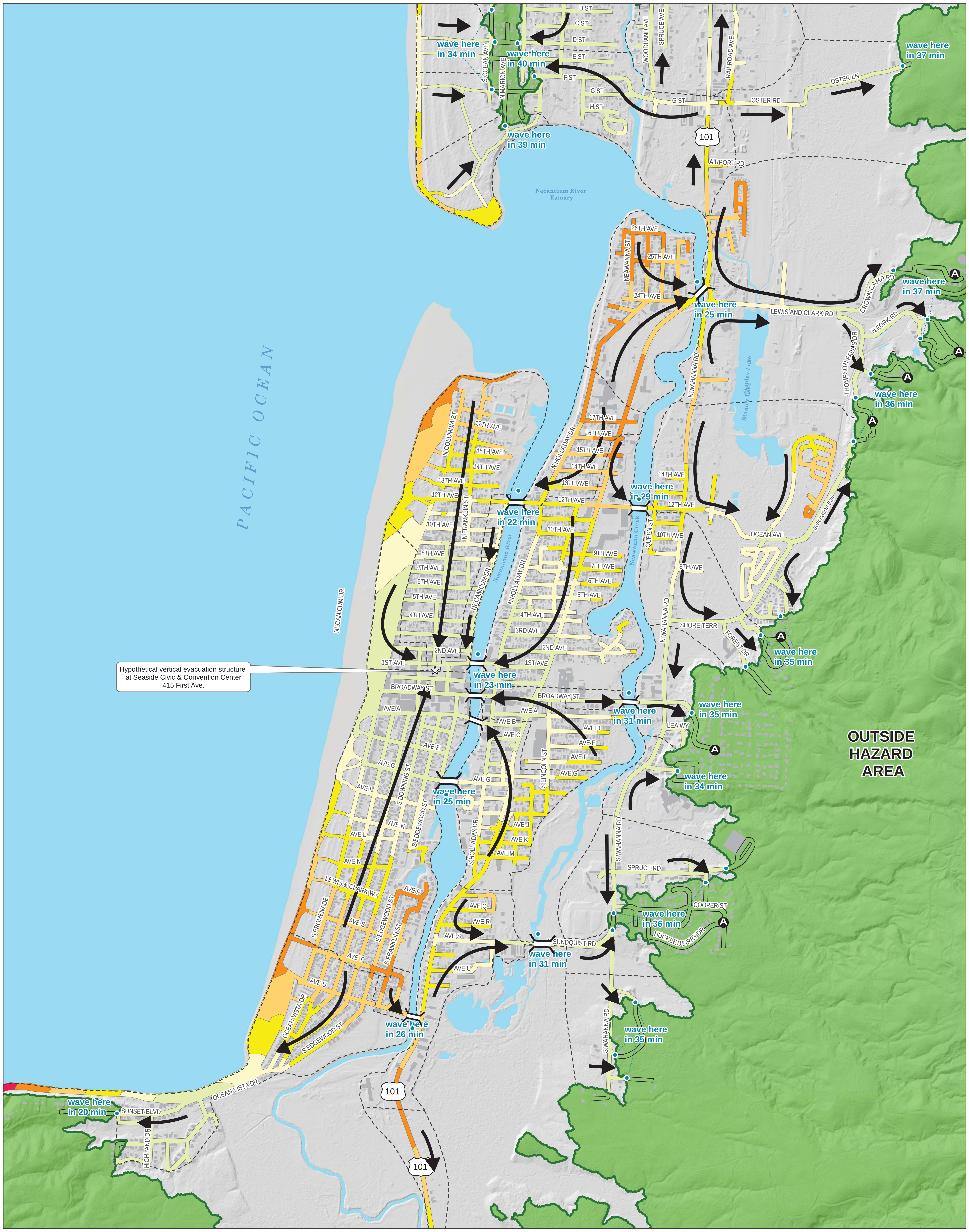

Source Data:
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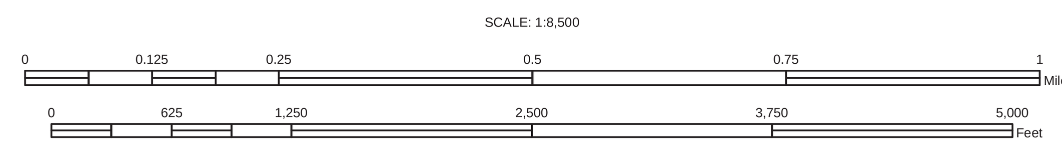
Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map

SCALE 1:8,500



APPROX. MEAN DECLINATION, 2014

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
www.OregonGeology.org

Ian P. Madin, Interim State Geologist

Modeled Pedestrian Evacuation Times at 4 Feet per Second During an L1 Local Tsunami Event, Seaside, Clatsop County, Oregon: Hypothetical Vertical Evacuation Structure at TrendwestResort All Bridges Intact

2015

OPEN-FILE REPORT O-15-02
Local Tsunami Evacuation Analysis of Seaside and Gearhart, Clatsop County, Oregon

By George R. Priest, Laura L. Stimely, Nathan J. Wood, Ian P. Madin, and Rudie J. Watzig

PLATE 6

This project was funded under award #NA13NWS4670013 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program.

Key

Time required after initial earthquake to reach ground outside the hazard area if walking at a rate of 4 feet/second (22 minutes/mile)

- 0-10 minutes
- 10-15 minutes
- 15-20 minutes
- 20-25 minutes
- 25-30 minutes
- 30-35 minutes
- 35-40 minutes
- 40-45 minutes
- 45+ minutes

- Location of hypothetical vertical evacuation structure
- Evacuation Flow Zone
- Evacuation route
- Bridge
- Building
- 17 Tsunami wave arrival time at key points (minutes)
- Safety (L1 inundation limit)
- Assembly Area

Note: For legibility of the evacuation modeling data, roads on this map are emphasized by extending the width 12 feet from the road edge; thus road ends appear to have a 12 ft extension that does not actually exist.

How to Use This Map

1. **Find your location on the map and note the color of the closest street.**
2. **Look at the map legend to see how long it will take to reach an area outside the hazard area from your location if you follow the path indicated by the arrows and travel at 4 ft/second (22 minutes/mile). Remember that EVACUATION FLOW ZONE boundaries are where it is equally efficient to follow two different routes to safety.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat**

Explanation

This map shows how long it should take to walk to a hypothetical vertical evacuation structure near the Trend West Resort or to ground outside the hazard area for a large (L1) tsunami caused by a magnitude 9.0 Cascadia subduction zone earthquake. Black arrows on the map show the fastest routes. The color at any location gives the walking time along the route. The routes follow paths or roads everywhere except the on beach. The time is based on a walking speed of 4 feet per second (22 minutes per mile) and takes into account variations in speed from slope and type of surface (e.g., pavement versus sand).

The map also shows the estimated time of tsunami arrival where major evacuation routes reach ground outside the hazard area and at key points such as bridges. Tsunami arrival time is counted from the start of the local earthquake. When estimating your own evacuation time remember that the earthquake may shake violently for 3-5 minutes, during which time you should "drop, cover, and hold on." In addition to this delay you should consider other factors such as your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake.

Note that this evacuation modeling approach restricts evacuation to streets and trails; thus, in some cases small areas above the tsunami inundation but with no street or trail connection are ignored. If you know there is ready access to such areas, then consider these off-street routes when planning your evacuation.

See the text from this open-file report for technical information on mapping methods. See DOGAMI Special Paper 43 or DOGAMI Open-File Report O-13-19 for explanations of the tsunami scenario used for these maps.

