Murphy Road Corridor Project
Existing Conditions and Deficiencies

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Introduction

This technical memorandum outlines the existing roadway and land use conditions in the vicinity of Murphy Road in southeast Bend. The study area for this analysis, as illustrated in Figure 1, is Murphy Road from SE 3rd Street to SE 27th Street. Parcels immediately to the north and south of Murphy Road are also considered. Where appropriate, the analysis has been organized by corridor segment as follows:

- **Segment 1** – SE 3rd Street to Parrell Road
- **Segment 2** – Parrell Road to Brosterhous Road
- **Segment 3** – Brosterhous Road to SE 15th Street
- **Segment 4** – SE 15th Street to SE 27th Street

The purpose of analyzing existing conditions is to identify geometric, traffic, or safety deficiencies in the study area, and flag potential land use and environmental constraints. A solid understanding of current deficiencies and constraints is critical for the project team as they move into the alternatives development and evaluation phase.

Key findings from this analysis are summarized below. The remainder of the memorandum includes a description of the project area, a brief inventory of current land uses and environmental constraints, a description of existing roadway geometry, and a traffic operations, safety, and utilities analysis.

Key Findings

Key deficiencies and constraints, as identified from the existing conditions analysis, are summarized over the next few pages.

Land Use Constraints

- **Land Use Assumptions** – The land use parcels along Murphy Road are largely zoned for residential use, with exceptions for a commercial uses near SE 3rd Street, future convenience near Brosterhous Road, and existing and future schools between Country Club Road and Brosterhous Road. The project analysis will assume growth consistent with regional projections in the area, but will conduct a sensitivity analysis for the preferred alternative to ensure that it will be effective under an alternate, expedited-growth scenario.

Environmental Constraints

- **Areas of Special Interest** – There are two Areas of Special Interest (ASIs) located in the study area. One ASI is located south of the existing Murphy Road between Country Club Drive and Brosterhous Road. The second ASI is located east of the existing terminus of Murphy Road at Brosterhous Road and immediately east of the railroad tracks. According to Section 2.7.700 of the Bend Code, public streets can be placed within an ASI if it is shown that no other practicable method exists to avoid the ASI.
Western Extent of Study Area:
Brookswood Blvd.

Eastern Extent of Study Area:
SE 27th Street

Figure 1
Murphy Road Corridor Study Area
Bend, Oregon

LEGEND

Murphy Road
Streets
Railroad
City Limits
Urban Growth Boundary

1 inch equals 1,500 feet
• **Social Characteristics** – The residents living within the social elements study area are of similar levels of diversity as the City of Bend and Deschutes County, though less diverse than the State of Oregon as a whole. The percent of residents in the study area that are below the poverty threshold are lower than the City and State average, though similar to the County average. There is a higher percent of the study area aged 65 or higher than the City, County, and State average.

**Safety Deficiencies**

• **Corridor Crash Rate** – The crash rate for the existing Murphy Corridor was 2.25 per million vehicle miles (MVM). The statewide average crash rate for urban collectors for the period 1999-2003 was 3.84 per MVM.

• **Intersection-Level Crash Rate** – A majority (63 percent) of intersection-level crashes were property-damage only (PDO) and did not cause injury. There were no fatalities recorded. Angle crashes were the most common intersection crash type (35 percent). The highest crash rate was located at Parrell Road, with a crash rate of 0.53 per million entering vehicles (MEV). Crash rates below 1.0 do not indicate a safety concern.

**Roadway Deficiencies**

• **Pedestrian Facilities** – Sidewalks do not exist on the western end of Murphy Road and are intermittent between Mel Court and Brosterhous Road. Sidewalks should be continuous and at least 5 feet wide on both sides of the roadway to meet minimum city standards. Future sidewalks will need to meet requirements from the Americans with Disabilities Act (ADA), including wheelchair ramps at intersection corners.

• **Horizontal Alignment** – Near Parrell Road and Mel Court, horizontal curve radii are shorter than design standard. This reduced radius may impact a drivers’ ability to safely navigate the curve at the posted speed.

• **Sight Distance** – Near Parrell Road and Mel Court, drivers on Murphy Road have restricted horizontal sight distance due to objects, such as trees, located close to the roadway on the inside of the curve. Objects that can obstruct a drivers line of sight through a corner need to be set back a specific distance from the centerline of the inside lane to provide the necessary stopping sight distance.

• **Median Width** – The current alignment of Murphy Road is a curb-to-curb width of 36 feet. This allows for two 12’ travel lanes and two 6’ bike lanes. As a Major Collector, the curb-to-curb width should be 52’ to also allow for a 16’ continuous center turn lane.

**Traffic Operations Deficiencies**

• Three study intersections are currently above acceptable levels of traffic mobility, defined as level-of-service (LOS). LOS is described in the main body of the existing conditions report. None of these intersections are along Murphy Road.

  – **Pinebrook Boulevard/SE 3rd Street** – The eastbound approach of Pinebrook Boulevard at SE 3rd Street currently is operating at LOS F
- **Pinebrook Boulevard/Brookswood Boulevard** – The westbound approach of Pinebrook Boulevard at Brookswood Boulevard is operating at LOS F.

- **China Hat Road/Ponderosa/US 97** – The westbound approach of China Hat Road/Ponderosa at US 97 operates at LOS F.

- The intersections of US97/China Hat-Ponderosa, 3rd/Pinebrook, 3rd/Murphy, and Brookswood/Pinebrook all have at least one lane group that has a 95th percentile queue that exceeds 200 feet. Potential areas of concern for these intersections are safety issues associated with the long queue or spillback of the queue to the previous intersection.

### Utilities Constraints

- **Cascade Natural Gas** – All of Cascade’s facilities are located underground and therefore will have minimal impacts while roadway improvements to Murphy Road are being constructed. Except for Segment 1, no new easements or right of way acquisition will be needed to remove/replace Cascade Natural Gas facilities. For Segment 1, the City of Bend will need to either have Cascade remove and relocate their existing gas main to Murphy’s new alignment or maintain an easement for their utility in its current location. In Segment 2, existing facilities like meters, for example, will need to relocated/adjusted to fit within the Murphy Road improvements.

- **Pacific Power** – Utilities will probably have the largest impact to the proposed roadway improvements. The right of way acquisition needed to make Murphy Road meet city requirements should be adequate to provide Pacific Power room to relocate their utilities. For Segment 1, the City of Bend will need to either have Pacific Power remove and relocate their existing power poles to Murphy’s new alignment or maintain an easement for their utility in its current location.

- **Central Electric** – The right of way acquisition needed for meeting city requirements should be adequate to provide Central Electric room to relocate their utilities.

- **USWEST/QWEST** – Telephone pedestals and utility locator poles at various locations along the road will need to be relocated to fit within the roadway improvements. The right of way acquisition needed to help Murphy Road meet city requirements should be adequate to provide USWEST/QWEST room to relocate their utilities.

- **Avion Water** – Impact to Avion Water’s facilities from roadway construction are expected to be minimal.

