SECTION 2

Travel Demand Modeling Data & Analysis

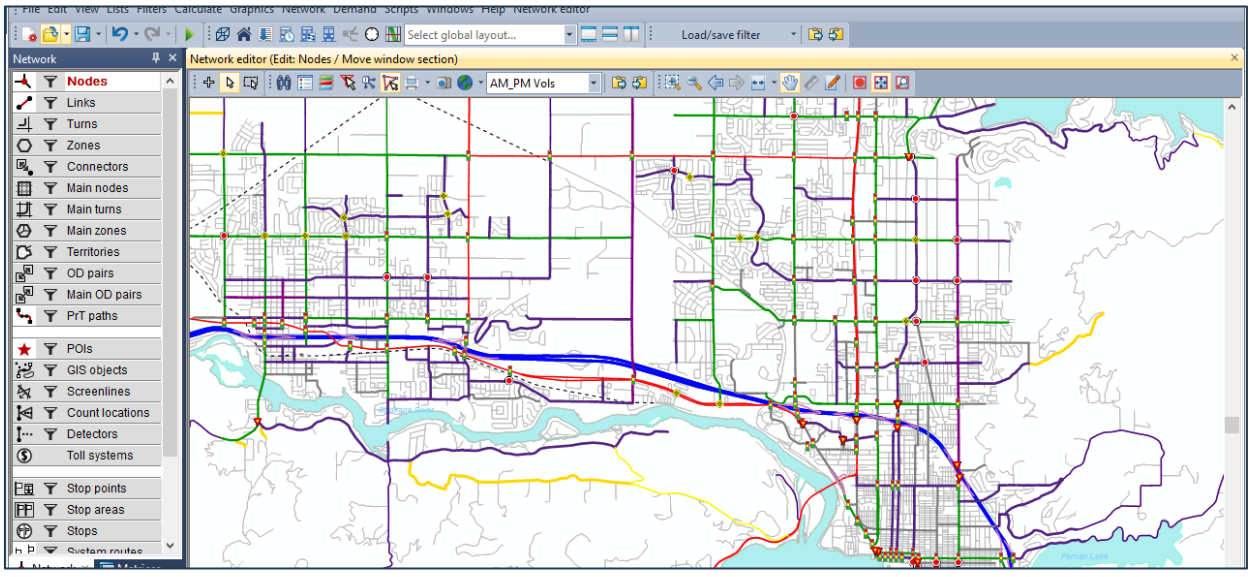
This section discusses the technical processes, procedures, assumptions and data input necessary to the estimation of future growth and travel patterns in Kootenai County. This is accomplished through the use of a regional travel demand model uniquely developed and calibrated to address travel behavior in Kootenai County.

KMPO TRAVEL DEMAND MODEL

KMPO developed and continuously maintains a regional travel demand model, using a nationally accepted computer software known as VISUM (*vĭ-zoom'*) created by PTV America. The purpose of the travel demand model is to allow KMPO to study existing regional travel patterns and to forecast the effectiveness of different investment strategies being considered for the transportation system. Travel demand analysis assists in determining the need for future roadway improvements by examining traffic flow patterns and by forecasting the impacts of population growth and its related demand on regional highways and arterials. The model allows planners, elected officials and the public to get a glimpse of what's to come, and then provide input to a dialogue on what to consider as future transportation investments and/or land development strategies within local comprehensive plans.

As a tool, the regional travel demand model does not and is not expected to precisely predict specific volumes of traffic on a specific roadway arterial, but rather the change in conditions. This is because only higher classified roads and streets are specifically included in the analysis. Virtually all local streets are grouped; therefore, transportation planners and project development engineers conduct post-processing to ensure additional considerations are part of the analysis process.

Figure 2.1 Screenshot of KMPO Travel Demand Model in VISUM



MODEL INPUTS

The model relies on a significant amount of data inputs. These inputs are divided into land use data (housing unit and employment information); transportation network data (layout and characteristics of regionally significant roadways); and travel behavior characteristics.

LAND USE DATA

A variety of land use data is used for model input and analysis:

- Building permit and plat information from local jurisdictions are reviewed.
- Current employment data are collected annually from the Idaho Department of Labor. These data are evaluated to determine the geographic dispersion of jobs in a variety of categories such as retail, finance, insurance, real estate, industrial, utilities, transportation, medical and government.
- Information on recreational opportunities, hotels/motels, school enrollment, colleges, publicly-owned properties, agriculture, and other land uses is collected through locally available sources.
- Future population and employment projections are prepared by KMPO staff and adopted by the KMPO Policy Board. The most recent projections, included in this MTP were adopted in December 2018.
- Comprehensive plans for Kootenai County and local agencies are also consulted in order to estimate future land uses.

TRANSPORTATION NETWORK

The transportation network is a computerized representation of the higher classified highway and street system. The network includes most routes within the study-area classified as collector or higher by the federal functional classification system (Section 3). Other roads are included to represent important local streets. The network is comprised of street segments that are represented in the computer model as links and intersections that are represented as nodes. Links on the network contain roadway features and performance attributes that influence modeled travel patterns, such as number of lanes, capacity and speed limit. Similarly, nodes are characterized by attributes such as control type (signalized, two-way stop, etc.) and intersection design. The layout and/or attributes of transportation network can be modified in order to study the effects of certain changes being considered during the evaluation of transportation projects.

An updated network of the study-area's existing (2018) street system, population and employment information was built using the VISUM software. For the future model year (2040 Build), the base-year network was then modified according to local transportation system plans, capital improvement programs and future population and employment forecasts adopted by the KMPO Board.

TRAVEL BEHAVIOR

A regional household travel survey is used collect how people in a household travel on a daily basis. This includes their types of trips, frequency of trips, where they travel, what do the use to make a trip (car, truck, bike, bus, walk, telecommute), how many people travel with them, the age of people in the household, the number of people in the household, and their household income. This information is used to establish a travel matrix in order to estimate current travel and travel patterns. KMPO's most recent survey was performed in 2005 and collected data on approximately 2,500 randomly selected homes throughout Kootenai County to estimate current travel behavior within Kootenai County.

Based on the 2018 Base model results, the model's trip generation for both the AM and PM peak hours still closely matches the results of the 2005 Household Survey, as shown in Tables 2.1 and 2.2. These results show that travel characteristics have not significantly changed in Kootenai County since 2005.

Table 2.1 2018 AM PK HR Model Trip Generation Results Comparison

TRIP PURPOSE	% of AM PK HR Modeled Trips	% AM PK HR of 2005 Trips (HH Travel Survey)	Δ	Total 2018 AM PK HR Trips
Home Based Work	24.1%	25.2%	-1.1%	14,335
Home Based Retail	5.3%	5.3%	0.0%	3,165
Home Based Other	30.2%	28.2%	+2.0%	17,968
Non-Home Based	20.1%	20.7%	-0.6%	11,947
Home Based School	20.2%	20.6%	-0.4%	12,035
Total	**100%**	**100%**		**59,450**

Table 2.2 2018 PM PK HR Model Trip Generation Results Comparison

TRIP PURPOSE	% PM PK HR of Modeled Trips	% PM PK HR of 2005 Trips (HH Travel Survey)	Δ	Total 2018 PM PK HR Trips
Home Based Work	13.4%	13.4%	+0.2%	10,472
Home Based Retail	11.2%	10.6%	+0.6%	8,607
Home Based Other	48.9%	48.1%	+0.8%	37,525
Non-Home Based	24.6%	26.2%	-1.6%	18,895
Home Based School	1.7%	1.7%	0.0%	1,314
Total	**100%**	**100%**		**76,813**

FOUR-STEP MODEL

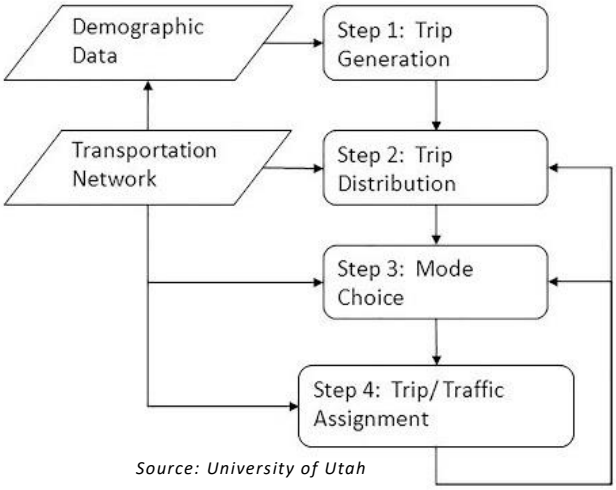
Land use, employment and transportation network data are input into a traditional four-step travel demand model in VISUM. The four-step modeling process has been used for more than 50 years and is one of several methodologies currently recognized and accepted by the Federal Highway Administration (FHWA) for projecting future travel demand.