References

Priest, G. R., Witter, R. C., Zhang, Y. J., Wang, K., Goldfinger, C., Stimely, L. L., English, J. T., Pickner, S. G., Hughes, K. L. B., Wille, T. E., and Smith, R. L., 2013, Tsunami inundation scenarios for Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-13-19, 18 p., GIS data.

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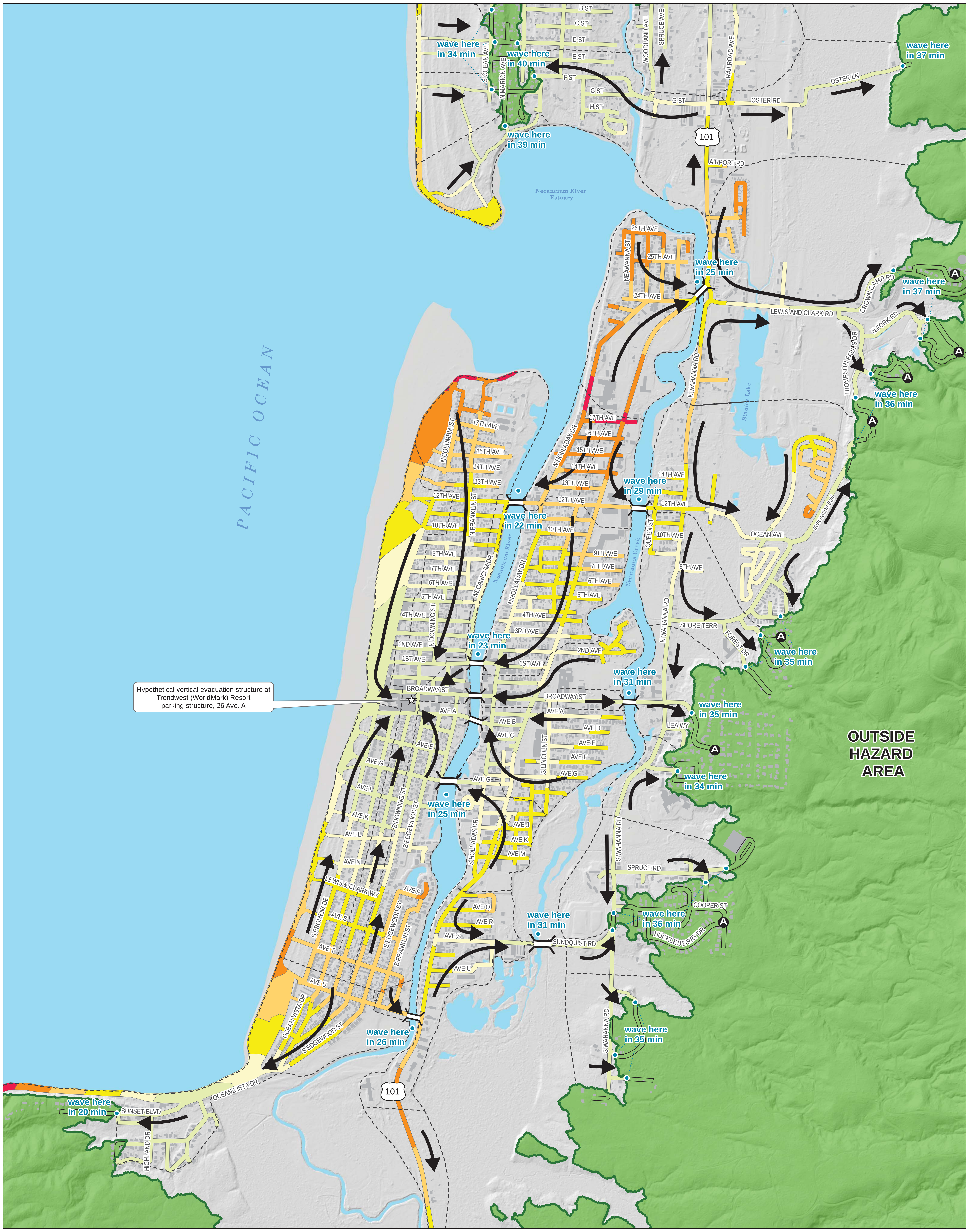

Source Data:
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Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map

SCALE: 1:8,500

0 0.125 0.25 0.5 0.75 1 Miles

0 625 1,250 2,500 3,750 5,000 Feet

0 0.125 0.25 0.5 0.75 1 Kilometers

APPROX. MEAN DECLINATION, 2014

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
www.OregonGeology.org
Ian P. Madin, Interim State Geologist

Modeled Wave Arrival Times for XXL1 Local Tsunami Event, Seaside and Gearhart, Clatsop County, Oregon

2015

OPEN-FILE REPORT O-15-02
Local Tsunami Evacuation Analysis of Seaside and Gearhart, Clatsop County, Oregon
By George R. Priest, Laura L. Stimely, Nathan J. Wood, Ian P. Madin, and Rudie J. Watzig

PLATE 7

This project was funded under award #NA13NWS4670013 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program.

Key

XXL1 wave arrival times

- 8 minutes
- 8-10 minutes
- 10-12 minutes
- 12-14 minutes
- 14-16 minutes
- 16-18 minutes
- 18-20 minutes
- 20-22 minutes
- 22-24 minutes
- 24-26 minutes
- 26-28 minutes
- 28-30 minutes
- 30-32 minutes
- 32-34 minutes
- 34-36 minutes
- 36-38 minutes
- 38-40 minutes
- 40-42 minutes
- 42-44 minutes
- 44-46 minutes
- 46-48 minutes
- 48-50 minutes
- 50-52 minutes
- 52-54 minutes
- 54-56 minutes
- 56-58 minutes
- 58+ minutes

- Bridge
- Building
- Tsunami arrival time at index contours
- 2-minute wave arrival time contours with thicker index contour every 10 minutes
- Assembly Area
- City of Gearhart Optional Assembly Area

* Optional high ground areas for the the City of Gearhart are being shown in case you are physically unable to get outside the hazard area or if there are impassable obstacles in your way (such as wetlands, rivers, lakes, or earthquake debris). This optional high

How to Use These Maps

1. **Find your location on the map and note the color band.**
2. **Find the color on the map legend to see when the first tsunami wave will arrive.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat the wave to that point.**

Explanation

The maps show estimated wave arrival times for a maximum-considered XXL1 tsunami caused by as magnitude 9.1 Cascadia earthquake. The tsunami starts toward shore at the moment the earthquake starts, but the shaking from the earthquake can last three to five minutes. You should consider this time delay in planning your evacuation. Wave arrivals are shown as the time when wave depth reaches 6 inches or greater at any location, and arrivals are timed from the start of the earthquake.

See the text from this open-file report for technical information on mapping methods. See DOGAMI Special Paper 43 or DOGAMI Open-File Report O-13-19 for explanations of the tsunami scenario used for these maps.