- **Roats Water** – The impacts to Roats Water facilities cannot be fully determined until more information is provided. The right of way acquisition needed to meet city requirements should provide room for Roats Water to relocate their utilities within the right of way. For Segment 1, the City of Bend will need to either have Roats Water remove and relocate their existing underground utilities to Murphy’s new alignment or maintain an easement for their utility in its current location.

- **City of Bend Water Department** – Impacts to the City’s Water facilities cannot be fully determined at this time. Right of way acquisition to meet city requirements should provide room for utility relocation within existing right of way, if needed.
Existing Conditions Analysis

Overview of Study Area

The City of Bend is located in Central Oregon at the eastern foothills of the Cascade Mountain Range, 131 miles southeast of Salem. At an elevation of approximately 3,600 feet, the city’s Urban Growth Boundary (UGB) encompasses 32 square miles. Bend was incorporated in 1904 and serves as the Deschutes County Seat.

Central Oregon’s population grew by 53 percent between 1995 and 2005, mostly due to immigration. Bend, as Central Oregon’s largest city, saw a population increase from 29,425 in 1995 to over 70,328 in 2005. Following the 2000 Census, Bend’s population growth triggered the formation of the Bend Metropolitan Planning Organization (MPO)\(^1\). Bend comprises the population majority for Deschutes County, which had a total population of 135,450 in 2005.

Listed below are some general demographic characteristics of Bend Residents, as obtained from the Bend Chamber of Commerce\(^2\).

- The median age for Bend residents is 34.8 years
- Of the total population, 27.3% are under the age of 19
- The Bend/LaPine School District enrolled 13,194 children at 5 high, 5 middle, 9 elementary, and 3 magnet schools in 2005. There are also several private schools in the Bend city limits.
- The Central Oregon Community College in Bend had 7,108 students (Full-time, Part-time, and Non-Credit) and OSU’s Cascades Campus has 435 students, as of 2005.
- The Bend Police Department had 70 sworn officers and 24 staff in 2005. The Fire Department has 76 paid staff and 20 volunteers at four stations.
- The Mt. Bachelor ski area was the initial draw for the visitor industry, which has expanded into industrial and commercial expansion. In 2003, approximately 7,585 employees worked in the Tourism Services industry; followed by 5,569 working in Health and Social Assistance. Bend is also the retail center of Central Oregon. Recreation is a large draw for the City and there are 37 developed city parks.
- The 2004 average price for a home in Bend was $271,457, while the median price was $227,500. Rental housing in the Bend area is estimated to average $935 and up for a three bedroom, two bath home.
- Property tax in 2004, for a home with an assessed value of $100,000 was $1,516.
- US 97/Bend Parkway provides north/south travel through Bend, while US Highway 20 provides access to cities to the west and east of Bend.

\(^1\) As per the Federal Aid Highway Act of 1962, metropolitan areas with a population of 50,000 persons or more must form a regional agency for the purpose of coordinated long-range transportation planning.

\(^2\) Information in the list above was obtained from the Bend Chamber of Commerce, http://www.bendchamber.org/about/glance1.asp (last accessed October 18, 2006)
• There is one municipal airport. AMTRAK passenger services do not extend to Bend, but Burlington Northern and Union Pacific provide freight service through Bend. Greyhound Bus Lines has a terminal in Bend.
• There is a Dial-A-Ride service in Bend that offers rides to the general public, as well as to the senior and disabled communities of Bend. The Bend Area Transit system now operates seven bus routes within city limits.

Murphy Road is located in southern Bend. The study area for this project is between SE 3rd Street on the west to SE 27th Street on the east. Murphy Road is classified as a Major Collector in the City of Bend’s Transportation System Plan (TSP) and currently exists as a two-lane roadway from SE 3rd Street to Brosterhous Road. The Burlington Northern Sante Fe (BNSF) Railroad operates in a north-south direction through the project area, between Brosterhous Road and SE 15th Street. There are rock outcroppings in the area immediately east of the railroad tracks that have been designated by the City of Bend as an Area of Special Interest (ASI).

**Existing Land Use Conditions**

**Zoning Designations**

The current zoning for parcels along Murphy Road includes Residential Low Density (RL), Residential Medium Density (RM), Residential Standard Density (RS) General Commercial (CG), Commercial Convenience (CC), and Urban Area Reserve 10 Acre Minimum (UAR10). These are illustrated in Figure 2 and described over the following pages.

The City of Bend’s Comprehensive Plan designations (shown in Figure 3) are largely consistent with the current zoning. There is one difference of note, which is the designation of areas currently used for schools or planned for future schools designated as Public Facility (PF) in the Comprehensive Plan, yet designated as residential or urban reserve in the Zoning Code.

Allowed and conditional uses for all zoning designations in the study area are described below.

**Residential Zones**

The RS zone is intended to provide opportunities for a wide variety of residential housing types at the most common residential densities in places where community sewer and water services are available. The residential density range in this district is 2.0 to 7.3 dwelling units per gross acre. Childcare facility (13 or fewer children) and personal services (barber shops, salons, etc.) are permitted land uses.

The RM zone is intended to provide primarily for the development of multiple family residential housing in areas where sewer and water service are available. The residential density range in the District is 7.3 to 21.7 units per gross acre and shall provide a transitional use area between other residential districts and other less restrictive areas.
Figure 3
Murphy Road Corridor
Comprehensive Plan
Bend, Oregon

LEGEND
Murphy Road
Other Streets
Railroad
City Limits
Urban Growth Boundary

City of Bend
Comprehensive Plan Designations
CC, COMMERCIAL CONVENIENCE
CG, COMMERCIAL GENERAL
RL, RESIDENTIAL LOW DENSITY
RM, RESIDENTIAL MEDIUM DENSITY
RS, RESIDENTIAL STANDARD DENSITY
IL, INDUSTRIAL LIMITED
PF, PUBLIC FACILITY

Deschutes County
Comprehensive Plan Designations
AG, AGRICULTURE
RREA, RURAL RESIDENTIAL EXCEPTION AREA
SM, SURFACE MINING
URA, URBAN RESERVE AREA

File Path: \Astoria\gisdata1\data\Proj\Murphy_Road\Gis\mxds\101706\Figure3_Murphy_Rd_CompPlan.mxd, Date: October 17, 2006 11:54:31 AM
The RL zone consists of large urban residential lots that are served with a community water system and Department of Environmental Quality (DEQ) permitted community or municipal sewer systems. The residential density range in this district is 1.1 to 2.2 dwelling units per gross acre.

Permitted land uses for all residential zones are:

- Single-family detached housing
- Accessory dwellings
- Manufactured homes on individual lots
- Adult foster homes (5 or fewer residents)
- Family Childcare home (16 or fewer children)
- Accessory Uses and Structures
- Neighborhood Parks
- Vacation Home Rental

Conditional Use applies to these uses in all residential zones:

- Temporary Housing
- Churches and places of worship
- Clubs, lodges, and similar uses
- Government offices and facilities
- Libraries, Community centers, museums, and similar uses
- Community and Regional parks, as well as recreational facilities
- Schools (Public and Private)
- Cemetery/Mausoleum
- Hospitals
- Childcare facilities (17 or more children)
- Food services less than 2,000 square feet, (with or without alcohol) excluding automobile dependent and automobile-oriented, drive-in, and drive-through uses
- Repair services, conducted entirely within building; excluding vehicle repair, small engine repair and similar services
- Bed & Breakfast Inns and Vacation rentals

Commercial Zones

The two commercial zones in the study area (CG and CC) allow many similar types of development. The CG zone is intended to provide a broad mixing of commercial uses that have large site requirements, are oriented to the highway, and provide services to the traveling public. The CC zone is typically adjacent and connected to a residential district, and provides larger scale uses and area than the neighborhood commercial zone. The CC zone provides for frequent shopping and service needs of nearby residents. New Convenience Commercial nodes shall develop as commercial centers rather than a commercial strip and be limited in size up to 5 acres.