The four-step process consists of four distinct procedures, generally described as follows:

- ***Trip generation*** is the first step in the process that determines how many daily trips are generated and attracted to each Transportation Analysis Zone (TAZ). A trip that is produced in a TAZ, such as a trip originating from a household in that TAZ, is called a production. A trip that is attracted to a TAZ is called an attraction. Trip generation produces an estimate of the number of trips produced in and attracted to each zone. The number of productions and attractions in each TAZ is based on its residential and employment characteristics.

- ***Trip distribution*** is the second step in the process, linking the productions and attractions generated during the trip generation step into complete trips. In the KMPO model, trip distribution is based on a gravity model, which assumes that time spent traveling is perceived negatively. In other words, if every TAZ had an identical land use composition, trips between nearby TAZs are more likely to occur than trips between TAZs separated by large distances. The product of trip distribution is a trip table that contains the number of trips between all zonal pairs.

Figure 2.2 Four-Step Model Process



Source: University of Utah

- ***Mode choice*** is the third step in the process and estimates what travel mode (i.e. transit, car, biking, walking) is being used for each trip, given the modes available. The automobile is the only travel mode available in the KMPO model, although it is possible to add other modes in future model updates.

- ***Trip assignment*** is the final step in the four-step process, in which trips from each zone are assigned to the street network. The assignment is based on three factors: the logical shortest paths between origin and destination; the accumulation of vehicle trips on each link; and the computation of congestion reflected in vehicle speed.

After the initial iteration of the four-step process, the results of the trip assignment step are cycled back through the steps of trip distribution, mode choice and assignment. This feedback looping is repeated until the results of the latest iteration falls within a specified deviation of the previous iterations. When the iterations are complete, the results from the model are used to forecast the level of congestion that will occur. This becomes the basis for assessing overall performance of the transportation system.

It is important to note that travel demand projection is not an exact science. Unanticipated or unexpected land use and development patterns can occur. Also, human behavioral patterns with respect to travel may shift over time in response to changing technology, enhancement of various modes of transportation and economic factors.

KMPO's VISUM travel demand model documentation may be found in Appendix B.

MODEL CALIBRATION & VALIDATION

Before the results of the model can be used to evaluate existing and future traffic conditions, the model is calibrated and validated. Calibration is the process of adjusting a model's parameters to replicate goodness-of-fit measures (reality), which are a function of actually observed base-year data. Calibration is completed through a series of model simulation runs to make minor adjustments to more discreet parameters. Land use data, household and zonal trip generation rates, gravity model exponents, and various model parameters are reviewed and adjusted following each simulation run.

Once a model has been calibrated, it must be validated using data that was not used during calibration. Most often, this is done by comparing base-year modeled traffic volumes with observed traffic counts from the same time period. Acceptable deviation error by roadway type is established per procedures outlined in National Cooperative Highway Research Program, NCHRP 765.

A successful calibration and validation process confirms the suitability of the model in forecasting existing traffic patterns. Once the model can be shown to reasonably replicate existing conditions, it can be used to forecast future conditions using forecasted land uses and planned network improvements.

KMPO's base model was most recently calibrated and validated in 2019.

MODELING ANALYSIS YEARS

2018 BASE MODEL

KMPO's base-year model (model year 2018) simulates existing traffic conditions using 2018 land use and population and the roadway infrastructure network as it existed in 2018. The base-year model provides a baseline from which to examine future traffic impacts of population growth and changes in land use and the transportation network. Current transportation conditions are described in Section 3 using KMPO's 2018 Base model.

2040 NO-BUILD MODEL

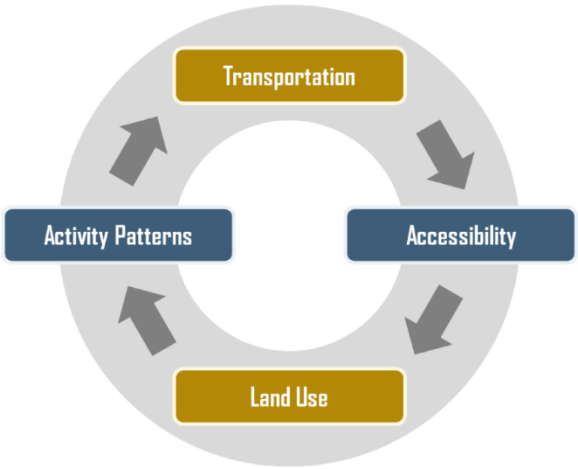
The 2040 No-Build model simulates future traffic conditions assuming land use and population continue to grow and no improvements are made to the existing roadway infrastructure network.

2040 BUILD MODEL

The 2040 Build model simulates future traffic conditions, assuming land use and population continue to grow and improvements are made to the existing roadway infrastructure. Network improvements incorporated into the 2040 Build model are limited to financially reasonable project lists submitted by each jurisdiction. The future year models (2040 No-Build and Build) are described in Section 4.

LAND USE ASSUMPTIONS

The overall transportation system serves the underlying land use of an area. As such, there is a direct relationship between land use and transportation. Under the Federally-enacted Fixing America's Surface Transportation Act (FAST Act), core metropolitan and statewide transportation requirements reinforced the relationship between land use and transportation. This act requires that transportation plans reflect land use plans and prescribes the need for a balance between future land use development and infrastructure needs.



As indicated at the beginning of this section, detailed land use data is one of the primary inputs into the regional travel demand model. Accurate information on existing and planned land use is the basis for KMPO's evaluation of existing system performance and is necessary to ensure that regional transportation investments are made appropriately.

LAND USE DATA AND FORECASTING

2018 BASE MODEL

Travel patterns in the region are primarily defined by where people live, work and shop. Although people make many other types of trips – for medical, recreational and social purposes, for example – travel to and from our homes, places of work and retail centers dominate the regional transportation network. Table 2.3 identifies the categories of land use data used by KMPO to develop and maintain the regional travel demand model.

Base-year land use data were derived from the Kootenai County Assessor's Office and GIS Department, Idaho Department of Labor, and KMPO staff research. Structure data from Kootenai County was used as the primary source for housing unit data. Manipulation of the dataset was done by KMPO staff to remove non-residential and other extraneous structures, as well as to categorize structures into their respective Land Use categories with the correct number of units. The Idaho Department of Labor provided data used to populate Land Use categories 3-8, 10, & 14-23. A number of these categories were completed or supplemented with additional staff research and/or Kootenai County Assessor's Office information. Using Spatial Overlay, all Land Uses were aggregated into their respective TAZ.

These categorized Land Use values by TAZ are entered into the model as the base Land Use.

