



TECHNICAL MEMORANDUM OR 66 Green Springs Highway IAMP

FINAL Technical Memorandum #4: Future Conditions Land Use Assumptions and Operational Analysis

Date: May 14, 2012 Project #: 11881
To: Project Team
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The purpose of this memorandum is to outline the land use conditions assumed for the future conditions analysis of the OR 66 Green Springs Highway Interchange Access Management Plan (IAMP) and document the future year analysis results. In addition, the memorandum contains documentation of initial concepts submitted to-date from the project team, agency staff and the general public. This memorandum is an expansion of Technical Memorandum #4a which focused only on the future land use assumptions.

FUTURE YEAR LAND USE APPROACH

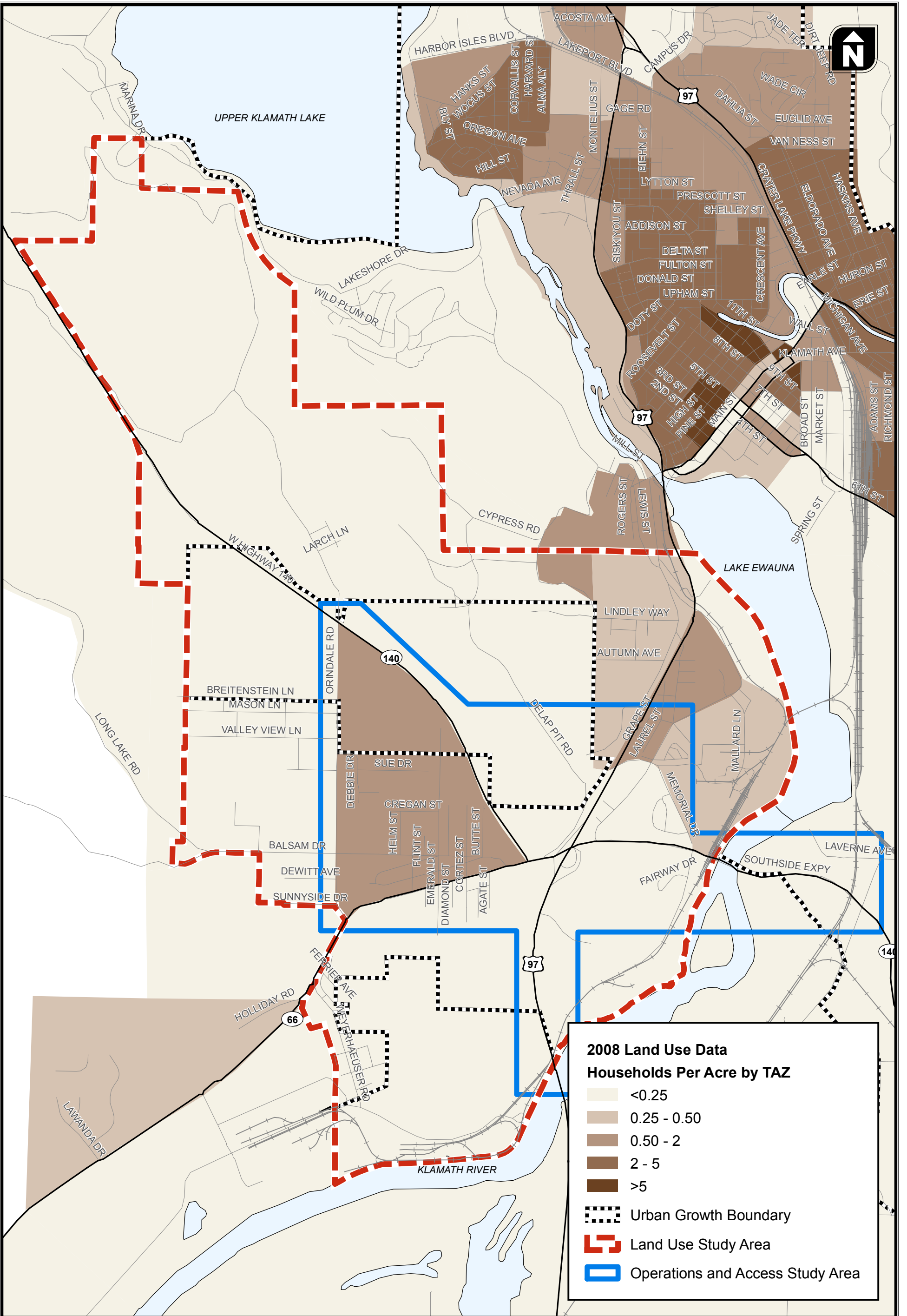
The future year land use was based on a 25-year horizon period for assumed development. This analysis was informed by the land use assumed in the Klamath Falls Urban Area Travel Demand Model. This model and the land use assumptions included within it were recently updated by a process that included input from ODOT, Klamath County representatives, and City of Klamath Falls representatives. As such, the future land use scenario has been previously informed by local representatives. In addition, this scenario was reviewed by the OR 66 Green Springs IAMP Project Team (PT) and confirmed as a reasonable future year analysis approach. These scenarios are the basis of the future year analysis.

The resulting land use assumptions for the base and future year in the vicinity of the IAMP study area are shown in subsequent figures. Specifically, the following assumptions from Klamath Falls Urban Area Travel Demand Model are summarized:

- Figure 1 – 2008 household density (HH/acre)
- Figure 2 – 2037 household density (HH/acre)
- Figure 3 – 2008-2037 household change (gross change)
- Figure 4 – 2008 employment density (employees/acre)

- Figure 5 – 2037 employment density (employees/acre)
- Figure 6 – 2008-2037 employment change (gross change)

The model does not reflect potential redevelopments through zone changes, and/or urban growth boundary (UGB) expansions. This IAMP provides a 25-year analysis and not a build-out scenario of the IMSA. Coordination with ODOT staff determined that such potential developments will go through the formal land use application processes to obtain approval, which will include the required amendments to the transportation system plan (TSP) and comprehensive plans.