Permitted land uses for the CG and CC zones are:

- Existing and new residential uses
• Retail sales and service (building footprint greater than 50,000 square feet is not permitted in the CC zone)
• Restaurants/food services without drive-through (with drive-through is conditional in CC)
• Offices and clinics
• Lodging
• Commercial and public parking
• Schools (colleges and vocational schools are not permitted in CC)
• Manufacturing and production less than 5,000 sq. ft. with retail outlet. Other industrial uses are permitted or conditional in CG zones.
• Mixed-use development is allowed, as long as the business/retail use is compatible with the zoning.

Urban Area Reserve 10 Acre Minimum Zone
The Urban Area Reserve District is a holding zone for urban development. The UAR10 zone allows a maximum residential density of 1 dwelling unit per 10 gross acres.

Public Facility Zone
The PF zone is intended to provide area for buildings and facilities that are owned and operated by federal, state, or local governments, public utilities, special districts, or non-profit organizations, and which are occupied to provide governmental or public services. This zone is also intended to provide for school sites, public parks and recreational facilities, natural areas, trails, wetlands, and similar types of open space owned and managed by a local government or special district. Some land uses are permitted on a conditional basis, including magnet and high schools operated by the Bend/LaPine School District, public utility maintenance facilities and operation yards with outdoor storage of supplies and materials, ball fields and similar outdoor recreational areas that have night lighting or amplified sound systems, public transmission tower sites, County solid waste disposal sites or solid waste transfer sites, Correctional facilities for adults and juveniles including work farms and training centers, and park sites with outdoor amphitheater or facilities for community events.

Description of Existing Uses
Existing uses along the corridor are described below by corridor segment (defined in introduction).

1. **SE 3rd Street to Parrell Road** – The current alignment of Murphy Road in this segment is next to land that is zoned for CG, RM, RS, and RL. The land use in the area conforms to the current zoning regulations with some automobile oriented businesses to the east of SE 3rd Street; there are several empty lots and a few apartments or duplexes directly on Murphy Road, while most of the houses are of low density and single story.

2. **Parrell Road to Brosterhous Road** – The land adjacent to Murphy Road in this segment is zoned for CC, RS, and RL. The land use in the area conforms to the current zoning regulations with the majority of the homes consisting of low density to moderate density. There are a few empty lots, mostly of flat, grassy terrain, and there is also one rock outcropping designated as an Area of Special Interest (ASI), which is adjacent to a
forested empty lot and a ridge with trees on it. The Jewell Elementary School is located at the eastern portion of this segment, which is acceptable under the RS zoning on a conditional use. There is also a parking lot for the Bend Area Transit buses and a utilities building on land that is zoned for RS; these uses are most likely permitted on a conditional basis. A single family farm is in this area and may have been built before zoning regulations, so it does not conform to zoning regulations. The section of this segment zoned for CC has an RV park on it; this is consistent with the zoning if the park is considered residential, lodging, or commercial parking.

3. **Brosterhous Road to SE 15th Street** – Murphy Road currently terminates at Brosterhous Road. East of Brosterhous, the land is zoned RS. West of the railroad (north of Murphy Road’s terminus), there is housing development that is consistent with the zoning regulation. There is also a former mobile home park to the west of the railroad (south of Murphy Road’s terminus). To the east of the railroad, where Murphy Road does not extend, there are empty lands that are flat in the northern section and in the southern section, there is a large rock outcropping that has been designated by the City of Bend as an ASI (described in future section on environmental constraints).

4. **SE 15th Street to SE 27th Street** – This section, which is partially located outside the City’s urban growth boundary, is zoned for UAR10, RS, and RL. The UAR10 land is consistent with the zoning designations, as most of the land is vacant and characterized by field or forest. The land to the north, at Ferguson Road, is zoned RL and that area is also consistent with current designations. The High Desert Middle school is located in this segment, which is acceptable under the RL zoning as a conditional use.

### Development Applications

As of October 2006, the City of Bend is considering the following development applications for areas within the Murphy Road corridor.

- **Crown Villa North** – This proposed development is located in the vicinity of the RV Park near the intersection of Murphy Road and Brosterhous. There are 99 lots proposed for residential use.

- **Crown Villa South** – This proposed development is located in the vicinity of the RV Park near the intersection of Murphy Road and Brosterhous. There are 82 lots proposed for residential use.

- **South Point** – This proposed development is located north of Murphy Road, off of Brosterhous Road. There are 33 lots proposed for residential use, with no direct access onto Murphy Road.

- **Shadow Glen** – This proposed development is located east of SE 15th Street, immediately south of the Central Oregon Canal. There are 368 lots proposed for residential use.

- **Wood Hill** – This proposed development is east of Brosterhous Road and west of the railroad tracks, at the former location of a mobile home park. There are an estimated 159 lots proposed for residential use.
Existing Environmental Conditions

The purpose of this section is to document the general existing environmental conditions in the Murphy Road corridor. The survey of existing environmental conditions identified three main subject areas. This section of the memorandum is organized by the following subject areas:

- Areas of Special Interest
- Environmental Reconnaissance
- Social Elements Reconnaissance

Figure 4 illustrates these areas of environmental consideration.

Areas of Special Interest

ASIs have been identified by the City of Bend as important features in the landscape intended to be preserved as growth occurs. According to the City of Bend Development Code, ASIs “consist of scattered rock outcrops, stands of trees, and dominant ridges and faults that are typical of the Central Oregon landscape. These areas contain high points or changes in elevation that break the line of sight so that the area retains a feeling of undeveloped open space.”

ASIs are mapped on the Bend Area General Plan Map and the City Zoning Map. The Upland Areas Special Interest Overlay Zone implements the vision of the Bend Area General Plan to retain and conserve the natural character of Bend. This overlay zone is intended to protect valuable natural resources within the Bend urban growth boundary and establishes clear and objective design and development standards to protect designated ASIs.

There are two ASIs in the Murphy Road corridor as identified in Section 2.7.700 of the Bend Development Code. These are illustrated in Figure 4.

According to the Bend Urban Area General Plan map, the first ASI is located south of Murphy Road, east of Country Club Drive. This ASI is aligned approximately northwest to southeast, and is approximately 2/10 mile wide by 1/3 mile long. At its southern end, the ASI parallels Country Club Drive. The northern boundary of the ASI roughly parallels Murphy Road, appearing to touch the existing right-of-way (ROW) approximately 500 feet east of Country Club Road. Alternatives widening Murphy Road to the south could touch this ASI. The project team will need to be aware of this constraint when developing and evaluating alternatives.