References

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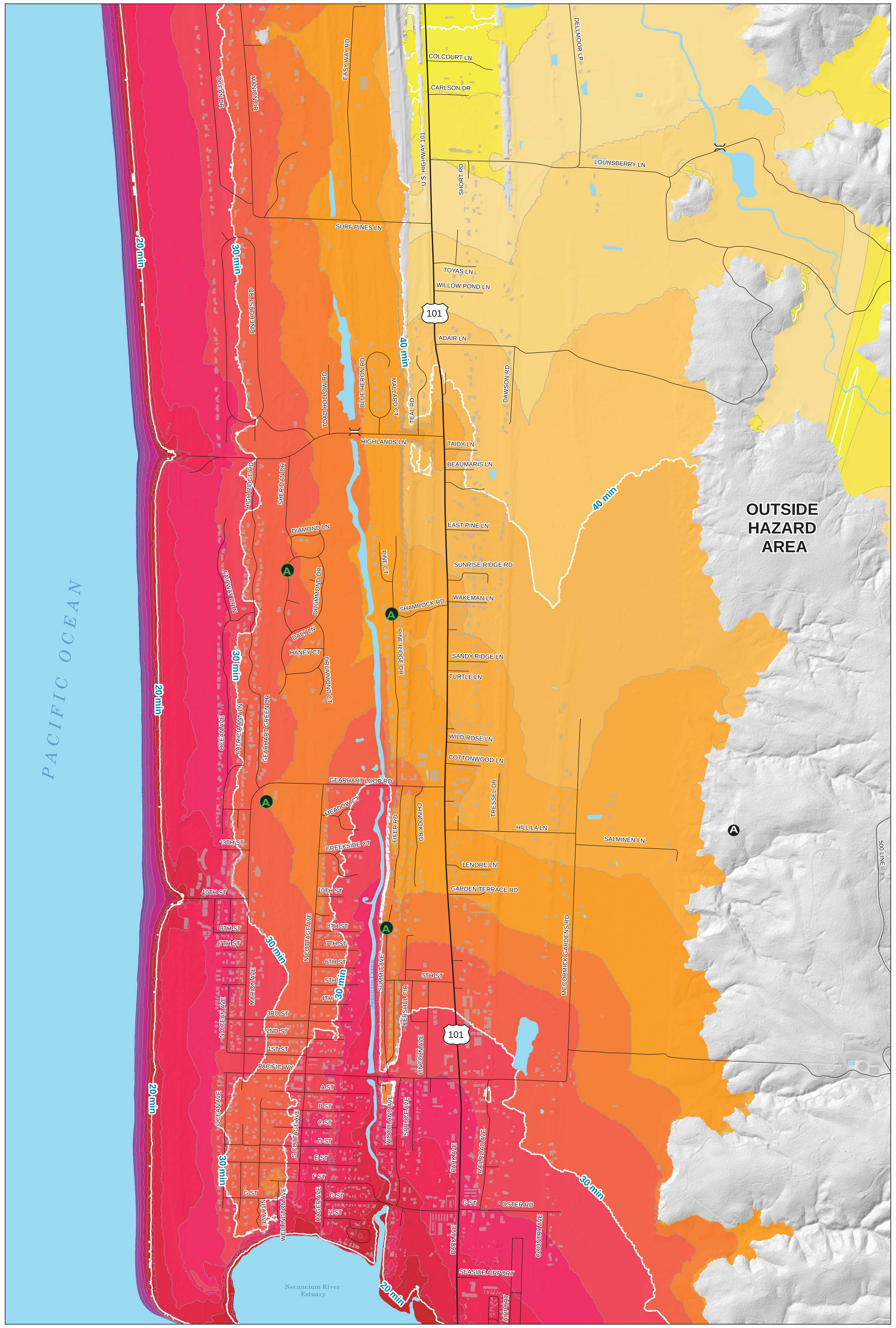
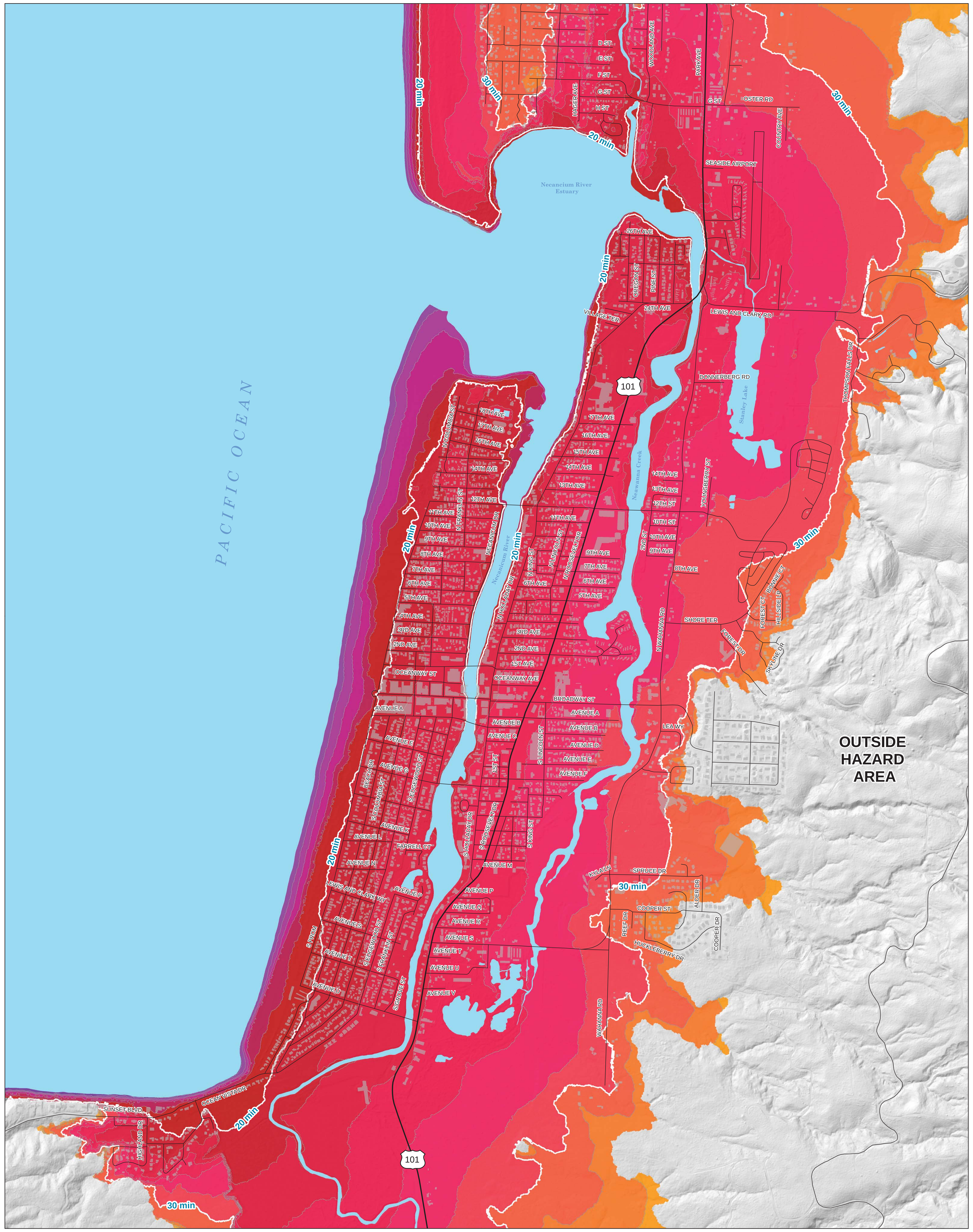
GEARHART



SEASIDE



Source Data:
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Lidar data are from DOGAMI Lidar Data Quadrangles LDQ-2011-45123-H8-Tillamook Head and LDQ-2011-46123-A8-Gearhart.

Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map

SCALE 1:8,500

DISCLAIMER

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
www.OregonGeology.org
Ian P. Madin, Interim State Geologist

Modeled Wave Arrival Times for an L1 Local Tsunami Event, Seaside and Gearhart, Clatsop County, Oregon

2015

OPEN-FILE REPORT O-15-02
Local Tsunami Evacuation Analysis of Seaside and Gearhart, Clatsop County, Oregon
By George R. Priest, Laura L. Stimely, Nathan J. Wood, Ian P. Madin, and Rudie J. Watzig

PLATE 8

This project was funded under award #NA13NWS4670013 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program.

Key

L1 wave arrival times

- 8 minutes
- 8-10 minutes
- 10-12 minutes
- 12-14 minutes
- 14-16 minutes
- 16-18 minutes
- 18-20 minutes
- 20-22 minutes
- 22-24 minutes
- 24-26 minutes
- 26-28 minutes
- 28-30 minutes
- 30-32 minutes
- 32-34 minutes
- 34-36 minutes
- 36-38 minutes
- 38-40 minutes
- 40-42 minutes
- 42-44 minutes
- 44-46 minutes
- 46-48 minutes
- 48-50 minutes
- 50-52 minutes
- 52-54 minutes
- 54-56 minutes
- 56-58 minutes
- 58+ minutes

Bridge

Building

30 Tsunami arrival time at index contours

2-minute wave arrival time contours with thicker index contour every 10 minutes

A Assembly Area

How to Use These Maps

1. **Find your location on the map and note the color band.**
2. **Find the color on the map legend to see when the first tsunami wave will arrive.**
3. **Check times at key tsunami wave arrival points, such as at bridges. You must be beyond this point at the time indicated to beat the wave to that point.**

Explanation

The maps show estimated wave arrival times for an L1 tsunami caused by as magnitude 9.0 Cascadia earthquake. The tsunami starts toward shore at the moment the earthquake starts, but the shaking from the earthquake can last three to five minutes. You should consider this time delay in planning your evacuation. Wave arrivals are shown as the time when wave depth reaches 6 inches or greater at any location, and arrivals are timed from the start of the earthquake.

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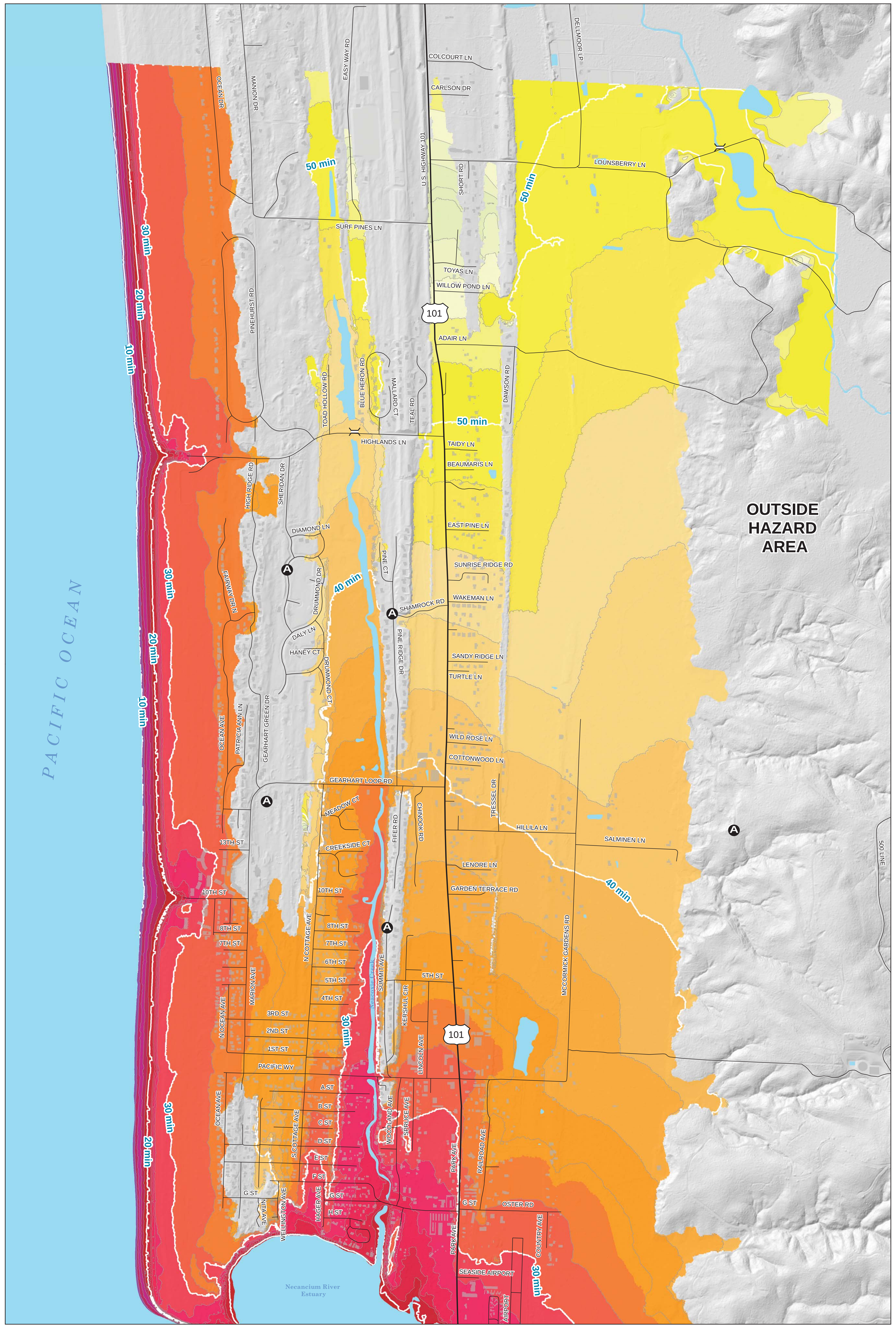
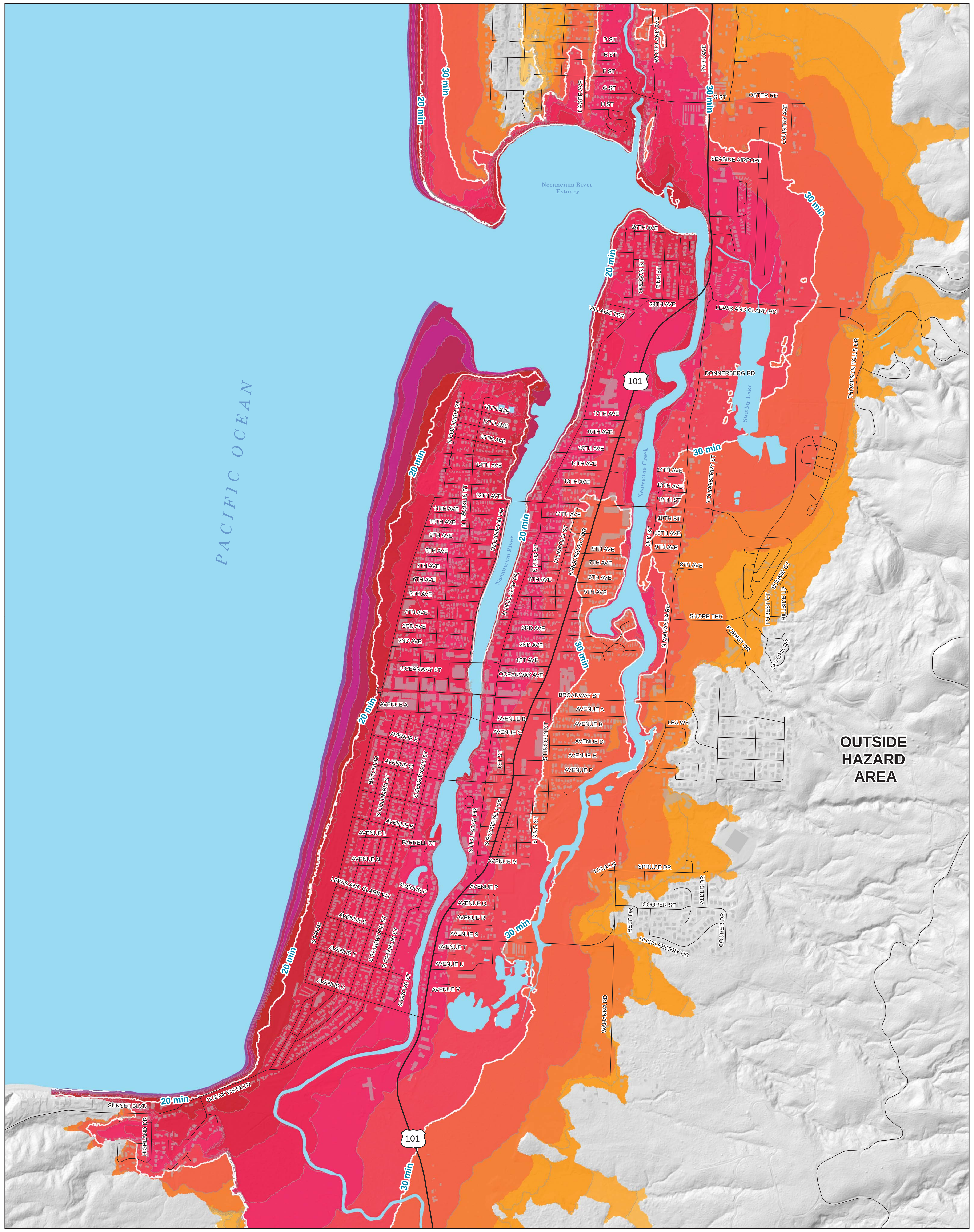
GEARHART