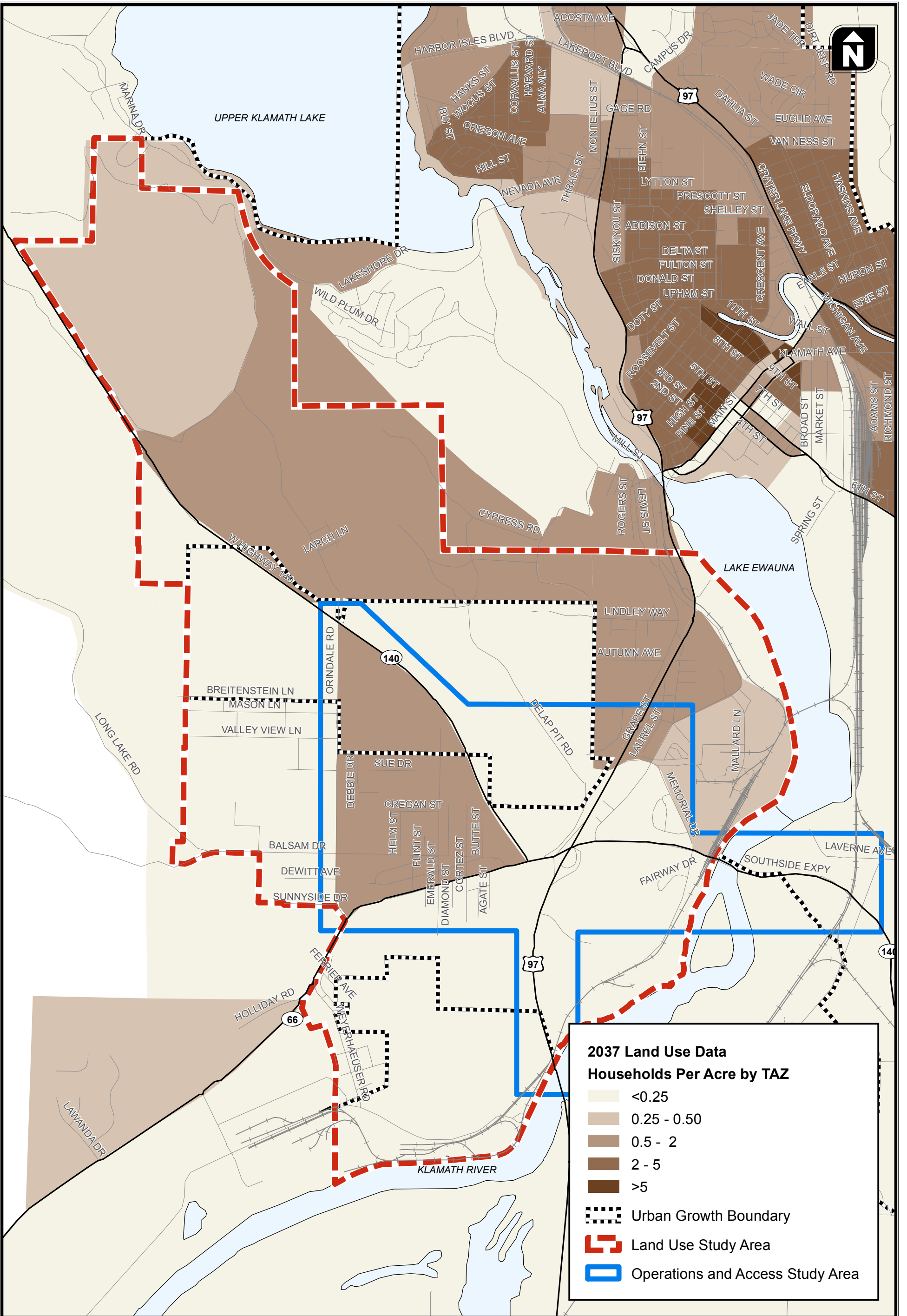


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2008 Household Density

Figure
1

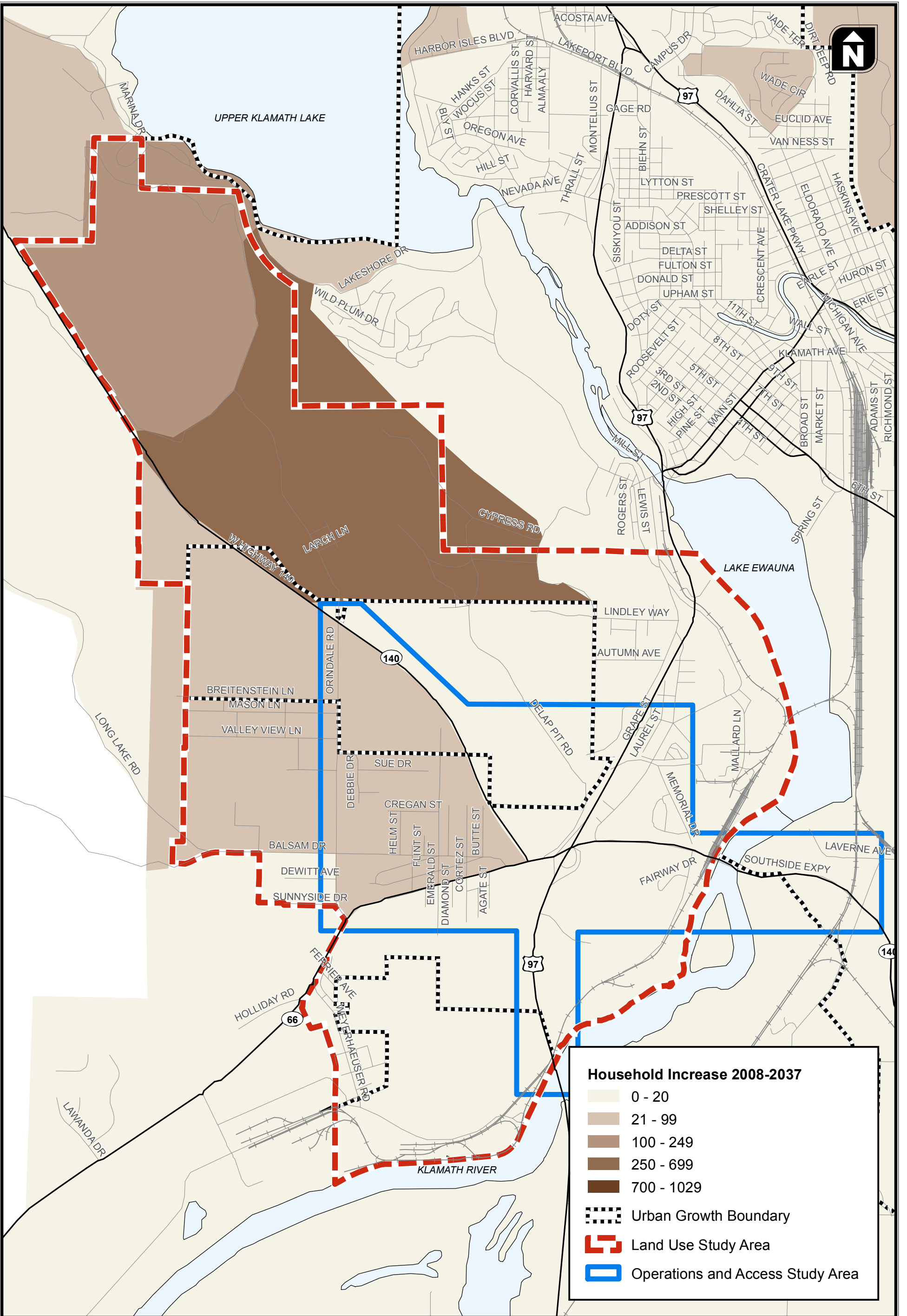


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2037 Household Density

Figure 2

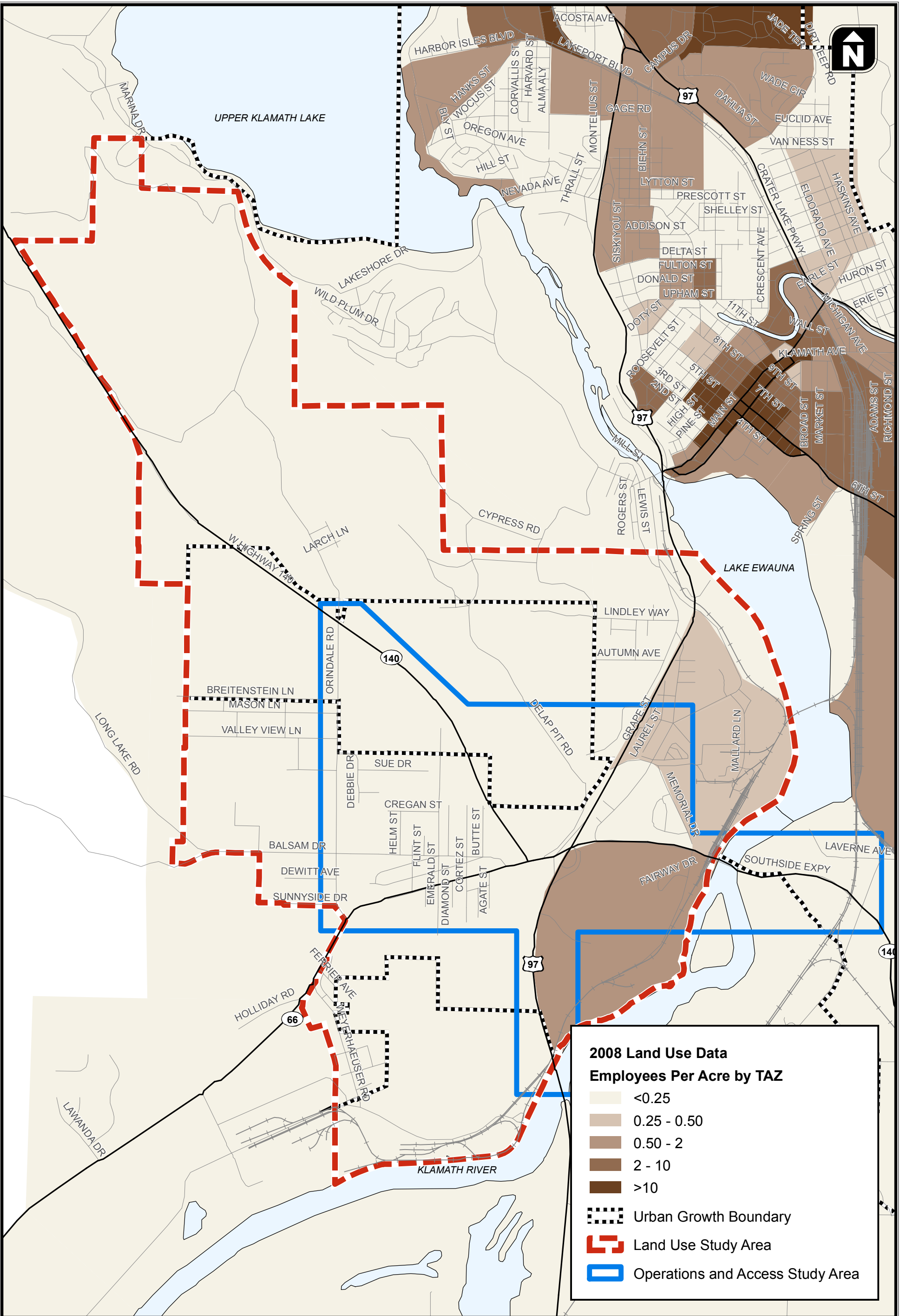


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2008-2037 Household Change

Figure 3

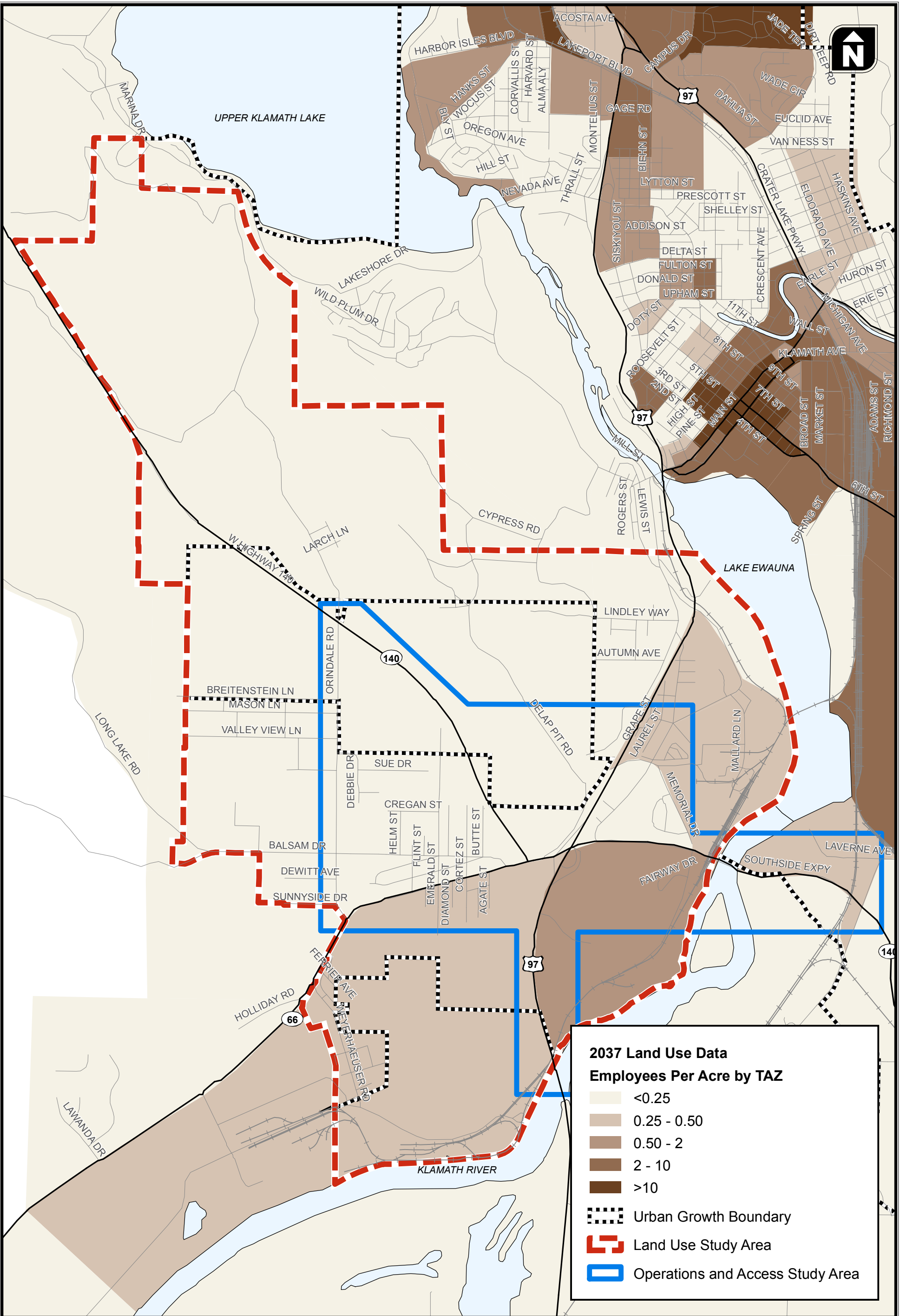


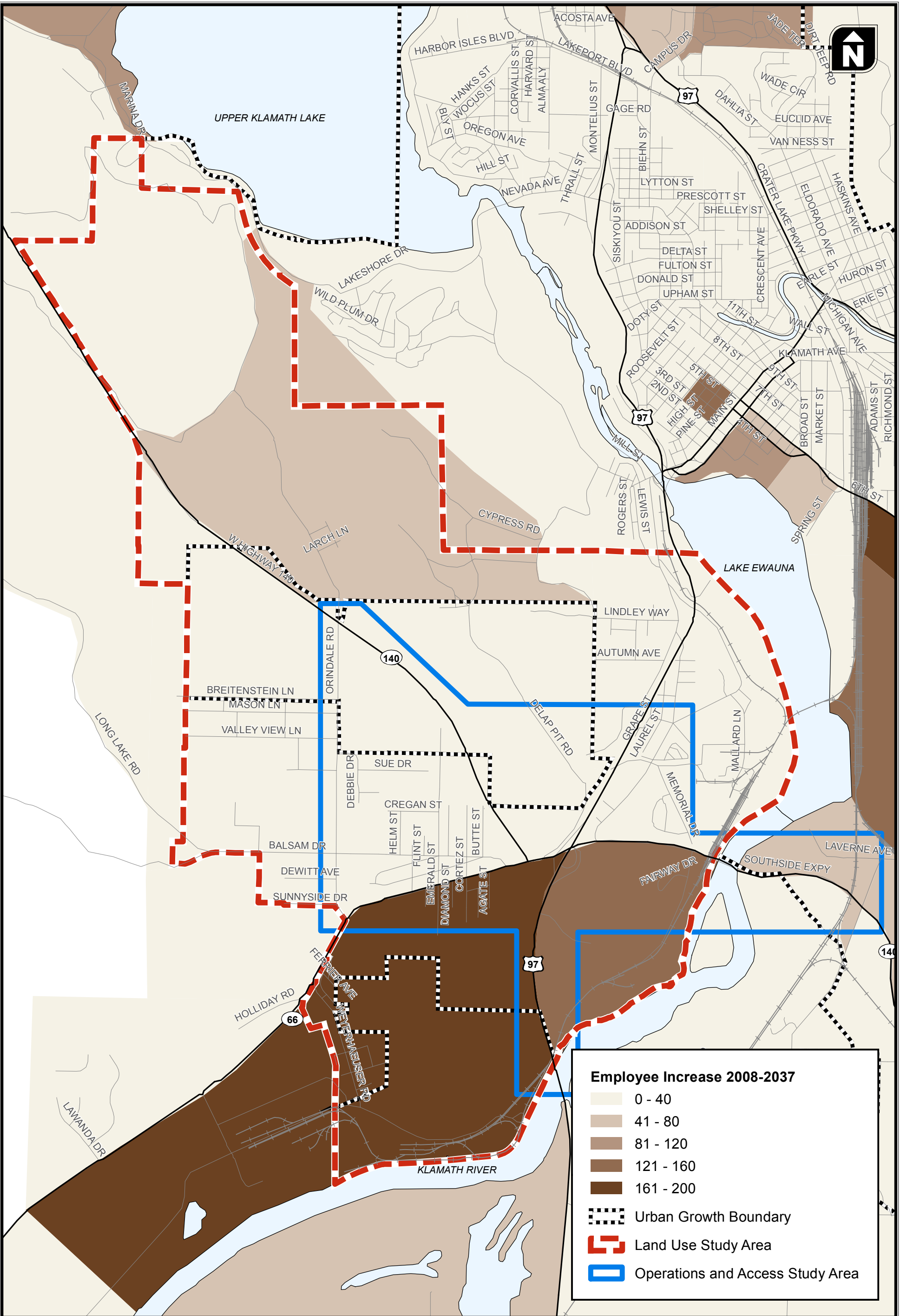
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2008 Employment Density

Figure 4





Employee Increase 2008-2037

- 0 - 40
- 41 - 80
- 81 - 120
- 121 - 160
- 161 - 200
- Urban Growth Boundary
- Land Use Study Area
- Operations and Access Study Area



2008-2037 Employment Change

Figure 6

FORECAST YEAR MODEL DEVELOPMENT

The Klamath Falls Urban Area Travel Demand Model was used to developed forecast year roadway volumes. ODOT staff generated base and future year travel demand model volumes for the study area that were used as a basis of comparison between existing and forecast conditions.

NCHRP 255 Methodology