Table 2.3 Land Use Categories

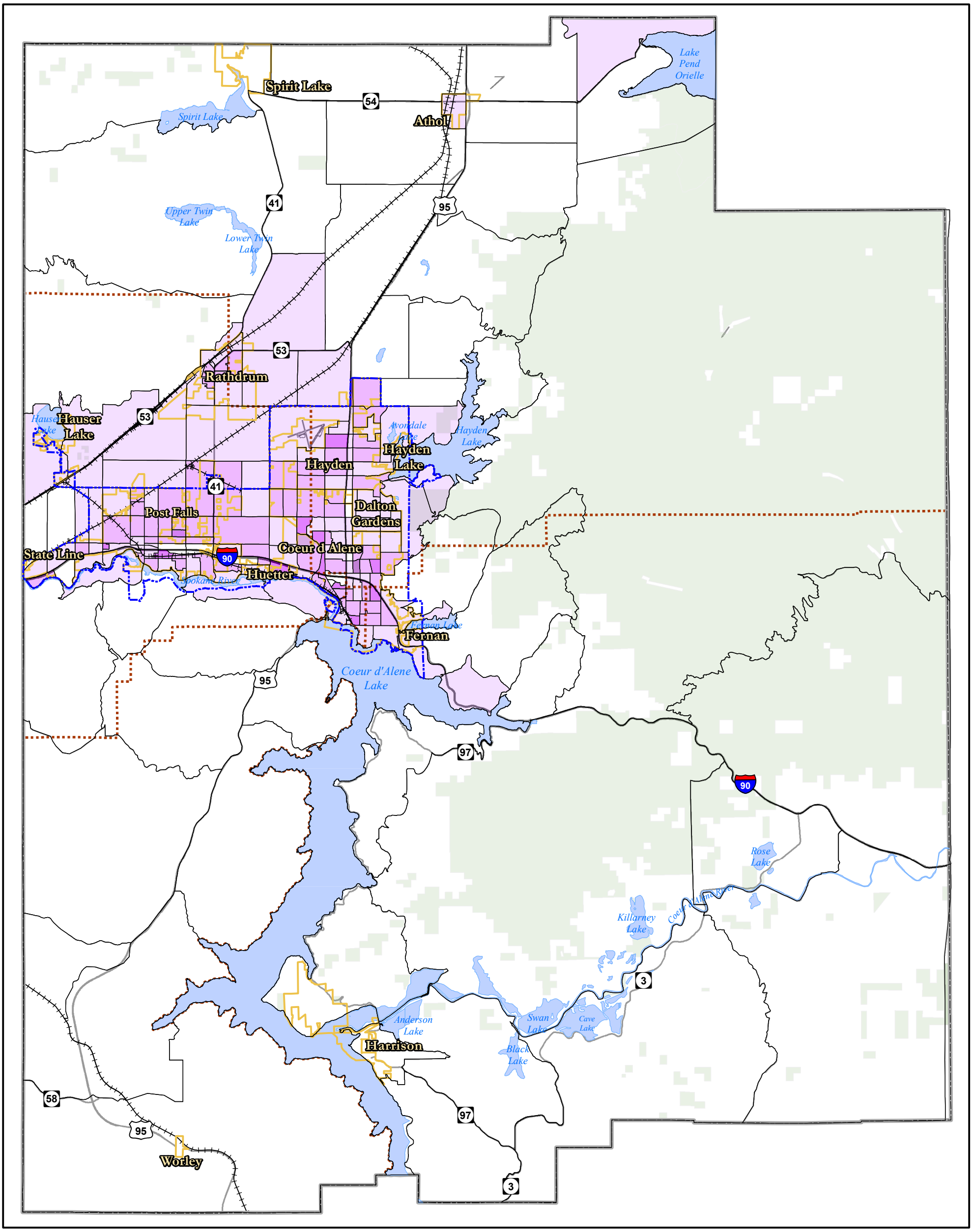
No.	Land Use Description	Unit of Measurement
1	Single Family Housing	Dwelling units
2	Multi-family Housing	Dwelling units
3	Retail Space	Employees
4	Finance, Insurance, & Real Estate	Employees
5	Industrial	Employees
6	Schools	Students
7	Accommodations	Rooms
8	Arts, Entertainment & Recreation	Spaces
9	Outer Single Family Residential	Dwelling units
10	Post-Secondary Schools	Students
11	Agriculture	Acres
12	Waterfront Units*	Dwelling units
13	Publicly Owned Land	Acres
14	Transportation & Warehousing	Employees
15	Medical	Employees
16	Government	Employees
17	Administrative and Support and Waste Management and Remediation Services	Employees
18	Professional, Scientific & Technical Services and Management of Companies	Employees
19	Education Services	Employees
20	Other Services	Employees
21	Information	Employees
22	Utilities and Construction	Employees
23	Food Service	Employees

*Waterfront Units are not currently used as a separate land use category in the regional travel demand model. For trip generation, waterfront dwellings are currently treated as either single or multi-family dwellings.

For population estimation, dwelling units were used as a starting point. With the total number of dwelling units calculated per city, population estimates were derived by multiplying the total number of units within each city by the city's average number of persons per household according to the US Census Bureau.

Figures 2.3a-b through 2.5a-b display residential, employment and retail density for 2018.

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 - 2040



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0 0.75 1.5 3 4.5 6
Miles

Kootenai MPO

WHERE PEOPLE LIVE - 2018
BY TRANSPORTATION ANALYSIS ZONE

Housing Units Per Acre by TAZ

- > 5
- 4 - 5
- 3 - 4
- 2 - 3
- 1 - 2
- 0.05 - 1
- < 0.05

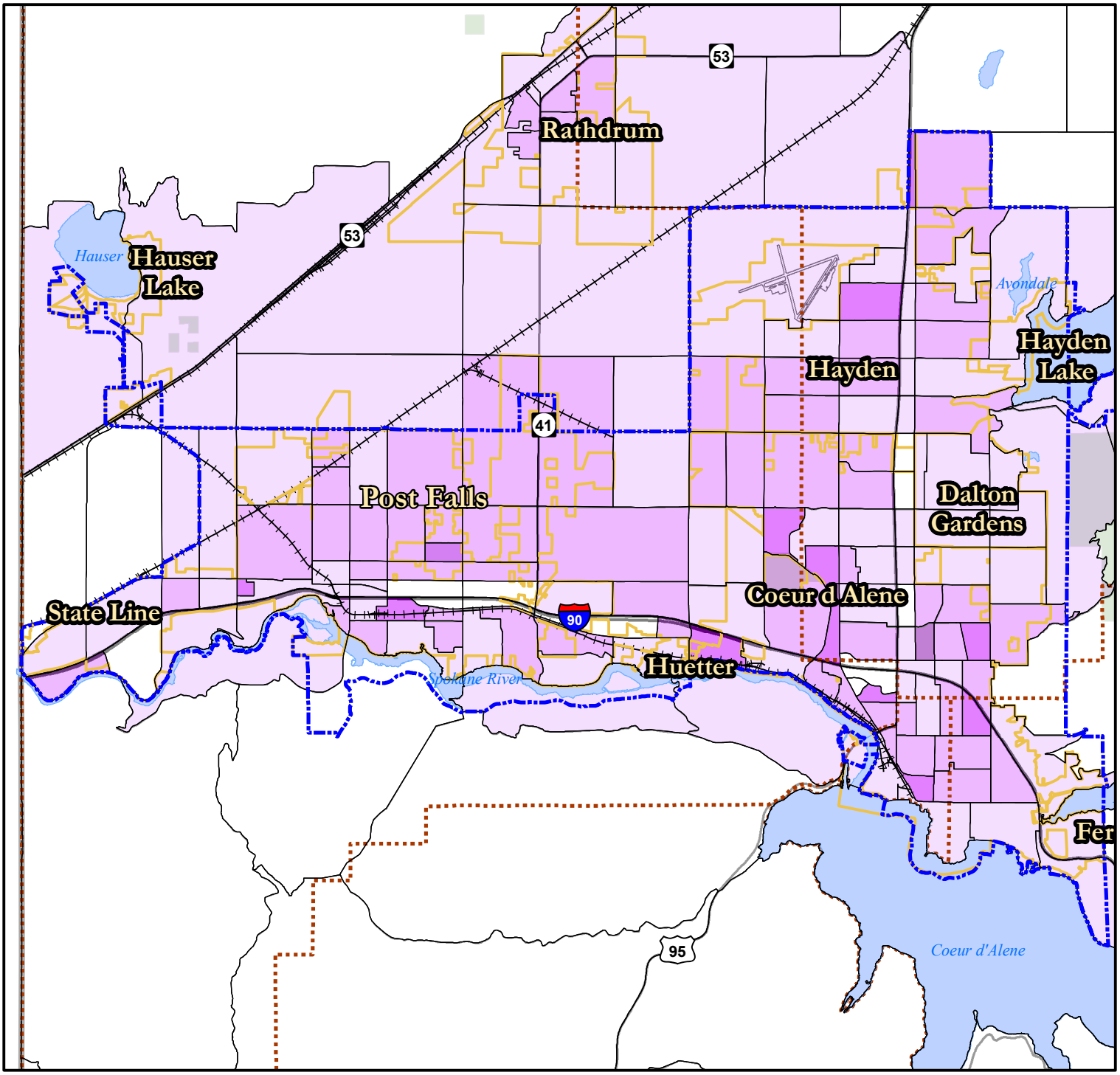
Physical Characteristics

- HwyDist_Arcs
- Interstate
- US/State Highways
- Railroad
- County Boundary
- Urban Area Boundary
- National Forest
- Water Features

*Data based on best available information.*Data for illustrative purposes only.