SEASIDE



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Coordinate System: Oregon Statewide Lambert Conformal Conic, Unit: International Feet, Horizontal Datum: NAD 1983 HARN, Vertical Datum: NAVD 1988.

Software: Esri ArcGIS® 10.1

Location Map

DISCLAIMER

BEAT THE WAVE! TSUNAMI EVACUATION MAP SEASIDE, OREGON

XXL1 Local Tsunami Event, 5-Minute Evacuation Delay, All Bridges Intact

TSUNAMI EVACUATION ROUTE

MAP LOCATION
OREGON

IF YOU FEEL AN EARTHQUAKE:
- Drop, cover, and hold
- Move immediately inland to higher ground
- Do not wait for an official warning

SI USTED SIENTE EL TEMBLOR:
- Tírese al suelo, cúbrase, y espere
- Diríjase de inmediato a un lugar más alto que el nivel del mar
- No espere por un aviso oficial

HOW TO USE THIS MAP

Find the nearest road to your location. Check the road color and speed. Maintain this speed all the way to the safe area.
If you can manage a clear and faster off-road route to the safe area, go that route!

running	*jogging*	*fast walking to slow jogging*	*walking*	*very slow walking*
5.5+ mph (8+ ft/sec)	4.1-5.5 mph (6-8 ft/sec)	2.7-4.1 mph (4-6 ft/sec)	1.4-2.7 mph (2-4 ft/sec)	0-1.4 mph (0-2 ft/sec)

ASSEMBLY AREA
ÁREA REUNIÓN

MAP SYMBOLS

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Assembly area
- Safety (XXL1 inundation limit)
- School
- Tsunami wave arrival time (minutes)
- Fire department
- Law enforcement
- Hospital

N

SCALE
0.5 mile
0.5 km

This map is based on modeling for a local tsunami generated by a magnitude 9.1 maximum-considered (XXL1) Cascadia Subduction Zone (CSZ) earthquake. The tsunami starts toward shore at the moment the earthquake starts, but the shaking from the earthquake can last three to five minutes. Evacuation speeds depicted on the map are minimums that must be maintained all the way to safety. If your speed falls below the minimums owing to difficult terrain such as soft sand or steep slopes, speed must be increased above the minimum in less challenging parts of the evacuation route. Users should test evacuation routes to see what speeds are necessary to reach safety before listed tsunami arrival times at safety shown on the map. Remember to factor in the estimated 5-minute evacuation delay time listed on this map. This delay is caused by earthquake shaking and common behavioral factors.

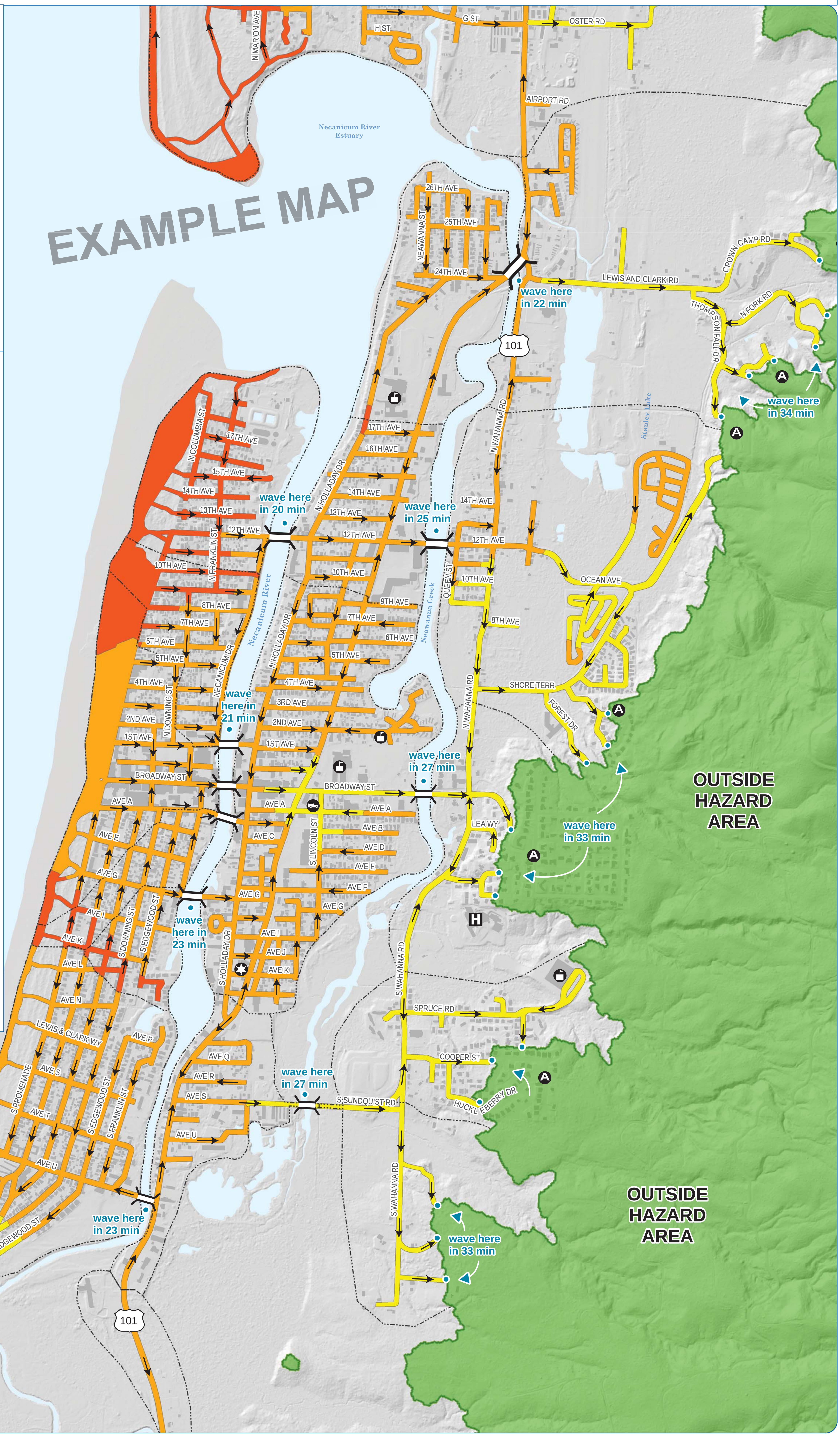
When estimating what speed you can maintain, consider your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake. Speeds and evacuation flow zones on this map reflect the assumption that all bridges remain standing after the CSZ earthquake. Flow zones depict regions that evacuate towards a specific critical point such as bridges and are directly analogous to watershed boundaries or drainage divides in the landscape. The boundaries between evacuation flow zones are where it is equally efficient to follow two different routes to safety.