Forecast intersection turning movement volumes was developed based on the procedures outlined in National Cooperative Highway Research Program (NCHRP) Report 255 (Reference 1). This procedure accounts for a combination of the 30th highest hour volumes measured at the intersections, and base and future year model forecasts from the EMME/2 model. The general methodology to develop the volumes is outlined below.

- The Year 2010 30th highest hour design volumes are used to represent the base volumes. These volumes will directly correlate to base year model volumes.
- The percentage change in the model's base and horizon year traffic volume for each movement is calculated and applied to the 2010 30th highest hour design volumes. Each table reports the existing model and future model volumes, in addition to the percentage change as applied.
- The numerical change (delta) in the model's traffic volumes is also calculated and applied to the 2010 30th highest hour design volumes.
- The results obtained from the percentage and numerical change calculations are averaged to obtain the design hour year 2035 analysis traffic volumes.

Post processing of the traffic volumes occurred on a link basis first. Once the volumes were adjusted, the link volumes were converted into turn movements at the intersections. This process was applied to all of the study intersections that exist in the base year model, as available. The reasonableness of the averaging method was reviewed at each location, especially in instances in which the numerical and percentage change yielded significantly different results (which can often occur on very low volume movements in the base model that increase significantly in 2035) or when the existing model differed significantly from the existing turning movement counts. On these occasions, the available data and travel forecasts was reviewed to determine the appropriate year 2035 analysis volumes. The resulting unbalanced year 2035 volumes were balanced, as appropriate, for use in the forecast conditions assessment.

The intersection performance of the 16 study area intersections was evaluated for year 2035 No Build conditions. These results are summarized in the following section.

FUTURE YEAR (2035) OPERATIONAL ANALYSIS

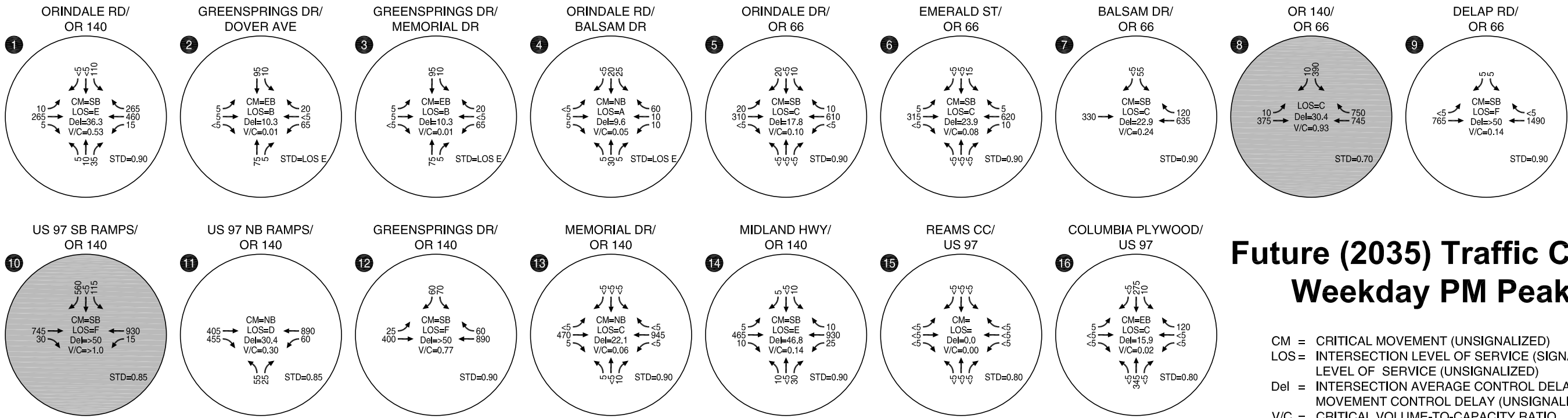
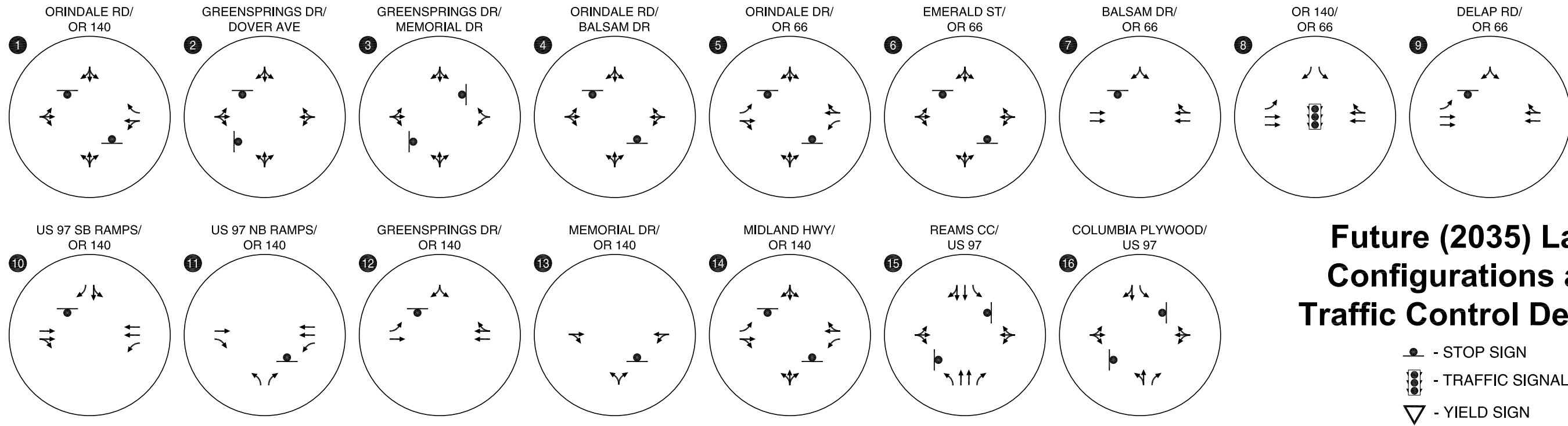
Based on the methodology described previously, future year (2035) traffic volumes were developed for the study intersections. The following subsections describe the results of that analysis and potential long-term deficiencies identified.