The second ASI is located east of Brosterhous Road and immediately east of the existing railroad tracks. According to the Bend Urban Area General Plan map, the ASI is approximately 1/4 mile wide and 2/10 mile long, and extends from the railroad tracks to the east past SE 15th Street, which cuts across the ASI. The ASI is aligned approximately southwest to northeast. An extension of Murphy Road due east of its current alignment would intersect with the ASI. The project team will need to be aware of this constraint when developing and evaluating alternatives.
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ASI Review and Development Standards

According to the Bend Development Code, road construction within the boundaries of an ASI is subject to ASI Review and is processed as a land use permit. The ASI Review application requires a form, filing fee, drawings, and other information, as specified in Section 2.7.700 (Upland Areas of Special Interest Overlay Zone).

The ASI boundary is delineated by the outside edge of the boundary line shown on the Bend Area General Plan map and the City Zoning Map. Development standards in Section 2.7.700 apply to road construction.

Section 2.7.700 also states that public or private streets and driveways can be placed within an Upland Area of Special Interest if it is shown that no other practicable method exists. The permanent alternation of an ASI by grading, excavation, or fill; the placement of impervious surfaces; or the removal of existing vegetation is only permitted if the following conditions are demonstrated (per Section 2.7.700):

- No other practicable access to the buildable area exists, or access from an off-site location through the use of easements is not possible;
- Roads and driveways are designed to be the minimum width necessary and the minimum intrusion into the Upland Area of Special Interest while also allowing safe passage of vehicles and/or pedestrians;
- The need for future extensions of shared access, access easements, or private streets to access potential new building sites have been considered at the time of this application in order to avoid subsequent encroachments into an Upland Area of Special Interest.

Section 2.7.700 contains additional standards for other development types, including utilities and drainage facilities. When a development impacts an ASI by grading, excavation, or fill; the placement of impervious surfaces; or by the removal of vegetation, a mitigation plan is required. Specifics of the mitigation plan are outlined in 2.7.700 of the Bend Code.

Environmental Reconnaissance

Air Quality

The Murphy Road corridor is not located in a DEQ designated Maintenance Area or Non-Attainment Area. Therefore, the air quality in the Murphy Road corridor meets the National Ambient Air Quality Standards (NAAQS) set by the Environmental Protection Agency (EPA).

Floodplains and Floodways

Floodplain boundaries are identified on Flood Insurance Rate Maps (FIRM), prepared by the Federal Emergency Management Agency (FEMA). None of the study area is within a FEMA designated 100-year floodplain or floodway.

Hazardous Substances

According to the DEQ’s Environmental Cleanup Site Information (ECSI) database, there are no sites within the study area with known contamination from hazardous substances.
Historic and Cultural Resources

There are no properties listed on the National Register of Historic Places (NRHP) in the Murphy Road corridor. Additionally, no portion of the corridor is located within a National Historic District. Analysis of state records of historic and cultural resources was not conducted as part of this project.

Natural Hazards

According to Deschutes County GIS data for the Murphy Road corridor:

- There are no slopes of 25 percent or greater; the probability of a landslide is “low.”
- There are no earthquake fault lines located along the corridor.
- Much of the eastern segment of the study area is located within a Deschutes County designated Wildfire Hazard area. Wildfire Hazard Areas are identified based on criteria including fuel, topography, weather, and development.

Topography

The topography of the corridor is generally flat with some rolling terrain. The primary vegetation in the corridor is Ponderosa Pine and bitterbrush.

Water Resources

The Murphy Road corridor lies within the Upper Deschutes River Sub-basin of the Deschutes River Basin. There are no free-flowing hydrologic features in the corridor, and therefore no riparian areas.

Wetlands

Wetlands within the City of Bend were inventoried and evaluated in 2000. According to Figures 2-4 of the Bend Area General Plan, there are no “significant” or “non-significant” wetlands in the Murphy Road corridor.

The National Wetland Inventory (NWI) identifies one wetland in the corridor, located in the southeast quadrant of the Paulina Lane/Murphy Road intersection. This wetland is approximately 0.89 acres, and has a Cowardin classification\(^3\) of \textit{Palustrine Unconsolidated Semipermanently Flooded (PUBFx)}\(^4\).

Social Elements Reconnaissance

Data were collected from the U.S. Census Bureau’s 2000 Decennial Census to determine if there are any disproportionately high minority, low-income, or elderly populations in the Murphy Road corridor. Due to the linear extent of the corridor, U.S. Census block groups

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\(^3\) A comprehensive classification system of wetlands and deepwater habitats developed in 1979 for the U.S. Fish and Wildlife Service.

\(^4\) Palustrine (P) - All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, Unconsolidated Bottom (UB) – All wetland and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%. Semipermanently Flooded (Fx) – Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface. For more information on wetland classification, see: http://www.fws.gov/nwi/Pubs_Reports/Class_Manual/class_titlepg.htm
were determined to be the appropriate geographic level for analysis. A study area was
developed using block group boundaries and was defined as all block groups in the
Murphy Road corridor between SE 3rd Street and SE 27th Street. This study area is illustrated
as the “Social Elements Study Area” in Figure 4 and is called the “study area” for the
remainder of this section. The three block groups that are within this area and define the
boundary of the study area are:

- Census Tract 9918, Block Group 4
- Census Tract 9919, Block Group 2
- Census Tract 9919, Block Group 3

The following summarizes the census data for minority, low-income, and elderly
populations within the study area and compares the proportion of minority, low-income,
and elderly populations to the City of Bend, Deschutes County, and the State of Oregon.

**Minority Populations**

Those races considered as part of minority populations analysis include African American,
Hispanic, Asian American, and American Indian/Alaska Native. Table 1 below illustrates
the breakdown of Bend area residents by race and ethnicity.

**Table 1**
Racial and Ethnic Composition by Geographic Area (2000)

<table>
<thead>
<tr>
<th>Race or Ethnicity</th>
<th>Study Area (Percentage of Residents)</th>
<th>City of Bend</th>
<th>Deschutes County</th>
<th>State of Oregon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>93.0%</td>
<td>91.6%</td>
<td>92.9%</td>
<td>83.5%</td>
</tr>
<tr>
<td>African American</td>
<td>0.2%</td>
<td>0.3%</td>
<td>0.2%</td>
<td>1.6%</td>
</tr>
<tr>
<td>American Indian/Alaskan Native</td>
<td>0.9%</td>
<td>0.7%</td>
<td>0.8%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Asian</td>
<td>0.6%</td>
<td>1.0%</td>
<td>0.7%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Native Hawaiian and Other Pacific Islander</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Other</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Two or More Races</td>
<td>1.7%</td>
<td>1.7%</td>
<td>1.6%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>3.5%</td>
<td>4.6%</td>
<td>3.7%</td>
<td>8.0%</td>
</tr>
<tr>
<td></td>
<td>100.1%</td>
<td>100.1%</td>
<td>100.1%</td>
<td>99.9%</td>
</tr>
</tbody>
</table>

Source: U.S Census Bureau, 2000 Decennial Census. Summary File 1, Table P8.