Figure 2.3a

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 - 2040



N
W E
S

0 0.5 1 2 3 4
Miles

Kootenai MPO

WHERE PEOPLE LIVE - URBAN - 2018
BY TRANSPORTATION ANALYSIS ZONE

Employees Per Acre by TAZ

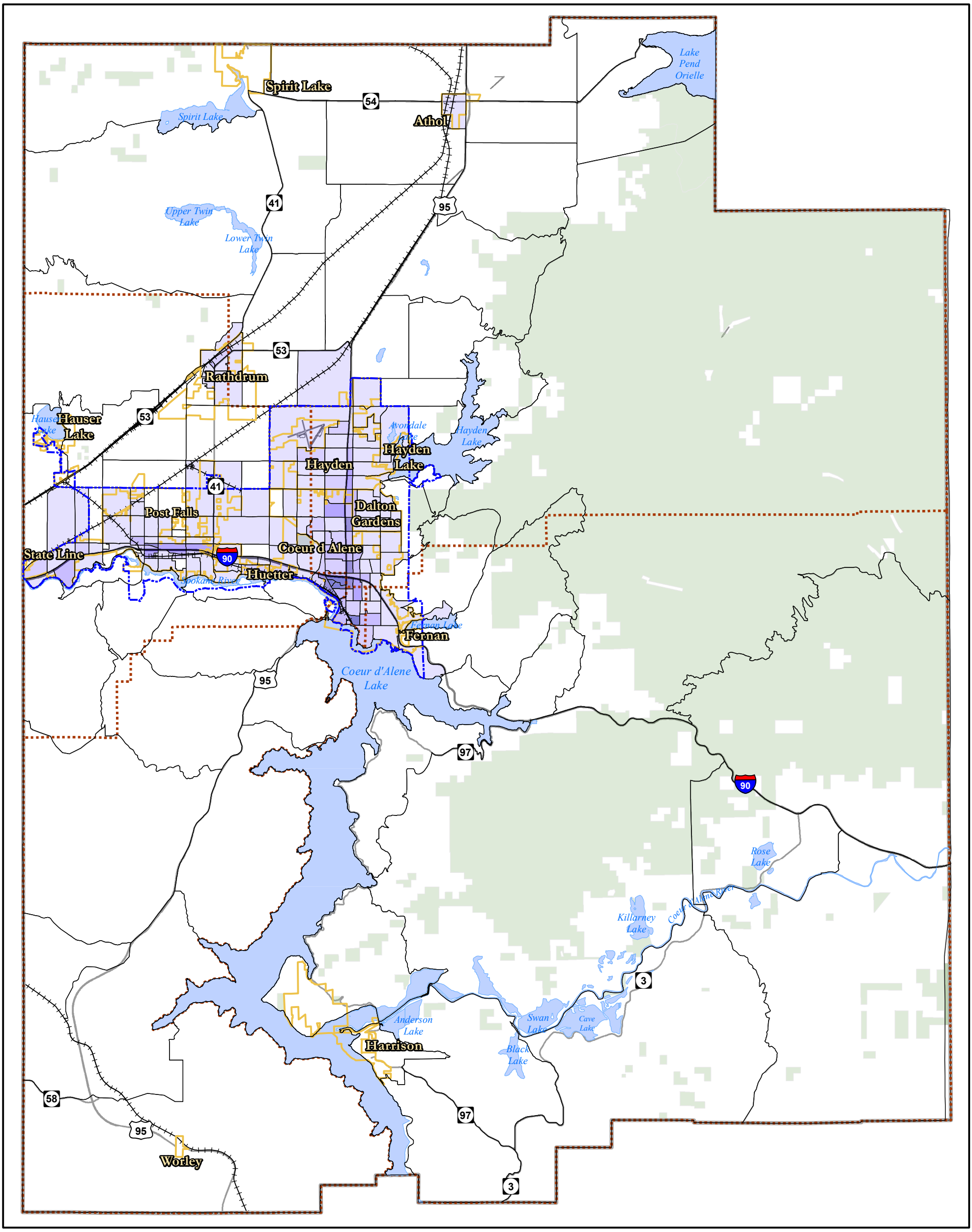
> 5	1 - 2
4 - 5	0.05 - 1
3 - 4	< 0.05
2 - 3	

Physical Characteristics

HwyDist_Arcs	Urban Area Boundary
Interstate	Municipal Boundaries
US/State Highways	National Forest
Railroad	Water Features
County Boundary	

*Data based on best available information.*Data for illustrative purposes only.

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 - 2040



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0 0.75 1.5 3 4.5 6
Miles

Kootenai MPO

WHERE PEOPLE WORK - 2018
BY TRANSPORTATION ANALYSIS ZONE

Employees Per Acre by TAZ

- > 10
- 7 - 10
- 5 - 7
- 3 - 5
- 1 - 3
- 0.05 - 1
- < 0.05

Physical Characteristics

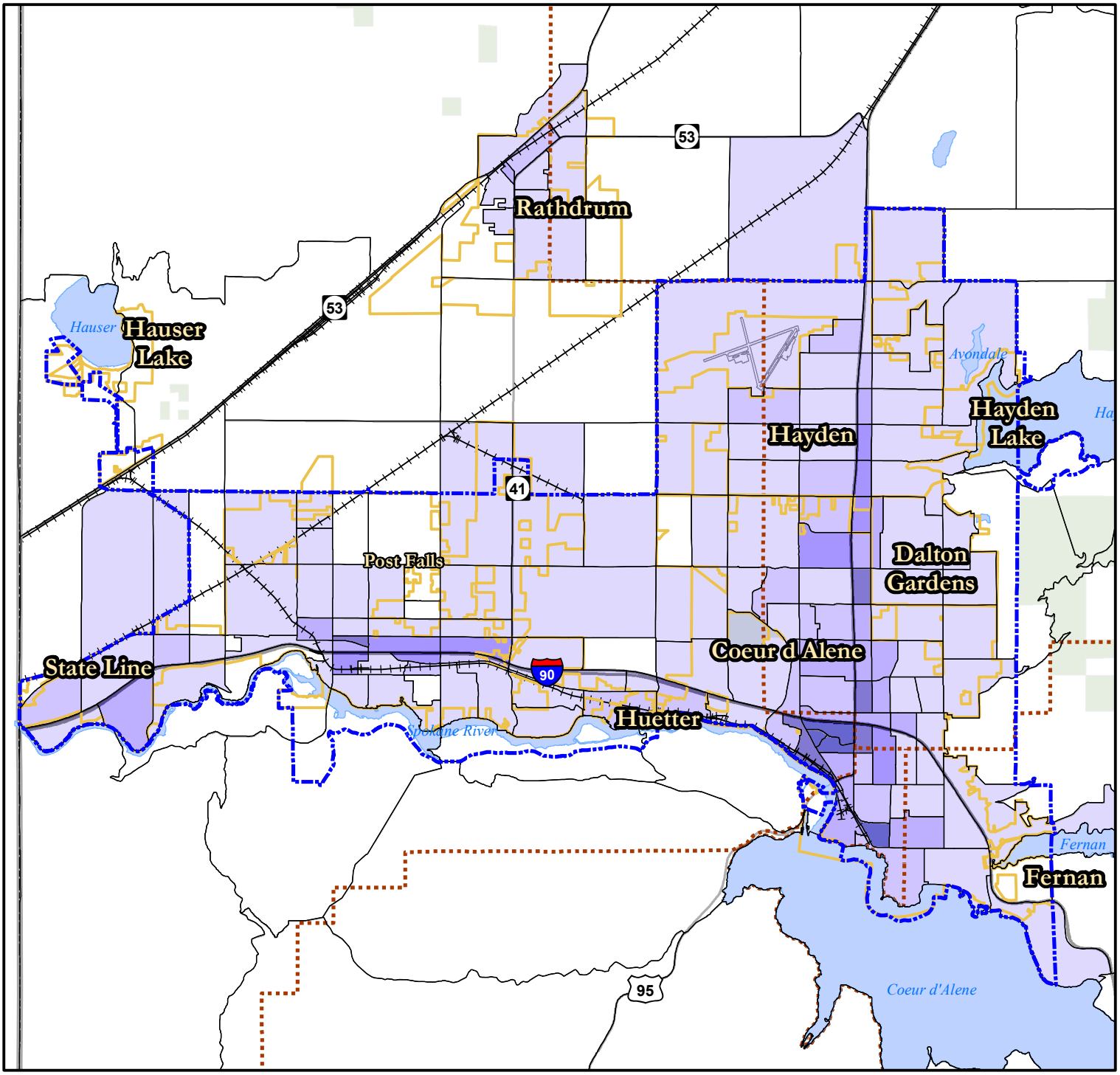
- HwyDist_Arcs
- Interstate
- US/State Highways
- Railroad
- County Boundary
- Urban Area Boundary
- Municipal Boundaries
- Water Features
- National Forest

See Table 6.4 For Complete Project Identification

*Data based on best available information.*Data for illustrative purposes only.