Note that this evacuation modeling approach restricts evacuation to streets and trails; thus, in some cases small areas above the tsunami inundation but with no street or trail connection are ignored. If you know there is ready access to such areas, then consider these off-street routes when planning or testing your evacuation.

NOTICE

This "beat the wave" tsunami evacuation map was developed by DOGAMI for the purpose of evaluating the most effective means to guide the public in the event of a tsunami evacuation. The map is based on preliminary data and should not be used for site-specific planning. This map adopts recommendations from the Oregon Tsunami Advisory Council. The evacuation routes were developed by local emergency officials and reviewed by the Oregon Department of Emergency Management.

MAP REVISED 08-03-15



BEAT THE WAVE! TSUNAMI EVACUATION MAP GEARHART, OREGON

TSUNAMI EVACUATION ROUTE

XXL1 Local Tsunami Event, 5-Minute Evacuation Delay, All Bridges Intact

MAP LOCATION
OREGON

IF YOU FEEL AN EARTHQUAKE:
- Drop, cover, and hold
- Move immediately inland to higher ground
- Do not wait for an official warning

SI USTED SIENTE EL TEMBLOR:
- Tírese al suelo, cúbrase, y espere
- Diríjase de inmediato a un lugar más alto que el nivel del mar
- No espere por un aviso oficial

HOW TO USE THIS MAP

Find the nearest road to your location. Check the road color and speed. Maintain this speed all the way to the safe area. If you can manage a clear and faster off-road route to the safe area, go that route!

running	*jogging*	*fast walking to slow jogging*	*walking*	*very slow walking*
5.5+ mph (8+ ft/sec)	4.1-5.5 mph (6-8 ft/sec)	2.7-4.1 mph (4-6 ft/sec)	1.4-2.7 mph (2-4 ft/sec)	0-1.4 mph (0-2 ft/sec)

ASSEMBLY AREA
ÁREA REUNIÓN

MAP SYMBOLS

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Assembly area
- City of Gearhart Optional Assembly Area*
- Outside hazard area for XXL1 inundation
- School
- Tsunami wave arrival time (minutes)
- Fire department
- Law enforcement
- Hospital

N

SCALE
0.5 mile
0.5 km

* Optional high ground areas for the the City of Gearhart are being shown in case you are physically unable to get outside the hazard area or if there are impassable obstacles in your way (such as wetlands, rivers, lakes, or earthquake debris). This optional high ground remains dry in 95 percent of tsunami scenarios analyzed.

This map is based on modeling for a local tsunami generated by a magnitude 9.1 maximum-considered (XXL1) Cascadia Subduction Zone (CSZ) earthquake. The tsunami starts toward shore at the moment the earthquake starts, but the shaking from the earthquake can last three to five minutes. Evacuation speeds depicted on the map are minimums that must be maintained all the way to safety. If your speed falls below the minimums owing to difficult terrain such as soft sand or steep slopes, speed must be increased above the minimum in less challenging parts of the evacuation route. Users should test evacuation routes to see what speeds are necessary to reach safety before listed tsunami arrival times at safety shown on the map. Remember to factor in the estimated 5-minute evacuation delay time listed on this map. This delay is caused by earthquake shaking and common behavioral factors.

When estimating what speed you can maintain, consider your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake. Speeds and evacuation flow zones on this map reflect the assumption that all bridges remain standing after the CSZ earthquake. Flow zones depict regions that evacuate towards a specific critical point such as bridges and are directly analogous to watershed boundaries or drainage divides in the landscape. The boundaries between evacuation flow zones are where it is equally efficient to follow two different routes to safety.

Note that this evacuation modeling approach restricts evacuation to streets and trails; thus, in some cases small areas above the tsunami inundation but with no street or trail connection are ignored. If you know there is ready access to such areas, then consider these off-street routes when planning or testing your evacuation.

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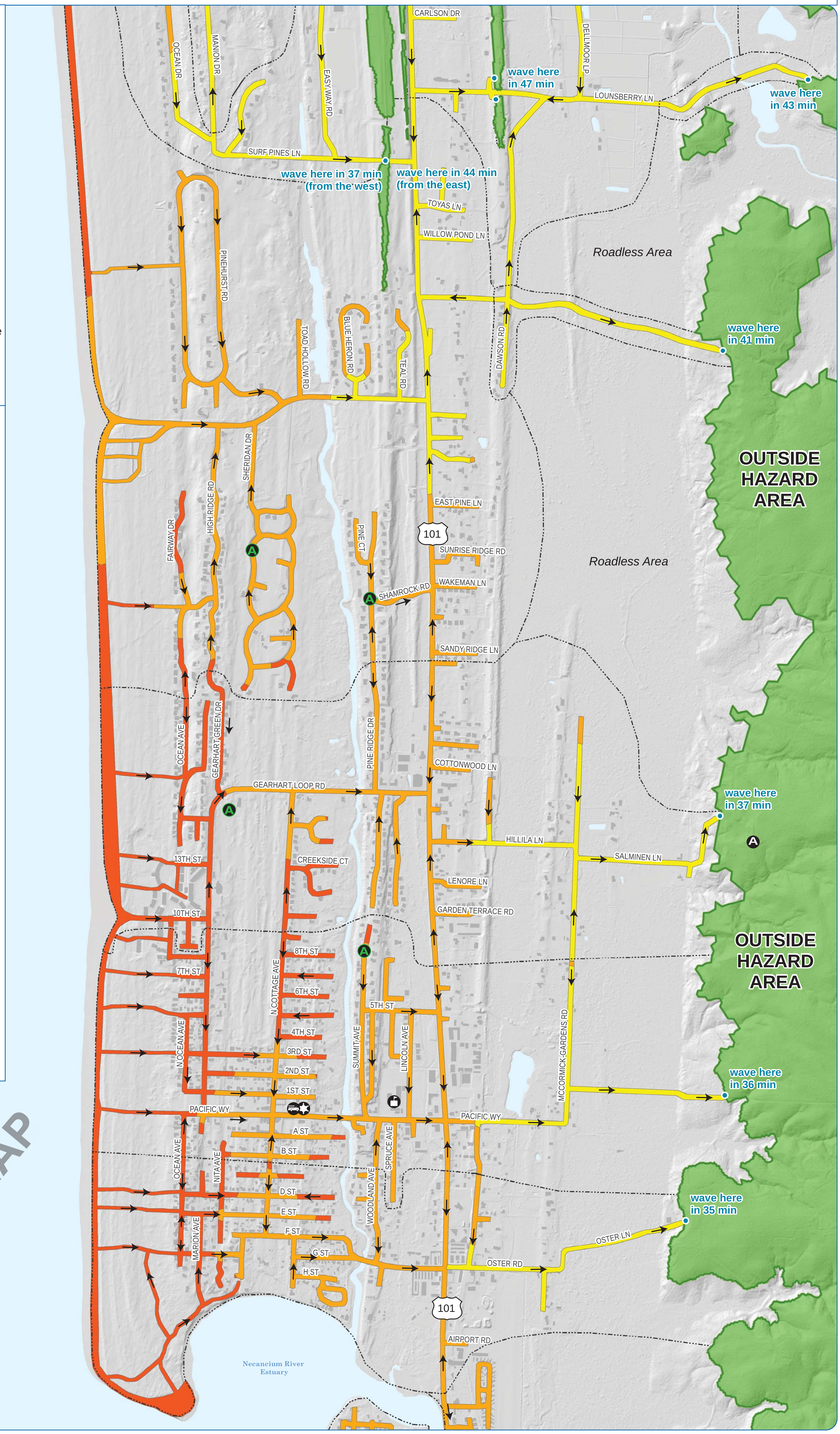
MAP REVISED 08-03-15