The study area is substantially less racially diverse than the state, though has similar
diversity to the City of Bend and Deschutes County. In the 2000 U.S. Census, 93 percent
of the total population in the study area considered themselves to be Caucasian, as compared
to 83.5 percent of people in the State of Oregon, 91.6 percent of people in the City of Bend,
and 92.9 percent of people in Deschutes County. People of Hispanic ethnicity compose 3.5
percent of the study area population.
Low-Income Populations
A low-income individual is defined as a person whose median household income is at, or below, U.S. Department of Health and Human Services poverty guidelines for that size of household. 2000 U.S. Census data indicate that the study area has the same proportion of households below the poverty level (6.3 percent) as Deschutes County (6.3 percent) and a lower proportion of households below the poverty level than the City of Bend (10.5 percent) and the State of Oregon (11.6 percent) (Table 2).

Table 2
Low-Income Composition by Geographic Area (2000)

<table>
<thead>
<tr>
<th>Geographic Area</th>
<th>Below the Poverty Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Census Tract 9918, Block Group 4</td>
<td>3.5%</td>
</tr>
<tr>
<td>Census Tract 9919, Block Group 2</td>
<td>8.0%</td>
</tr>
<tr>
<td>Census Tract 9919, Block Group 3</td>
<td>6.8%</td>
</tr>
<tr>
<td>Social Elements Study Area</td>
<td>6.3%</td>
</tr>
<tr>
<td>City of Bend</td>
<td>10.5%</td>
</tr>
<tr>
<td>Deschutes County</td>
<td>6.3%</td>
</tr>
<tr>
<td>State of Oregon</td>
<td>11.6%</td>
</tr>
</tbody>
</table>

Source: U.S Census Bureau, 2000 Decennial Census. Summary File 3, Table P87.

Elderly Populations
Elderly populations are defined as people aged 65 years and older. The percentage of elderly persons for the block groups in the study area ranged between 11.0 and 19.3 percent. For the entire study area, elderly persons averaged 15.6 percent of the total population (see Table 3). The percentage of elderly persons is slightly higher than the corresponding values for the City of Bend (12.4 percent), Deschutes County (13.0 percent), and the State of Oregon (12.8 percent).

Table 3
Elderly Composition by Geographic Area (2000)

<table>
<thead>
<tr>
<th>Geographic Area</th>
<th>Percent Elderly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Census Tract 9918, Block Group 4</td>
<td>11.0%</td>
</tr>
<tr>
<td>Census Tract 9919, Block Group 2</td>
<td>14.9%</td>
</tr>
<tr>
<td>Census Tract 9919, Block Group 3</td>
<td>19.3%</td>
</tr>
<tr>
<td>Social Elements Study Area</td>
<td>15.6%</td>
</tr>
<tr>
<td>City of Bend</td>
<td>12.4%</td>
</tr>
<tr>
<td>Deschutes County</td>
<td>13.0%</td>
</tr>
<tr>
<td>State of Oregon</td>
<td>12.8%</td>
</tr>
</tbody>
</table>

Source: U.S Census Bureau, 2000 Decennial Census. Summary File 1, Table P12.
Existing Safety Conditions

Crash data were obtained from the City of Bend for the past three years (between January 1, 2003 and December 31, 2005) for the existing Murphy Road corridor, located between SE 3rd Street and Brosterhous Road.

Corridor Crash Analysis

Crash rates are expressed in crashes per million vehicle miles (MVM) traveled. This rate describes how many crashes might be expected of vehicles traveling through a particular section of a roadway for a cumulative total of one million miles.

There were 16 crashes reported along Murphy Road during the three year study period. Of the 16 crashes, 11 crashes (69 percent) occurred at or west of the Parrell Road intersection. The predominant crash types were turning and angle accidents (38 percent for both crash types). Turning movement accidents occur when one or more vehicles making a turn collides with another vehicle and angle accidents are those that occur when a vehicle traveling one direction collides with vehicle entering from another road or access point. Half of the crashes were property damage only (PDO) and half were injury crashes; there were no fatalities accidents along the corridor. The crash rate for the three-year study period was 2.25 per MVM (Table 4).

Table 4
Murphy Road Three-Year Crash History: January 1, 2003 to December 31, 2005

<table>
<thead>
<tr>
<th>Location</th>
<th>Crash Type</th>
<th>Crash Severity</th>
<th>Total Crashes</th>
<th>Crash Rate (per MVM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murphy Road</td>
<td>Rear End</td>
<td>PDO</td>
<td>8</td>
<td>2.25</td>
</tr>
<tr>
<td></td>
<td>Turning</td>
<td>Injury</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Angle</td>
<td>Fatal</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other$^5$</td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Data Source: City of Bend, 2006

The majority of crashes on Murphy Road occurred on a dry roadway surface (75 percent) and during daylight conditions (69 percent) (Table 5).

Table 5
Murphy Road Corridor Crash Conditions: January 1, 2003 to December 31, 2005

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Crashes</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>12</td>
<td>75%</td>
</tr>
<tr>
<td>Wet</td>
<td>3</td>
<td>19%</td>
</tr>
<tr>
<td>Ice</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Snow</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>11</td>
<td>69%</td>
</tr>
</tbody>
</table>

$^5$ Other includes: Fixed Object, Sideswipe, Pedestrian, and Head-on
Table 5
Murphy Road Corridor Crash Conditions: January 1, 2003 to December 31, 2005

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Crashes</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark</td>
<td>4</td>
<td>25%</td>
</tr>
<tr>
<td>Dusk</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Dawn</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: City of Bend, 2006

Intersection Crash Analysis

Intersection crash rates are calculated in the same way as corridor crashes, but do not include a segment distance because they occur at a single location. The number of crashes per million entering vehicles (MEV) is used to calculate an intersection crash rate. A crash rate greater than 1.0 per MEV is the common threshold to identify intersections with high crash rates. The Murphy Road study intersections with reported crashes during the 3-year study period were:

- SE 3rd Street
- Parrell Road
- Country Club Drive
- Brosterhous Road

Table 6 identifies the crash type, severity, and crash rates for the study intersections where crashes were reported. Of the 16 intersection crashes, 7 crashes (44 percent) occurred at the SE 3rd Street intersection, and 6 crashes (38 percent) occurred at the SE Parrell Road intersection. Therefore, 13 of the 16 intersection crashes (81 percent) occurred at these two intersections.

Table 6
Murphy Road Crash Descriptions: January 1, 2003 to December 31, 2005

<table>
<thead>
<tr>
<th>Murphy Road Intersection</th>
<th>Crash Type</th>
<th>Crash Severity</th>
<th>Total Crashes</th>
<th>Crash Rate (per MEV)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rear End</td>
<td>Turning</td>
<td>Angle</td>
<td>Other</td>
</tr>
<tr>
<td>SE 3rd Street</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Parrell Road</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Country Club Drive</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Brosterhous Road</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All Intersections</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: City of Bend, August 2006

 Others includes: Fixed Object, Sideswipe, Pedestrian, and Head-on

---
A majority (63 percent) of the crashes were PDO accidents. Angle crashes were the most common intersection crash type (38 percent). The highest crash rate was located at the Parrell Road intersection, which has a crash rate of 0.53 per MEV. None of the Murphy Road study intersections have a crash rate that exceeds 1.0 per MEV. Crash rates below 1.0 do not indicate a safety concern.