Figure 2.4a

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 - 2040



N
W E
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0 0.5 1 2 3 4
Miles

Kootenai MPO

WHERE PEOPLE WORK - URBAN - 2018
BY TRANSPORTATION ANALYSIS ZONE

Employees Per Acre by TAZ

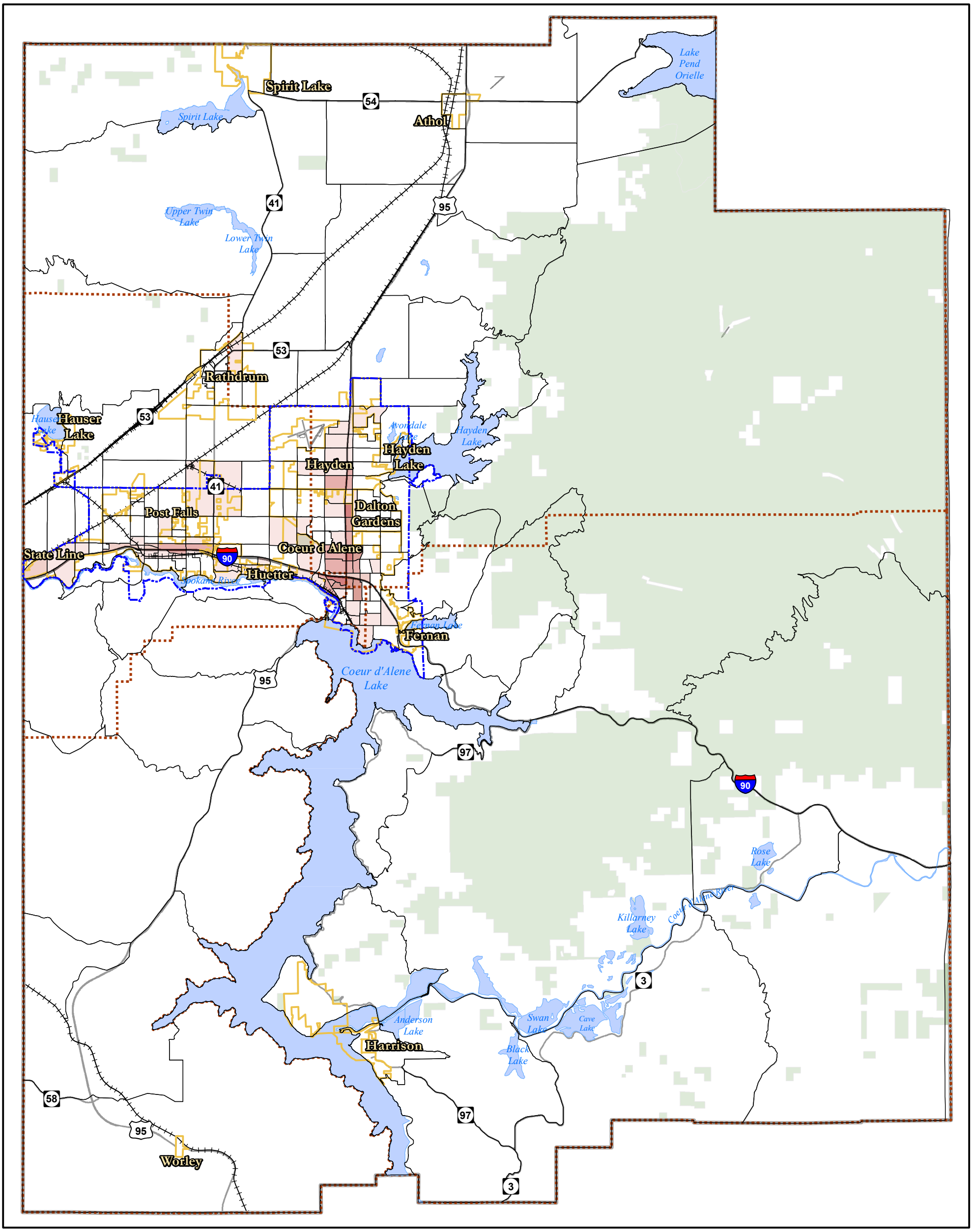
> 10	1 - 3
7 - 10	0.05 - 1
5 - 7	< 0.05
3 - 5	

Physical Characteristics

- Urban Area Boundary
- Municipal Boundaries
- Water Features
- County Boundary
- HwyDist_Arcs
- Railroad
- National Forest
- Interstate
- US/State Highways

*Data based on best available information.*Data for illustrative purposes only.

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 - 2040



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W E
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0 0.75 1.5 3 4.5 6
Miles