BEAT THE WAVE! TSUNAMI EVACUATION MAP SEASIDE, OREGON

TSUNAMI EVACUATION ROUTE

XXL1 Local Tsunami Event, 5-Minute Evacuation Delay, Only Retrofitted Bridges Intact

MAP LOCATION
OREGON

IF YOU FEEL AN EARTHQUAKE:

- Drop, cover, and hold
- Move immediately inland to higher ground
- Do not wait for an official warning

SI USTED SIENTE EL TEMBLOR:

- Tírese al suelo, cúbrase, y espere
- Diríjase de inmediato a un lugar más alto que el nivel del mar
- No espere por un aviso oficial

HOW TO USE THIS MAP

Find the nearest road to your location. Check the road color and speed. Maintain this speed all the way to the safe area. If you can manage a clear and faster off-road route to the safe area, go that route!

running	jogging	fast walking to slow jogging	walking	very slow walking
5.5+ mph (8+ ft/sec)	4.1-5.5 mph (6-8 ft/sec)	2.7-4.1 mph (4-6 ft/sec)	1.4-2.7 mph (2-4 ft/sec)	0-1.4 mph (0-2 ft/sec)

ASSEMBLY AREA / ÁREA REUNIÓN

MAP SYMBOLS

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Bridge out
- Assembly area
- Outside hazard area for XXL1 inundation
- Tsunami wave arrival time (minutes)
- School
- Fire department
- Law enforcement
- Hospital

N

SCALE

0.5 km
0.5 mile

This map is based on modeling for a local tsunami generated by a magnitude 9.1 maximum-considered (XXL1) Cascadia Subduction Zone (CSZ) earthquake. The tsunami starts toward shore at the moment the earthquake starts, but the shaking from the earthquake can last three to five minutes. Evacuation speeds depicted on the map are minimums that must be maintained all the way to safety. If your speed falls below the minimums owing to difficult terrain such as soft sand or steep slopes, speed must be increased above the minimum in less challenging parts of the evacuation route. Users should test evacuation routes to see what speeds are necessary to reach safety before listed tsunami arrival times at safety shown on the map. Remember to factor in the estimated 5-minute evacuation delay time listed on this map. This delay is caused by earthquake shaking and common behavioral factors.

When estimating what speed you can maintain, consider your physical limitations, the possibility of evacuation at night or in bad weather, and earthquake damage to evacuation routes. Streets may be cracked or covered in wet sand from liquefaction, overhead electrical lines may be down, window glass and bricks may have fallen into the streets, and bridges may be damaged. When practicing your evacuation route, find out which bridges have and have not been designed to withstand a large earthquake. Speeds and evacuation flow zones on this map reflect the assumption that only bridges seismically retrofitted as of 2015 will remain intact after the CSZ earthquake. Flow zones depict regions that evacuate towards a specific critical point such as bridges and are directly analogous to watershed boundaries or drainage divides in the landscape. The boundaries between evacuation flow zones are where it is equally efficient to follow two different routes to safety.

Note that this evacuation modeling approach restricts evacuation to streets and trails; thus, in some cases small areas above the tsunami inundation but with no street or trail connection are ignored. If you know there is ready access to such areas, then consider these off-street routes when planning or testing your evacuation.

NOTICE

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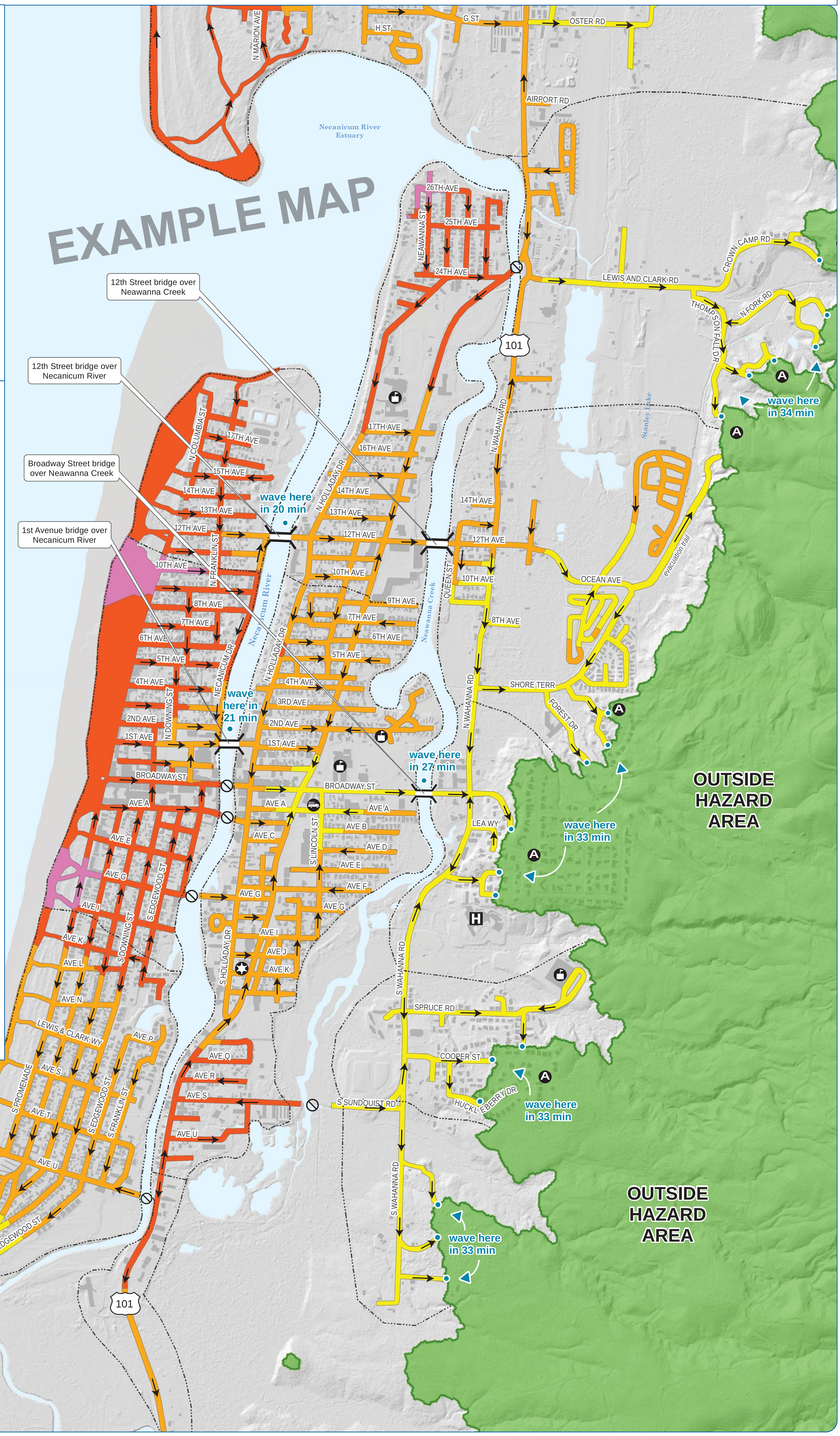
MAP REVISED 08-03-15