The majority of study intersection crashes occurred on a dry roadway surface (71 percent) and during daylight conditions (59 percent) (Table 7).

Table 7
Murphy Road Corridor Crash Conditions: January 1, 2003 to December 31, 2005

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Crashes</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roadway Surface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>12</td>
<td>71%</td>
</tr>
<tr>
<td>Wet</td>
<td>4</td>
<td>24%</td>
</tr>
<tr>
<td>Ice</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Snow</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17</td>
<td>101%</td>
</tr>
<tr>
<td><strong>Light</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>10</td>
<td>59%</td>
</tr>
<tr>
<td>Dark</td>
<td>6</td>
<td>35%</td>
</tr>
<tr>
<td>Dusk</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Dawn</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17</td>
<td>101%</td>
</tr>
</tbody>
</table>

Source: City of Bend, 2006

**Existing Roadway Geometric Conditions**

Roadway design standards are developed to support safety and mobility goals. Roadway deficiencies can have an impact on the safe and efficient use of the road by all travelers. This section highlights the existing roadway deficiencies of Murphy Road.

This analysis surveyed the geometric, access, and bicycle/pedestrian conditions in the vicinity of Murphy Road. These current conditions were compared with relevant City standards, supplemented by AASHTO standards. Data for analysis were collected from field measurements. The review of deficiencies was completed using:

- Posted Speed: 35 mph
- Design Speed for Deficiency Review: 40 mph
- City designation: Major Collector

A review of the vertical alignment of Murphy Road will not be addressed at this time, due to a lack of as-built information.
Throughout the corridor, Murphy Road runs east and west, has a speed limit of 35 mph and is classified as a Major Collector by the City of Bend. Murphy Road has one travel lane in each direction with turn pockets at some intersections. There are also bike lanes on each side of the roadway. Sidewalks are provided intermittently along both sides of Murphy Road.

The existing roadway conditions analysis of Murphy Road has been organized into two segments, as listed below:

- **Segment 1**—SE 3rd Street to Parrell Road
- **Segment 2**—Parrell Road to Brosterhous Road

**Segment 1: SE 3rd Street to Parrell Road**

The list below summarizes existing geometric deficiencies for Segment 1. Design features that meet standards are not discussed.

- **Pedestrian Facilities** — There are no sidewalks on either side along most of Segment 1. Sidewalks should be at least 5’ wide on both sides of the roadway to meet minimum city standards. Any sidewalks constructed in the future will also need to meet Americans with Disabilities Act (ADA) requirements, including wheelchair ramps at all intersection corners.

- **Horizontal Alignment** — Murphy Road is an urban street with no superelevation through any of its horizontal curves. Drivers on this urban corridor anticipate normal-crown curves and adjust their driving accordingly. Therefore, the standards for a low-speed urban street may be applied. The first curve near Parrell Road, contains a curve with an approximately 500’ radius. The minimum radius for a low speed, urban street should be 675’ to meet current design standards. This reduced radius may impact a driver’s ability to safely navigate the curve at the posted speed.

- **Sight Distance** — Through the same curve, traffic traveling west on Murphy Road has restricted horizontal sight distance due to objects, such as trees, located close to the roadway on the inside of the curve. Objects that can obstruct a drivers line of sight through a corner need to be set back a specific distance from the centerline of the inside lane to provide the necessary stopping sight distance. In this case, trees located approximately 18’ from the centerline of the inside lane restrict drive line of sight. To meet current safety standards, no objects that block line of sight should be closer than 23’ for this curve. This restriction reduces the safe stopping sight distance from the standard of 305’ to 267’ or from a design speed 40 mph to 35 mph.

- **Median Width** — To the east of the signalized intersection with SE 3rd Street, Segment 1 narrows down to an curb-to-curb width of 36’. This allows for two 12’ travel lanes and two 6’ bike lanes. As a Major Collector, the curb-to-curb width should be 52’ to also allow for a 16’ continuous center turn lane.

---

Segment 2: Parrell Road to Brosterhous Road
The list below summarizes geometric deficiencies for Segment 2. Design elements that meet standards are not discussed.

- **Pedestrian Facilities** — In this segment, there are limited sidewalks along most of the south side. Sidewalks are also lacking on the north side of Murphy Road from Parrell Road to Mel Court. Sidewalks should be at least 5’ wide on both sides of the roadway to meet minimum city standards. Any sidewalks constructed in the future will also need to meet ADA requirements, including wheelchair ramps at all intersection corners.

- **Horizontal Alignment** — As discussed above, the standards for a low-speed urban street are applied through this segment. This segment contains a horizontal curve by Mel Court, which does not meet current design standards. The radius of the curve is 400’. To meet current design standards the radius needs to be at least 675’. This reduced radius may impact a driver’s ability to safely navigate the curve at the posted speed.

- **Sight Distance** — Through the same curve, traffic traveling east on Murphy Road have restricted horizontal sight distance due to objects, such as trees, located close to the roadway on the inside of the curve. Objects that can obstruct a driver’s line of sight through a corner need to be set back a specific distance from the centerline of the inside lane to provide the necessary stopping sight distance. In this case, a group of trees located approximately 12’ from the centerline of the inside lane restrict drive line of sight. To meet current safety standards, no objects that block line of sight should be closer than 23’ for this curve. This restriction reduces the safe stopping sight distance from the standard of 305’ to 218’ or from a design speed 40 mph to 30 mph.

- **Median Width** — The entire length of Segment 2’s curb-to-curb width is 36’. This allows for two 12’ travel lanes and two 6’ bike lanes. As a Major Collector, the curb-to-curb width should be 52’ to also allow for a 16’ continuous center turn lane.

Existing Traffic Operations
The Murphy Road study area has been analyzed for motor vehicle operations for the existing (2006) P.M. peak hour conditions based on the existing roadway geometry and lane configuration. Traffic counts have been taken at the study area intersections in August and September 2006 for use in this analysis. These data are used to determine roadway operating conditions within the study area.

Study Intersections and Raw Traffic Counts
The intersections included in the Murphy Road corridor study are listed below. The only signalized intersection is SE 3rd Street and Murphy Road. The first 13 intersections exist today. The final two intersections are potential future intersections of Murphy Road and both SE 15th Street and SE 27th Street. See Figure 5 for study intersection locations, channelization, and traffic control.

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As part of this study’s next phase (future conditions), the extension of Murphy Road will be considered and analyzed. This analysis will look at the possibility of extending Murphy Road east to either SE 15th Street or SE 27th Street. This would create two new intersections, one at Murphy Road and SE 15th Street as well as Murphy Road and SE 27th Street. Because of this potential extension a description of SE 15th Street and SE 27th Street are provided.

Each of the study intersections is described below. Appendix A provides an overview of the traffic analysis methodology. Appendix B contains raw traffic volumes for each intersection.