Kootenai MPO

WHERE PEOPLE SHOP - 2018
BY TRANSPORTATION ANALYSIS ZONE

Retail Employees Per Acre by TAZ

- > 4
- 3 - 4
- 2 - 3
- 1 - 2
- 0.5 - 1
- 0.05 - 0.5
- > 0.05

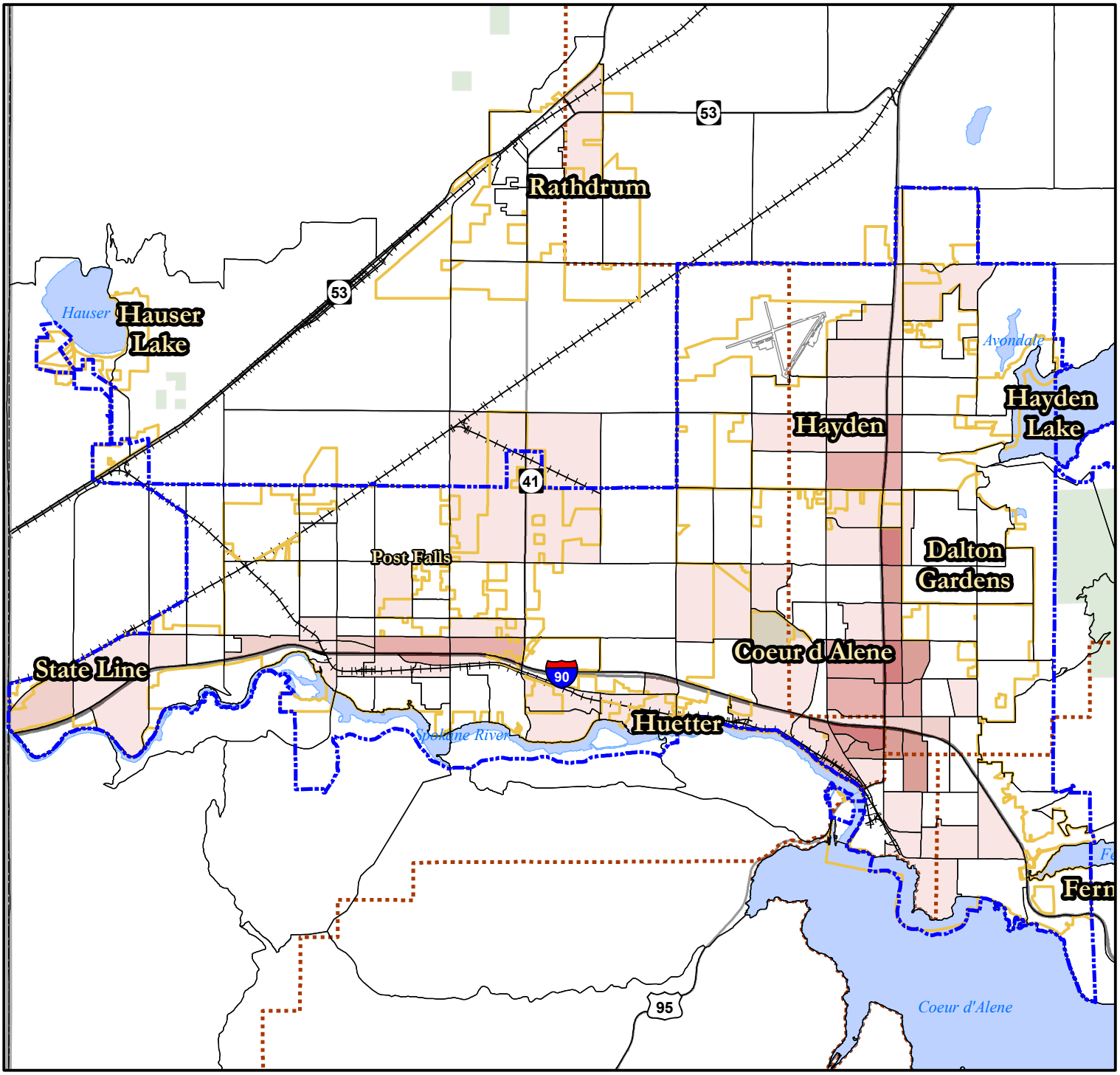
Physical Characteristics

- HwyDist_Arcs
- Interstate
- US/State Highways
- Railroad
- County Boundary
- Urban Area Boundary
- Municipal Boundaries
- Water Features
- National Forest

*Data based on best available information.*Data for illustrative purposes only.

Figure 2.5a

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 - 2040



N
W E
S

0 0.5 1 2 3 4
Miles

Kootenai MPO

WHERE PEOPLE SHOP - URBAN - 2018 BY TRANSPORTATION ANALYSIS ZONE

Employees Per Acre by TAZ

> 4	0.5 - 1
3 - 4	0.05 - 0.5
2 - 3	> 0.05
1 - 2	

Physical Characteristics

- Urban Area Boundary
- Municipal Boundaries
- Water Features
- County Boundary
- HwyDist_Arcs
- Railroad
- National Forest
- Interstate
- US/State Highways

*Data based on best available information.*Data for illustrative purposes only.

2040 BUILD AND NO-BUILD MODELS

Population and land use projections for Kootenai County are based on observations of where growth has occurred, where it is now occurring, and where it can and is expected to occur by local jurisdictions to occur in the future.

Projecting the population for Kootenai County from 2018-2040 required a number of sources, including the US Census population count from 1990-2010 and estimates for 2018. For the purposes of forecasting future transportation needs, KMPO used the following population growth assumptions:

- An average overall annual growth rate of 2.4% for Kootenai County.
- Kootenai County's largest city, Coeur d'Alene, will grow at an overall annual rate of about 2.5% through 2040.
- The highest increases in urban population and dwelling units are to occur over the Rathdrum Prairie, as the cities of Post Falls, Rathdrum, and Hayden annex additional land. Overall annual growth rates of 4.8%, 3.5% and 3.8% are assumed for these cities, respectively.
- Population levels within unincorporated portions of Worley Highway District and East Side Highway District are expected to remain relatively stable. These areas roughly correspond to the Worley, Mica, Bitterroot, East Lake Coeur d'Alene, and southern portion of Fernan Sub-Areas of Kootenai County's comprehensive plan. In these locations, a relatively slow rate of development in outer rural areas is expected to be offset as rural areas closer to Coeur d'Alene, Worley and Harrison are annexed.
- By 2040, Post Falls Highway District will lose a large portion of its rural lands to annexation by Post Falls, Rathdrum or Hayden. Additionally, continued high rural growth rates are expected to occur within the remaining rural portions of this district. The County's comprehensive plan envisions concentrated development throughout the Rathdrum Prairie. KMPO projects an overall annual rural growth rate of 0.2% for Post Falls Highway District, with higher growths over the Prairie balanced by lower growth rates in the northern portion of the district where community water and sewer systems are not expected to be available to support higher density developments.
- Lakes Highway District is also expected to see additional rural growth, some of which will be offset by annexation of areas near Rathdrum, Hayden, Spirit Lake and Athol. Rural areas within Lakes Highway District roughly correspond to the Selkirk, North Kootenai and northern portions of Fernan and Bitterroot Sub-Areas of Kootenai County's comprehensive plan. An overall annual rural growth rate for this highway district is anticipated to be about 0.4%, with rural development predominantly

concentrated within the rough rectangle formed by Spirit Lake, Rathdrum, Hayden and Athol.

With these assumed population growth rates, Kootenai County is expected to add 53,066 new dwelling units by 2040. This will bring the county's overall population from its current (2018) total of 166,667 people to approximately 304,234 by the year 2040 (Table 2.4). This represents a 3.7% annual rate of growth and total growth of 83%.

residential growth for Single-family (LU 1) and Multi-family (LU 2) Dwelling Units was placed in each respective TAZ. The remaining 25% was set aside for hand placement by the responsible jurisdiction. Additionally, each TAZ was analyzed via ortho photos to determine if it was currently built out. The residential growth for TAZs that were identified as being built out was added to the "pot" for hand placement, as well.

Table 2.4 Population Estimates, 2018-2040*

LOCATION	2018	2040	Magnitude of Growth	% Growth
Kootenai County	166,667	304,234	137,567	83%
Coeur d'Alene	49,780	85,681	35,901	72%
Post Falls	36,555	102,561	66,006	181%
Hayden	15,400	34,955	19,555	127%
Rathdrum	8,562	18,441	9,879	115%

*Estimates derived by staff using data from jurisdictions and US Census

Figure 2.6 graphically depicts Kootenai County's existing and projected housing densities by TAZ.

KMPO staff developed population growth forecasts for the year 2040 as shown in Appendix C.

The 2040 forecasts developed from the 2018 base model built upon methodology used for the 2016 model update approved by the KMPO Board in December 2018, described as follows:

All residential Land Use categories (Land Use 1, 2 and 9) were grown based on the respective jurisdiction's annual growth rate. 75% of new

All non-residential land use categories (Land Use 3-23) were extrapolated at an overall annual growth rate of 2.4%. For new Retail (Land Use 3) and Medical (Land Use 15) growth, 70% was allocated in TAZs where similar uses were already occurring, and the remaining 30% was hand-placed where new growth was expected to occur. Agriculture (Land Use 11) was estimated to decrease by 3% per year in future years.

KMPO staff worked with each jurisdiction during the entire land use update process. All jurisdictions reviewed the draft land use forecasts, distribution and corrections made by

KMPO staff. The final land use was recommended by KCATT and approved by the KMPO Board on December 13, 2018.

Figure 2.7 depicts Kootenai County's existing and projected commercial and industrial density by TAZ.

Various references were used to assist in the process, including but not limited to: land use maps, subdivision maps, zoning maps, demographic analysis, project studies, strategic plans, comprehensive plans and orthophotos.