Future Year Analysis Assumptions

No major transportation improvements for the operational study area are currently included in the Statewide Transportation Improvement Program (STIP) or the City of Klamath Falls Capital Improvement Program (CIP). Further, no improvements funded by other means are currently planned for the vicinity. As such, the future year analysis described in this memorandum assumed the same lane configurations as exist today. However, peak hour factors (PHF) were adjusted as recommended in the ODOT Analysis Procedures Manual (APM) to account for increasing travel demand and peak demand spreading. Specifically, the PHFs were adjusted to 0.95 or 0.90 based on the roadway facility type as outlined in the APM. Where the existing PHF was higher than the suggested adjustment value, the existing PHF was retained.

Operational Analysis Results

The study intersections were analyzed based on the 2035 traffic conditions developed based on the assumptions described previously. The results of that analysis are shown in Figure 7.



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Future (2035) Lane Configurations and Traffic Control Devices / **Future (2035) Traffic Conditions Weekday PM Peak Hour**

Figure 7

As shown, two study intersections are expected to operate unacceptably based on the future year analysis. These include:

- OR 66/OR 140
- OR 140/US 97 Southbound Ramp Terminal

These intersections are expected to fail due to a large increase in travel demand from the US 97 southbound off-ramp to OR 140. This demand is largely associated with development assumed to occur along OR 140 to the northwest of the study area, including developments within the Running Y area as well as continued development in other residential areas such as Southview.

Within the p.m. peak hour demand analyzed for this study, the demand is observed to be largely directional in nature with heavy volumes heading from US 97 to OR 140. *An a.m. analysis was not conducted, but one could assume that the demand would likely be reversed in directionality due to the commuting nature of the trips.*

Future Year Analysis Summary

- Future evening demand is expected to be directional from the US 97 southbound off-ramp to OR 140 based on the travel demand model.
- Future morning demand is also anticipated to be directional with heavy demand going from OR 140 to US 97.
- Two study intersections are expected to operate in excess of current performance standards during the horizon year. These include the OR 66/OR 140 intersection and OR 140/US 97 Southbound Ramp terminal.
- The Delap Road/OR 140 intersection is between the two intersections that are expected to operate unacceptably during future conditions. As such, high traffic demands are expected on OR 140 at the intersection, potentially resulting in difficult turning movements from Delap Road to OR 140.
- The existing interchange form is well suited to serve the forecasted demand given the typical southbound off-ramp and loop northbound on-ramp configurations. Specifically, this configuration would result in the highest demand turns (southbound to westbound vehicles turning onto OR 140) during the p.m. peak hour to be served by a right-turn movement. Similarly, the highest demand turns (eastbound to northbound vehicles turning onto US 97) during the a.m. peak hour to be served by a right-turn movement.
- The OR 140/OR 66 intersection will also need to accommodate all other turning movements in the future as it does today.

INITIAL INTERCHANGE AREA DESIGN CONCEPTS

The project conducted a Public Visioning Workshop on December 19, 2011 where the PT and public provided initial feedback and ideas regarding potential improvements to address existing and future deficiencies. See Attachment "A" for original scanned comments.

The review of these comments and refinement process yielded several promising concepts for evaluation. To assist with this, the study area was divided into three areas that allow simplified development of future combinations of solution concepts. The following describes the sub-areas:

- West of the interchange
 - OR 140 and OR 66 are classified as Statewide and District Highways, respectively. These classifications differ from OR 140 east of the interchange.
- East of interchange
 - OR 140 is classified as a Statewide Expressway, which differs from OR 140 and OR 66 west of the interchange.
- Interchange form
 - The interchange form will guide the approach alignments along OR 140 and OR 66, as well as the location of the first full access intersection away from the ramp terminal intersection.

These concepts do not currently reflect or recommend any specific intersection traffic control. Rather, the future alternative analysis will explore the appropriate intersection traffic control for each study intersection. The intersection control options include:

- Unsignalized
- Signalized
- Roundabout.

The concepts presented herein are intended to document suggestions presented to the project team to date. These concepts have the potential to be modified from what is currently shown. As such, this is not an exhaustive list of potential alternatives. Further, the concepts shown could be "mixed" to concepts that incorporate individual aspects of one of more alternatives shown.

West of the Interchange

Three concepts have been identified for the road network to the west of the interchange that summarizes the comments to date. There are likely smaller alterations and combinations between these (such as an overcrossing of US 97 connecting the southwest and southeast quadrants of the interchange), but these should reflect a reasonable range of concepts for initial consideration.

West Side Concept W-1: Realign OR 140

- Realign OR 140 to the west of the existing OR 66 intersection to lengthen the spacing of the highway from the interchange. The south leg of this intersection would provide access to the southwest quadrant of the interchange.
- Realign Balsam and Delap Road to form a new intersection with the realigned OR 140.
 - A Balsam Drive connection is not necessarily needed due to alternate access to OR 66 via the Stewart-Lennox roadway system.
 - Previous plans indicated that Delap Road could be connected to Riverside Drive to the north.
- The objective for this concept is to increase intersection spacing and provide sufficient segment length for future anticipated queues and lane positioning.