BEAT THE WAVE! TSUNAMI EVACUATION MAP SEASIDE, OREGON

TSUNAMI EVACUATION ROUTE

XXL1 Local Tsunami Event, 10-Minute Evacuation Delay, Only Retrofitted Bridges Intact

MAP LOCATION
OREGON

IF YOU FEEL AN EARTHQUAKE:
- Drop, cover, and hold
- Move immediately inland to higher ground
- Do not wait for an official warning

SI USTED SIENTE EL TEMBLOR:
- Tírese al suelo, cúbrase, y espere
- Diríjase de inmediato a un lugar más alto que el nivel del mar
- No espere por un aviso oficial

HOW TO USE THIS MAP

Find the nearest road to your location. Check the road color and speed. Maintain this speed all the way to the safe area. If you can manage a clear and faster off-road route to the safe area, go that route!

running	***jogging***	***fast walking to slow jogging***	***walking***	***very slow walking***
5.5+ mph (8+ ft/sec)	4.1-5.5 mph (6-8 ft/sec)	2.7-4.1 mph (4-6 ft/sec)	1.4-2.7 mph (2-4 ft/sec)	0-1.4 mph (0-2 ft/sec)

ASSEMBLY AREA
ÁREA REUNIÓN

MAP SYMBOLS

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Bridge out
- Assembly area
- Outside hazard area for XXL1 inundation
- Tsunami wave arrival time (minutes)
- School
- Fire department
- Law enforcement
- Hospital

N SCALE 0.5 km 0.5 mile

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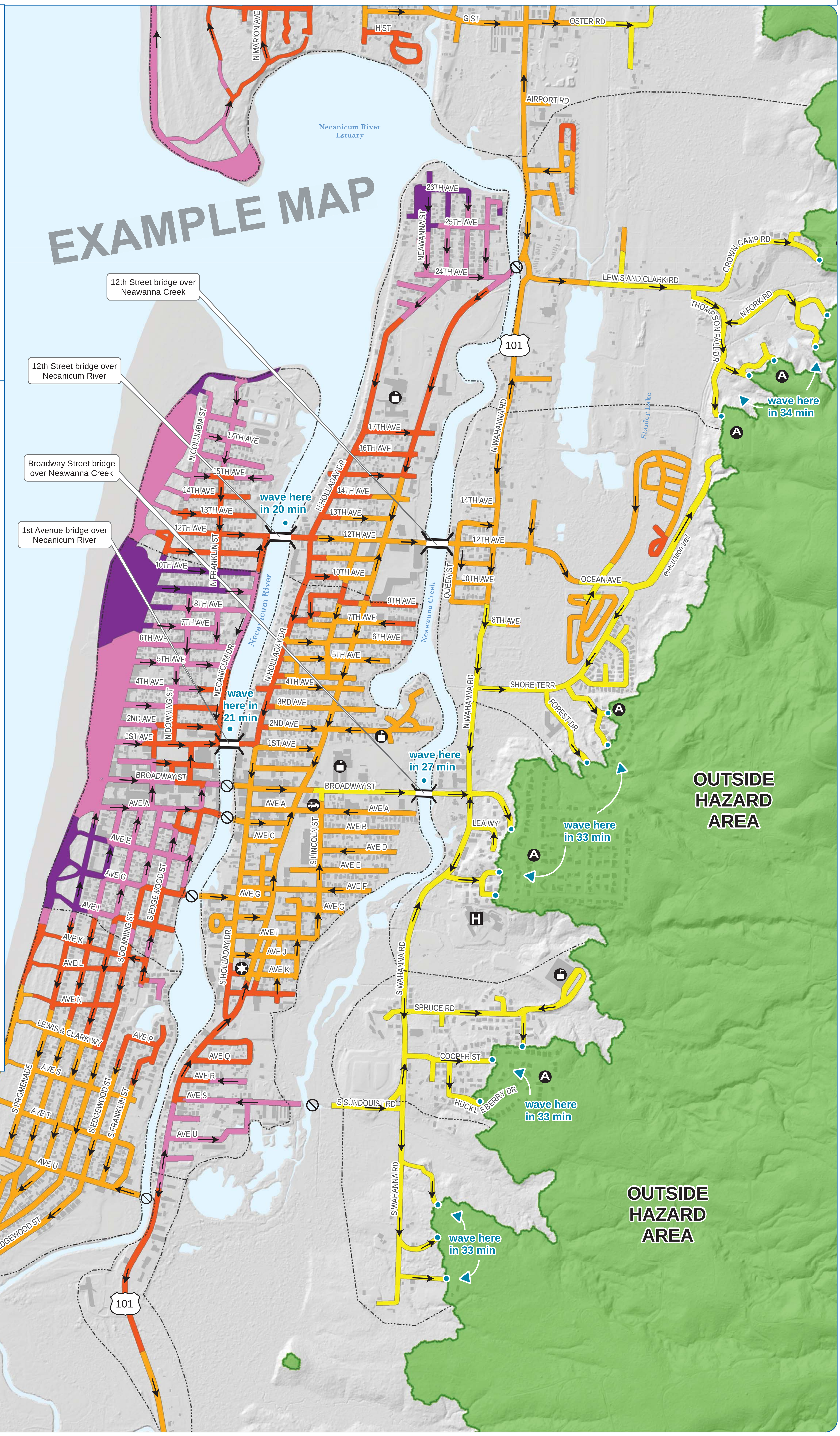

NOAA
OEM

BEAT THE WAVE! TSUNAMI EVACUATION MAP GEARHART, OREGON

TSUNAMI EVACUATION ROUTE

MAP LOCATION
OREGON

XXL1 Local Tsunami Event, 10-Minute Evacuation Delay, Only Retrofitted Bridges Intact

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ASSEMBLY AREA
ÁREA REUNIÓN

MAP SYMBOLS

- Evacuation Flow Zone
- Evacuation route
- Bridge
- Assembly area
- City of Gearhart Optional Assembly Area*
- Outside hazard area for XXL1 inundation
- School
- 17 Tsunami wave arrival time (minutes)
- Fire department
- Law enforcement
- Hospital

N

SCALE

0.5 mile
0.5 km

* Optional high ground areas for the the City of Gearhart are being shown in case you are physically unable to get outside the hazard area or if there are impassable obstacles in your way (such as wetlands, rivers, lakes, or earthquake debris). This optional high

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