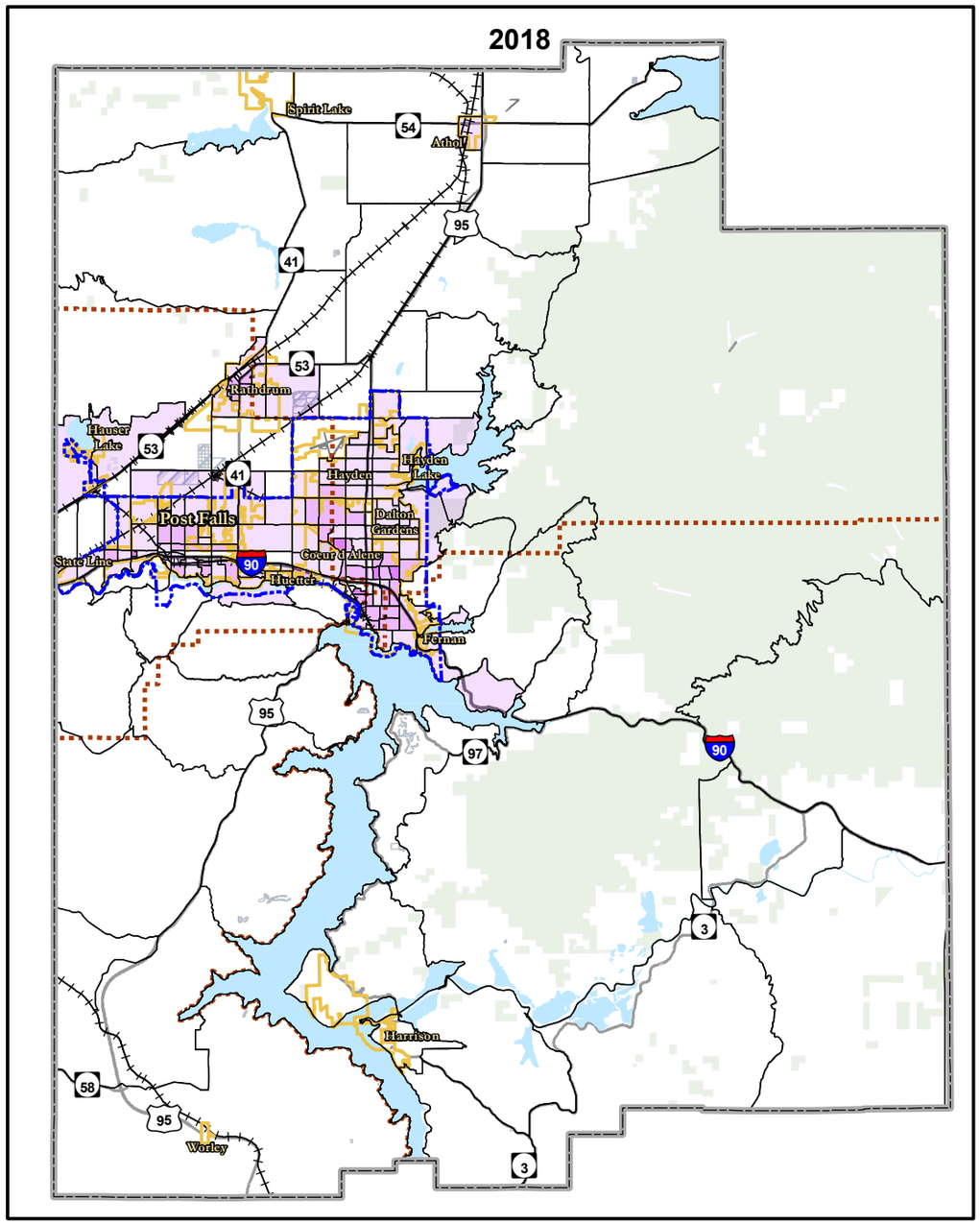
ANTICIPATING GROWTH PATTERNS

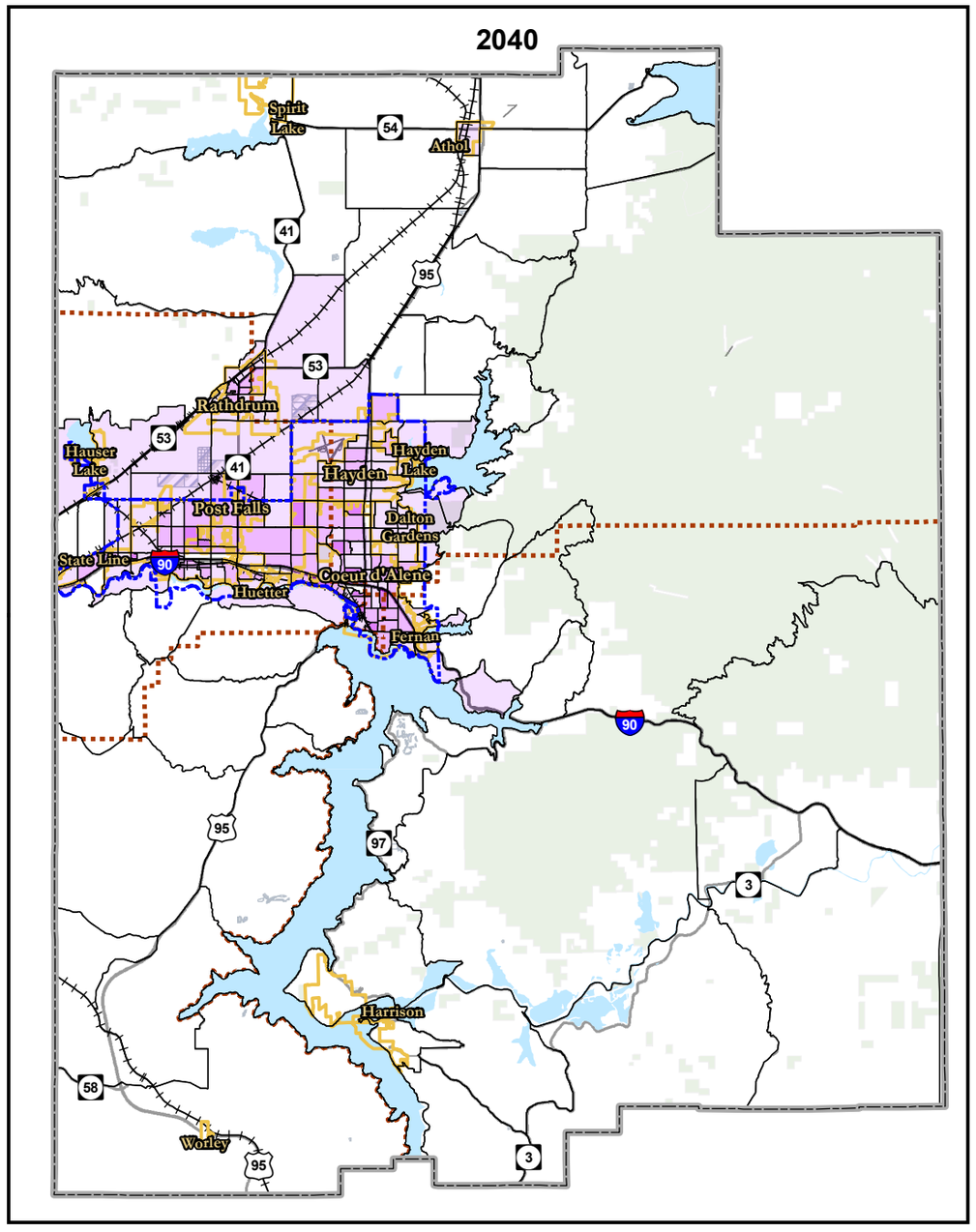
KMPO recognizes that actual growth and development may not occur exactly as forecasted due to fluctuating market conditions, infrastructure funding availability, and other factors. To keep current with changing conditions, KMPO collects annual housing and employment land use data to reflect ongoing building and platting activity approved by local agencies and jurisdictions. Future growth projections are revised accordingly with each update to the model.

Sometimes developments are proposed which require amendments to adopted comprehensive plans. At other times, large development proposals may be consistent with local comprehensive plans but inconsistent with localized growth patterns assumed for regional transportation planning. Consequently, major development proposals and potential comprehensive plan amendments can have unanticipated impacts on the regional transportation system. When this occurs, local jurisdictions may request KMPO to assist in reviewing the proposal's impact on the regional transportation system.

KMPO also assists local jurisdictions and highway districts in the development and update of their Comprehensive and Transportation Plans. KMPO provides scenario analysis on the various alternatives being considered in the update process. As plans are adopted, the new plans are incorporated into the MTP's forecast years to ensure continuity between local and regional transportation planning activities.