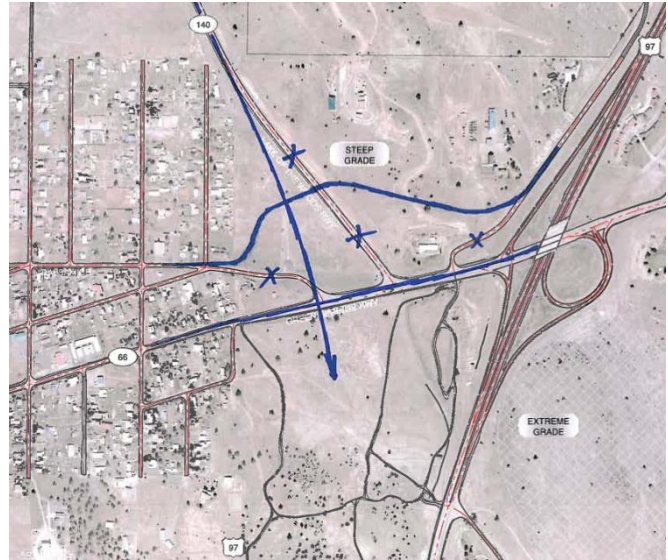


Exhibit 1 Concept W-1: Realign OR 140

West Side Concept W-2: Align OR 140 with OR 140 East of Interchange

- Realign OR 140 to form a continuous alignment with OR 140 to the east of the interchange.
- Realign OR 66 to form a new intersection with the realigned OR 140.
- Realign Balsam Drive to intersect with the realigned OR 66 and provide access to the southwest quadrant of the interchange.
- Realign Delap Road to align with the realignment of OR 66. Previous plans indicated that Delap Road could be connected to Riverside Drive to the north.

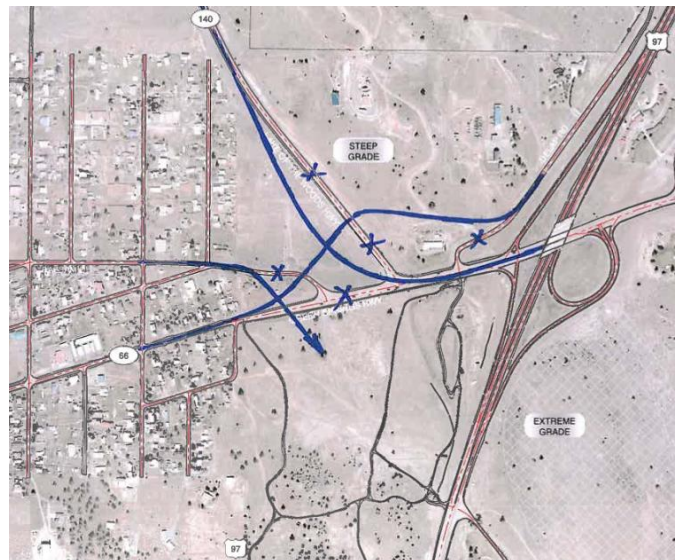


Exhibit 2 Concept W-2: Align OR 140 with OR 140 East of Interchange

- The objective for this concept is to address the anticipated travel demand associated with future growth to the northwest of the interchange. In addition, it will connect OR 140, (the higher order road hierarchy) to OR 140 on the east side of the interchange.

West Side Concept W-3: Realign OR 140 and Disconnect Balsam Drive and Delap Road

- Realign OR 140 to the west of the existing OR 66 intersection to lengthen the spacing of the highway from the interchange. The south leg of this intersection would provide access to the southwest quadrant of the interchange; as well extend to provide access to the southeast quadrant of the interchange via an overpass.
- Disconnect Balsam Drive due to alternate access to OR 66 via the Steward-Lennox roadway system.
- Disconnect Delap Road because previous plans indicated that Delap Road could be connected to Riverside Drive to the north. However, emergency access could be maintained to OR 140.
- The objective for this concept is similar to Concept W-1 that increases intersection spacing; however, it also disconnects Balsam Drive and Delap Road to reduce the number of intersections within the interchange influence area.



Exhibit 3 Concept W-3: Realign OR 140 and Disconnect Balsam and Delap

East of Interchange

Four concepts have been identified for the road network to the east of the interchange. Again, there are likely smaller alterations and combinations between these, but these should reflect a reasonable range of concepts for the west side of the interchange.

East Side Concept E-1: Greensprings Drive-Memorial Drive Frontage Road

- Realign Greensprings Drive and Memorial Drive to from a new frontage road north of OR 140 and introduce a new intersection farther to the east away from the interchange.
- Realign Memorial Drive on the south side of OR 140 to form the southern leg of the new intersection on OR 140.
- The longitudinal grade on OR 140 in the vicinity of the new intersection location could be a problem.
- Disconnect access to Country Club on US97 and provide access to Memorial Drive.

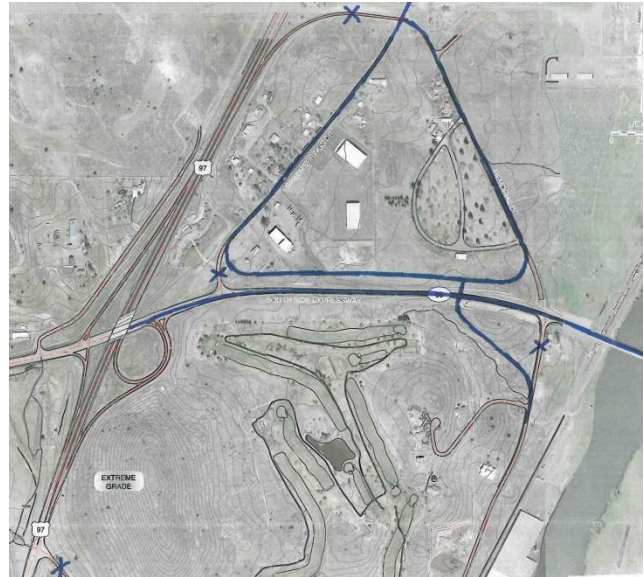


Exhibit 4 Concept E-1: Greensprings-Memorial Frontage Road

- The objective for this concept is to increase the intersection spacing between Greensprings Drive-Memorial Drive and the US 97 Northbound Ramp terminal and provide sufficient segment length for future anticipated queues and lane positioning.

East Side Concept E-2: Realign Greensprings Drive

- Realign Greensprings Drive along a property line and introduce a new intersection farther to the east away from the interchange.
 - Cul-de-sac Greensprings Drive in its current location.
- Realign Memorial Drive on the south side of OR 140 to form the southern leg of the new intersection on OR 140.
- The longitudinal grade on OR 140 in the vicinity of the new intersection location could be a problem.
- Disconnect access to Country Club on US97 and provide access to Memorial Drive.

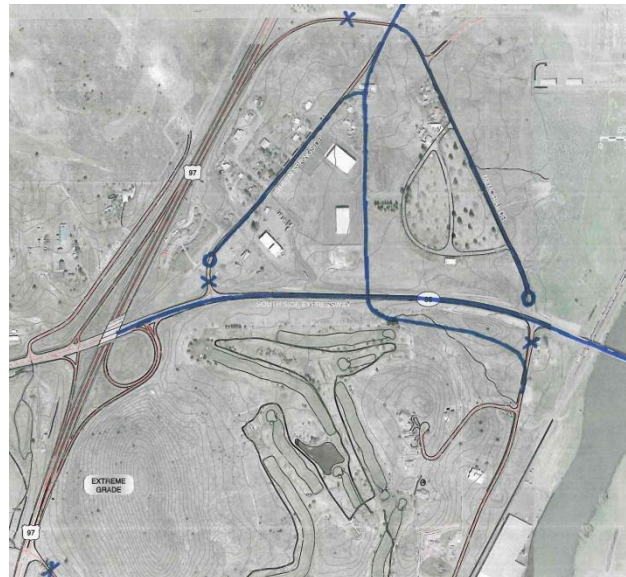


Exhibit 5 Concept E-2: Realign Greensprings

- The objective for this concept is similar to Concept E-1 that increases intersection spacing.