- **SE 3rd Street and Murphy Road** – The intersection of Murphy Road and SE 3rd Street is controlled by a traffic signal. The west leg of the intersection is a driveway. Both SE 3rd Street approaches provided two-way traffic operations with two lanes per direction and left turn pockets. The north leg also provides a right turn pocket. SE 3rd Street classified by the City of Bend as a Principal Arterial with posted speeds of 45 miles per hour on each leg.

- **Parrell Road and Murphy Road** – Parrell Road provides two-way traffic with one lane per direction at the intersection with Murphy Road. It is currently stopped controlled on Parrell Road approaches with a posted speed of 40 miles per hour. Parrell Road is classified as a Major Collector by the City of Bend.

- **Country Club Road and Murphy Road** – Country Club Road is a two-way road with one lane in each direction at the Murphy Road intersection. Country Club Road has a posted speed of 40 miles per hour on the south leg and 25 miles per hour on the north leg. The south leg of Country Club road is striped with one lane in each direction. On-street parking is only allowed on the north leg of the intersection. Country Club Road is classified as a Major Collector south of Murphy Road by the City of Bend.
• **Brosterhous Road and Murphy Road** – Murphy Road currently terminates at Brosterhous Road. If Murphy Road is extended to the east, this will be the origin of the potential extension project. Brosterhous Road is a two-way road with one lane in each direction, has a posted speed of 40 miles per hour, and is functional classified by the City of Bend as a Major Collector.

• **SE 15th Street and Murphy Road** – If Murphy Road is extended to the east, it could intersect with SE 15th Street. Currently, SE 15th Street varies between 40 and 55 mph between Ferguson Road and Knott Road. Between these intersections, SE 15th Street is a two-way road with one lane per direction. It is currently classified as a Minor Arterial.

• **SE 27th Street and Murphy Road** – If Murphy Road is further extended to the east, it could also intersect with SE 27th Street. Currently, SE 27th Street has a posted speed of 45 mph between Ferguson Road and Knott Road. Between these roads, SE 27th Street operates as a three-lane roadway with one lane operating in both directions with a two-way left turn lane. SE 27th Street is currently classified as a Minor Arterial.

• **Powers Road and US 97/Bend Parkway (Southbound Ramps)** – The US 97/Bend Parkway southbound ramps join together to form a T-intersection with Powers Road; west of US 97 and on the south side of Powers Road. The southbound loop on-ramp provides access onto US 97/Bend Parkway for vehicles traveling on Powers Road in both the west and east directions. (Vehicles from the east on Powers Road that want to head south on US 97, proceed through the US 97 signalized intersection and turn left at this on-ramp.) Likewise the southbound off-ramp provides access to Powers Road in both directions and is stop controlled. Powers Road provides two-way traffic operations with one lane in each direction as well as a left-turn pocket for vehicles heading south onto US 97. Powers Road’s posted speed limit is at 35 mph. Powers Road and the parkway ramps provide bike lanes on both sides of the road.

• **Powers Road and US 97/Bend Parkway (Northbound Ramps)** – The intersection of Powers Road and the US 97/Bend Parkway is served by on and off-loop ramps that form a T-intersection; east of US 97 on the north side of Powers Road. The northbound on-ramp to US 97/Bend Parkway provides access for vehicles on Powers Road in both the west and eastbound directions. (Vehicles from the west on Powers Road that want to head north on US 97, proceed through the US 97 signalized intersection and turn left at this on-ramp.) Likewise, the northbound off-ramp provides east and west access for vehicles coming from US 97 and is the intersection’s stop-controlled approach. Powers Road provides two-way traffic operations with one lane in each direction with a posted speed limit is 35 mph. A left turn pocket onto northbound US 97 on-ramp is provided for vehicles coming from the west along Powers Road. The north leg of the intersection (US 97/Bend Parkway ramp) is stop controlled. Powers Road and the parkway ramps provide bike lanes on both sides of the road.

• **Parrell Road and Powers Road** – The intersection of Parrell Road and Powers Road is three-legged with Parrell Road being the stop controlled approach. There is a fourth approach to the intersection which generates a very low amount of traffic. Powers Road is the east and west road, while Parrell Road aligns to the north and south. Each leg of the intersection provides one travel lane in each direction. Parrell Road has striped shoulders on each side of the roadway. The posted speed limit on Parrell Road north of
Powers Road is 35 mph and south of Powers Road 40 mph. The speed limit on Powers Road, is posted at 35 mph. Both Parrell and Powers Roads are classified as Major Collectors.

- **SE 15th Street and Ferguson Road/Sherwood Forest Drive** – The intersection of SE 15th Street and Ferguson Road/Sherwood Forest Drive is four-legged and stop controlled on the Ferguson Road/Sherwood Forest Drive approaches. SE 15th Street runs north/south and has a speed limit of 40 mph. Ferguson Road is a skewed northwest approach with a speed limit of 40 mph. Sherwood Forest Drive is a skewed northeast approach that is a private road servicing a housing development. Ferguson Road is the only leg with bicycle lanes, which are on both sides of the roadway. All four legs provide one travel lane in each direction. SE 15th Street is classified as a Minor Arterial and Ferguson Road is classified as a Major Collector.

- **SE 27th Street and Ferguson Road** – The intersection of SE 27th Street and Ferguson Road is a three-legged intersection that is stop controlled on the Ferguson Road approach. SE 27th Street is a north/south arterial and has a posted speed limit of 40 mph. Ferguson Road is an east/west collector road that is eastern terminus is at SE 27th Street. Ferguson Road has a posted speed limit of 40 mph. The SE 27th Street south leg has one through lane and a left turn pocket, the north leg has a through lane and a right turn pocket. Ferguson Road provides a shared right/left turn lane. SE 27th Street is classified as a Minor Arterial and Ferguson Road is classified as a Major Collector.

- **US 97 and Ponderosa Drive/China Hat Road** – US 97 at Ponderosa Drive/China Hat Road is a four-legged intersection with the Ponderosa Drive/China Hat Road approaches being stop controlled. US 97 is a north/south facility with a speed limit of 55 mph. There are two general travel lanes in each direction, with right and left turn pockets in each direction at the intersection. The east leg of the intersection, China Hat Road provides one travel lane in each direction with a posted speed limit of 40 mph. China Hat Road widens at the intersection to provide a left turn pocket. The western leg of the intersection, Ponderosa Drive, provides one travel lane in each direction with a posted speed limit of 25 mph. The north, south, and east legs of the intersection have striped shoulders of varying width. US 97 is classified as an Expressway by ODOT and both China Hat Road and Ponderosa Drive are classified as Major Collectors by the City of Bend.

- **Knott Road and SE 15th Street/Tekampe Road** – The four-legged intersection of Knott Road and SE 15th Street/Tekampe Road is stop controlled on the SE 15th Street/Tekampe Road approaches. Knott Road is an east/west road with a posted speed limit of 40 mph to the west of the intersection and 45 mph to the east of the intersection. The north leg of the intersection is SE 15th Street has a speed limit of 40 mph while the south leg, Tekampe Road, has a speed limit of 25 mph. Each leg of the intersection provides a travel lane in each direction. Knott Road though provides east and westbound left turn pockets at the intersection. The north, east, and west legs have stripped shoulders of varying widths. Both Knott Road and SE 15th Street are classified as Minor Arterials. Tekampe Road is classified as a Local Road by the City of Bend.