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 -2040





Kootenai County Existing& Projected Housing Density by TAZ 2018 and 2040

Housing Units Per Acre by TAZ

- > 5
- 4 - 5
- 3 - 4
- 2 - 3
- 1 - 2
- 0.05 - 1
- < 0.05

Physical Characteristics

- HwyDist_Arcs
- Interstate
- US/State Highways
- Railroad
- County Boundary
- Urban Area Boundary
- Municipal Boundaries
- Land App Sites
- National Forest
- Water Features

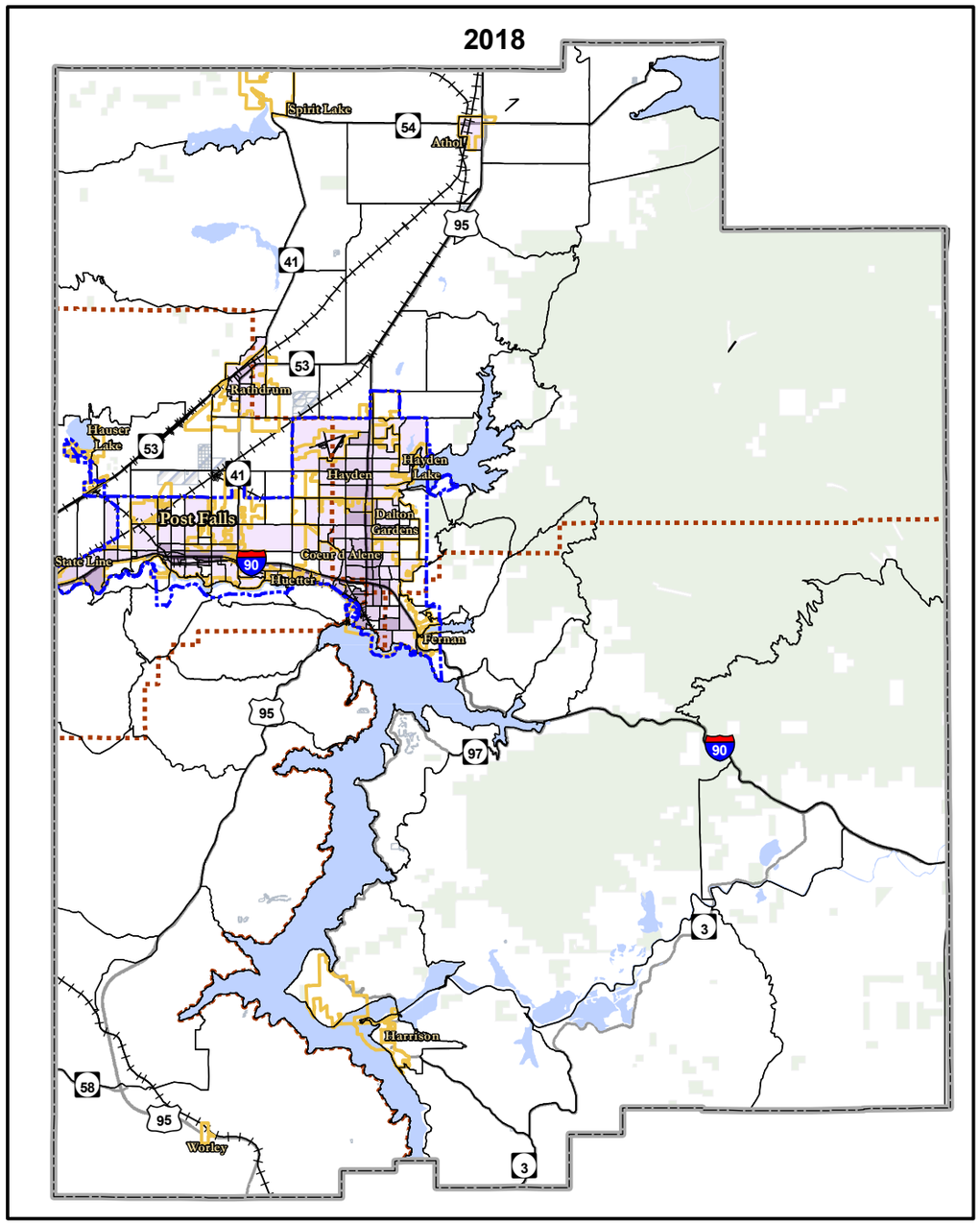
*Data based on best available information.
*Data for illustrative purposes only.

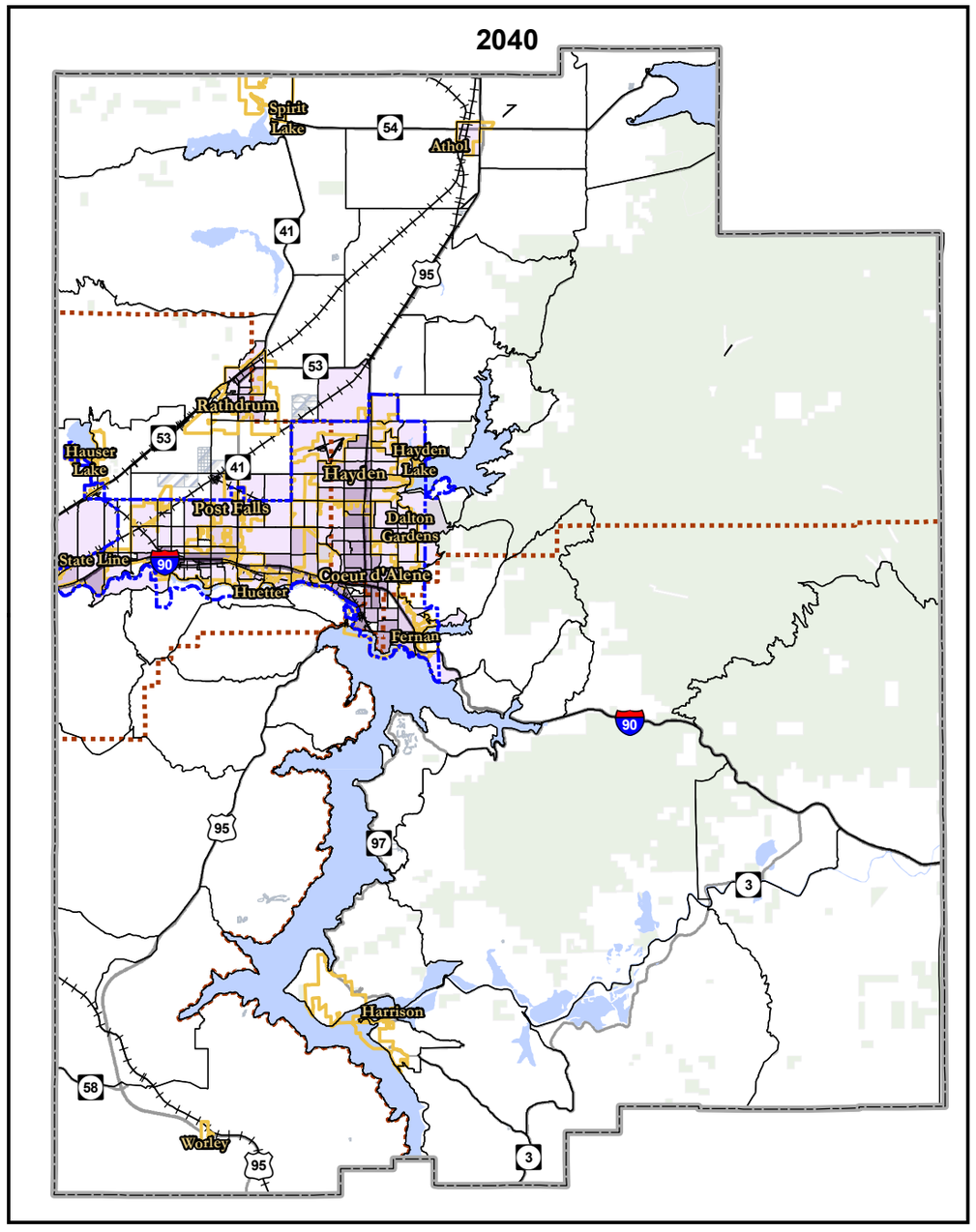
N W E S

0 1.25 2.5 5 7.5 10
Miles

Kootenai MPO

KOOTENAI METROPOLITAN TRANSPORTATION PLAN
2020 -2040





Kootenai County Existing & Projected Commerical & Industrial Density by TAZ 2018 and 2040

Employees Per Acre by TAZ

- > 6
- 4 - 6
- 2 - 4
- 1 - 2
- 0.5 - 1
- 0.05 - 0.5
- > 0.05

Physical Characteristics

- HwyDist_Arcs
- Interstate
- US/State Highways
- Railroad
- County Boundary
- Urban Area Boundary
- Municipal Boundaries
- Land App Sites
- National Forest
- Water Features

*Data based on best available information.
*Data for illustrative purposes only.

N W E S

0 1.25 2.5 5 7.5 10
Miles

Kootenai MPO