East Side Concept E-3: Realign Greensprings Drive & Memorial Drive

- Cul-de-sac Greensprings Drive in its current location, while opening Memorial Drive from the north on OR 140.
- This concept will require the widening of the existing bridge on OR 140 over the river to provide adequate turning lanes in the westbound direction.
- Disconnect access to Country Club on US97 and provide access to Memorial Drive.
- The objective for this concept is similar to Concept E-1 that increases intersection spacing. This location will meet the interspacing spacing standard for Statewide (Expressway) designated facilities.

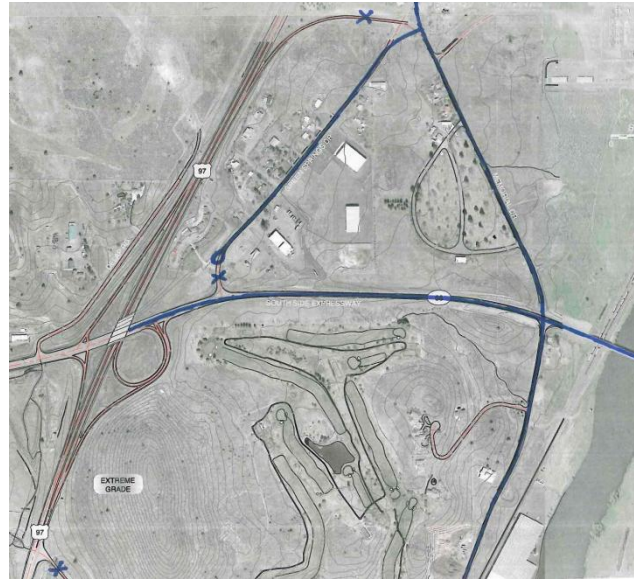


Exhibit 6 Concept E-3: Memorial Full Access

meet the interspacing spacing standard for Statewide

East Side Concept E-4: Memorial Drive Jughandle

- Provide a grade-separated crossing of Memorial Drive on OR 140 immediately west of the river bridge with right-in/right-out connections on US 97.
- Cul-de-sac Greensprings Drive in its current location, while providing access to Memorial Drive.
- Disconnect access to Country Club on US 97 and provide access to Memorial Drive.
- The objective for this concept is similar to Concept E-3 by shifting the intersection as far as possible to the east. The grade separation will eliminate the existing at-grade full access intersection at Memorial Drive. This will then provide a typical expressway facility from the US 97 interchange through the Washburn Way interchange to the east.

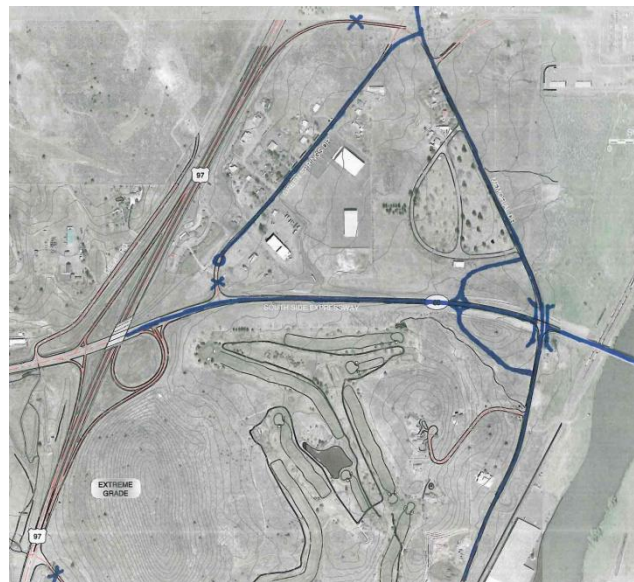


Exhibit 7 Concept E-4: Memorial Drive Jughandle

east. The grade separation will eliminate the existing at-grade full access intersection at Memorial Drive. This will then provide a typical expressway facility from the US 97 interchange through the Washburn Way interchange to the east.

Interchange Form

The interchange form will set the future footprint of the interchange and influence the surrounding road network. The respective concepts to the west and east of the interchange will have to be refined to fit the ultimate interchange form.

West Side Concept I-1: Improve Existing Interchange

- Maintain the existing interchange configuration.
- Close the existing second US97 Northbound Off-ramp onto Greensprings Drive
- Realign the US 97 Southbound off-ramp to address existing longitudinal approach grade.
- Improve the US 97 Southbound ramp terminal intersection angle to improve intersection sight distance.
- The objective of this interchange configuration is to continue accommodating the future directional demand during the morning and evening peak periods.

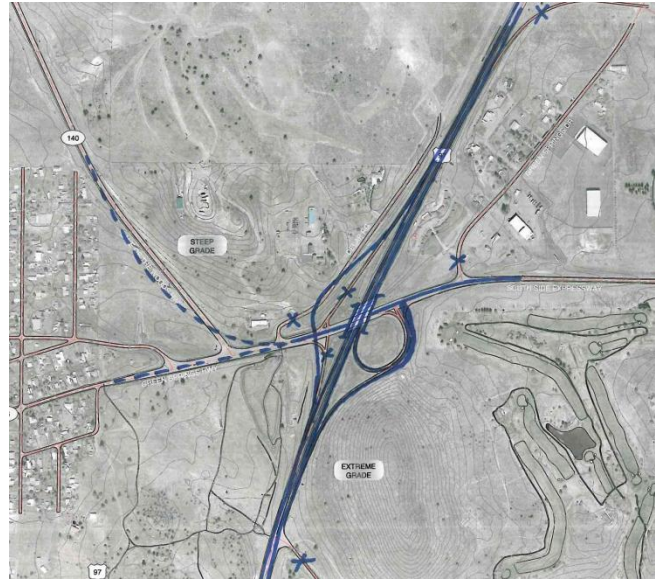


Exhibit 8 Concept I-1: Improve Existing Interchange

West Side Concept I-2: Diamond Interchange

- Convert the interchange to a diamond interchange form.
- Close the existing second US 97 Northbound Off-ramp onto Greensprings Drive
- Disconnect access to the Country Club on US 97 and provide access via Memorial Drive.
- Eliminating the US 97 northbound loop on-ramp will convert the eastbound free right-turn to a left-turn that will negatively impact traffic operations at the US 97 Northbound Ramp terminal.

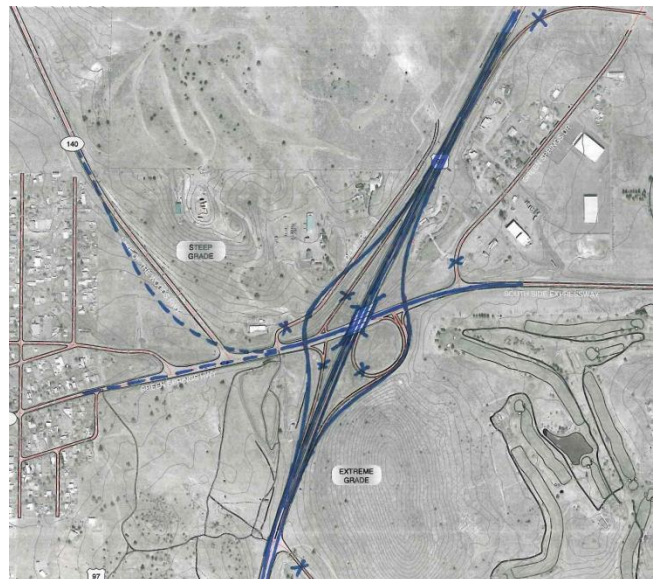


Exhibit 9 Concept I-2: Diamond Interchange

West Side Concept I-3: Partial Cloverleaf Interchange

- Convert the interchange to partial cloverleaf interchange form by adding a southbound loop off-ramp.
- Close the existing second US 97 Northbound Off-ramp onto Greensprings Drive
- Disconnect access to Country Club on US97 and provide access via Memorial Drive.
- This option would convert the southbound right-turn from the US 97 Southbound off-ramp to a left-turn that will negatively impact traffic operations at the US97 Southbound Ramp terminal.

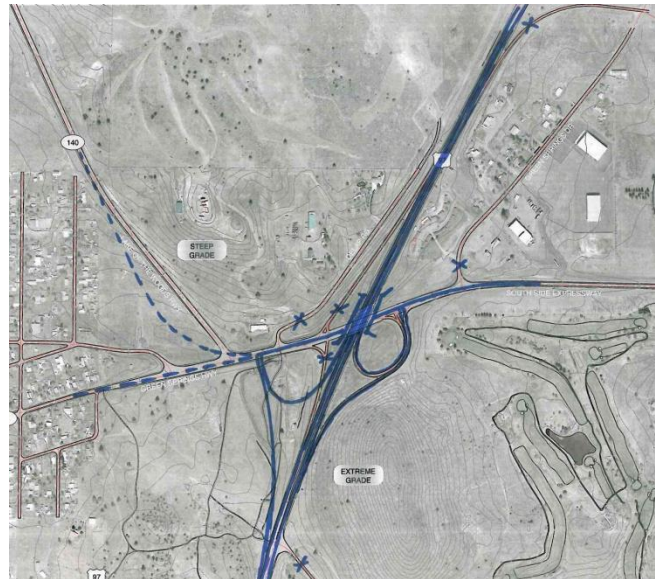


Exhibit 10 Concept I-3: Partial Cloverleaf Interchange

West Side Concept I-4: SPUI Configuration

- Convert the interchange to a single-point urban interchange (SPUI) form.
- Close the existing second US 97 Northbound Off-ramp onto Greensprings Drive
- Disconnect access to the Country Club on US 97 and provide access via Memorial Drive.
- The SPUI configuration typically provides significant operational benefit, especially with high turning movements. Due to the required large intersection, it is seen as pedestrian and bike unfriendly compared to typical diamond interchanges.

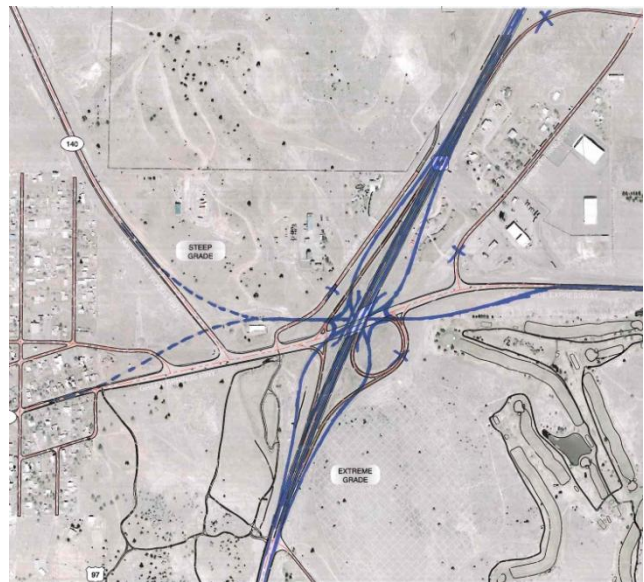


Exhibit 11 Concept I-4: SPUI Configuration

West Side Concept I-5: Diverging Diamond Interchange

- Convert the interchange to a diverging diamond interchange (DDI) form.
- Close the existing second US 97 Northbound Off-ramp onto Greensprings Drive
- Disconnect access to the Country Club on US97 and provide access via Memorial Drive.
- This is a relative new interchange form, but has shown operational benefit due to reducing the number of phases at the traffic signals. It also maintains a narrower cross-section between the ramp terminals because of the elimination of long left-turns storage areas.

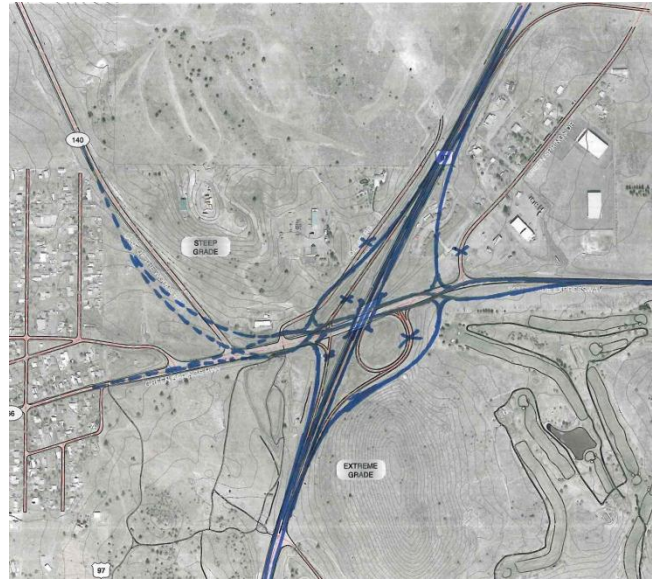


Exhibit 12 Concept I-5: Diverging Diamond Interchange

West Side Concept I-6: Full Cloverleaf Interchange

- Convert the interchange to a full cloverleaf interchange form.
- Close the existing second US 97 Northbound Off-ramp onto Greensprings Drive
- Disconnect access to the Country Club on US97 and provide access via Memorial Drive.
- All movements at the ramp terminal intersections are converted to right-in/right-out movements.
- This concept has a large footprint with topographical challenges in the northwest and southeast quadrants.

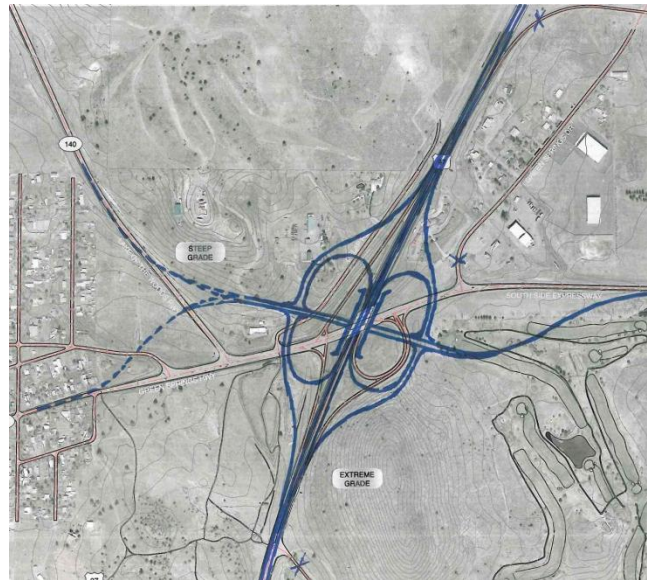


Exhibit 13 Concept I-6: Full Cloverleaf Interchange

NEXT STEPS

Based on the traffic forecasts developed and interchange area comments received to-date, the project team will develop a series of system alternatives to evaluate. These alternatives and analysis results will be presented at the upcoming project team meeting and public open house for comment.

ATTACHMENTS

Attachment A: Original Submitted Comments

REFERENCES

1. National Cooperative Highway Research Program, Highway traffic Data for Urbanized Area Project Planning and Design (Report 255). 1982.
2. Oregon Department of Transportation. *Analysis Procedures Manual*, 2006.