- **Brookswood Boulevard and Pinebrook Boulevard** – The three-leg intersection of Brookswood Boulevard and Pinebrook Boulevard is stop controlled on the Pinebrook...
Boulevard approach. Brookswood Boulevard is a north/south road with a speed limit of 35 mph. Pinebrook Boulevard’s western terminus forms the T-intersection. The posted speed limit on Pinebrook Boulevard is 25 mph. Each intersection approach has one travel lane in each direction, as well as bike lanes. There is also a southbound left turn pocket on Brookswood Boulevard. Brookswood Boulevard is classified as a Minor Arterial and Pinebrook Boulevard is classified as a Local Road.

**Analysis Methodology**

Operational analysis of existing conditions for the thirteen study intersections was performed using Synchro analysis software. Appendix C provides the complete report output for each intersection.

Chapter 4.7 of the Bend Development Code (City of Bend Traffic Impact Analysis Development Requirements)\(^9\), the following operations standards define acceptable intersection operations within the City of Bend.

- **Two-Way Stop Control (TWSC):**
  - Delay for individual lane groups < or equal to 50 seconds,
  - V/C Ratio for individual lane groups < or equal to 1.0, and
  - 95th Percentile queuing is < or equal to storage length available.

- **All-Way Stop Control (AWSC):**
  - Delay for intersection as a whole < or equal to 80.0 seconds.

- **Roundabout:**
  - V/C ratio for the intersection as a whole < or equal to 1.0

- **Signalized Intersection:**
  - Delay for intersection as a whole < or equal to 80.0 seconds,
  - V/C ratio for the intersection as a whole < or equal to 1.0, and
  - 95th Percentile queuing is < or equal to storage length available.

The Level-of-service (LOS) of an intersection is based on the average total delay that a vehicle experiences at an intersection as outlined in the Highway Capacity Manual. The City of Bend only uses the average total delay, and not the corresponding LOS to determine if an intersection is operating at an acceptable level.

The Oregon Department of Transportation uses the V/C ratio of the major road and side street to determine acceptable intersection operations. For the intersections along US 97 that were located within ODOT’s jurisdiction, the following V/C standards were used.

- Major Road V/C Ratio < 0.90
- Side Street V/C Ratio < 0.80

\(^9\) Bend’s Traffic Impact Analysis (TIA) Development Requirements are found at [www.ci.bend.or.us/online_forms_and_documents/docs/Street_Policy_6_Traffic_Impact_Analysis_May_7_-3.doc](http://www.ci.bend.or.us/online_forms_and_documents/docs/Street_Policy_6_Traffic_Impact_Analysis_May_7_-3.doc)
Average Daily Traffic Volumes

Average daily traffic (ADT) volumes for key study roadways are reported in Table 8.

Since ADT field counts were only collected at two locations within the study area, the ADT for the majority of roadways were calculated using a peak factor ratio. ADT field counts were collected for both directions along SE 15th Street south of Ferguson Road (2004) and along SE 27th Street south of Ferguson Road (2006). A peak hour ratio (P.M. peak hour volume/ADT) was then calculated from each of these daily field counts. The average peak hour ratio from the two locations determined the study area’s peak hour ratio of 0.09.

Table 8
Average Daily Traffic Volumes

<table>
<thead>
<tr>
<th>Roadway Section</th>
<th>Direction</th>
<th>P.M. Peak Hourly Volume</th>
<th>ADT Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinebrook Blvd.– East of Brookswood Boulevard</td>
<td>E-W</td>
<td>380</td>
<td>4,220</td>
</tr>
<tr>
<td>Powers Road – West of Parrell Road</td>
<td>E-W</td>
<td>185</td>
<td>2,060</td>
</tr>
<tr>
<td>Parrell Road – South of Powers Road</td>
<td>N-S</td>
<td>285</td>
<td>3,170</td>
</tr>
<tr>
<td>Parrell Road – North of Murphy Road</td>
<td>N-S</td>
<td>180</td>
<td>2,000</td>
</tr>
<tr>
<td>SE 3rd Street – North of Pinebrook Boulevard</td>
<td>N-S</td>
<td>1,380</td>
<td>15,330</td>
</tr>
<tr>
<td>SE 3rd Street – South of Murphy Road</td>
<td>N-S</td>
<td>1,120</td>
<td>12,440</td>
</tr>
<tr>
<td>US 97 – South of China Hat Road</td>
<td>N-S</td>
<td>2,535</td>
<td>28,170</td>
</tr>
<tr>
<td>SE 27th Street – South of Ferguson Road</td>
<td>N-S</td>
<td>815</td>
<td>9,550</td>
</tr>
<tr>
<td>SE 15th Street – South of Ferguson Road</td>
<td>N-S</td>
<td>320</td>
<td>3,560</td>
</tr>
<tr>
<td>SE 15th Street – North of Knott Road</td>
<td>N-S</td>
<td>295</td>
<td>3,280</td>
</tr>
<tr>
<td>Murphy Road – West of Brosterhous Road</td>
<td>E-W</td>
<td>470</td>
<td>5,220</td>
</tr>
<tr>
<td>Murphy Road – West of Country Club Road</td>
<td>E-W</td>
<td>630</td>
<td>7,000</td>
</tr>
<tr>
<td>Murphy Road – West of Parrell Road</td>
<td>E-W</td>
<td>785</td>
<td>8,720</td>
</tr>
</tbody>
</table>

1 – ADT values were obtained by applying a peak hour ratio of 0.09 to the P.M. peak hour volumes. The peak hour ratio of 0.09 was obtained from an average of four field count locations: NB & SB SE 15th Street and NB & SB SE 27th Street
2 – Actual measured ADT is reported for the intersection of SE 27th Street/Ferguson Road.

Traffic Operations

Manual turning movement counts were collected for 15 intersections within the City of Bend on typical weekdays in August and September 2006. All counts were collected during the P.M. peak period (4:00-6:00 P.M.), which is when traffic volumes were determined to be highest on the study area roadways. These counts were collected to evaluate the existing roadways and intersection operations within the City of Bend. Appendices A - C provide a summary of the traffic methodologies, raw traffic data, and the raw traffic operational analysis results.

The operational analysis of the existing (2006) conditions is provided in Table 9 below.
<table>
<thead>
<tr>
<th>Intersection</th>
<th>Control Type</th>
<th>Existing (2006)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Powers Road at US 97/Bend Parkway (SB Ramps)</td>
<td>TWSC</td>
<td>0.29</td>
<td>12.3</td>
</tr>
<tr>
<td>Powers Road at US 97/Bend Parkway (NB Ramps)</td>
<td>TWSC</td>
<td>0.25</td>
<td>10.4</td>
</tr>
<tr>
<td>Parrell Road at Powers Road</td>
<td>TWSC</td>
<td>0.20</td>
<td>11.3</td>
</tr>
<tr>
<td>SE 15th Street at Ferguson Road</td>
<td>TWSC</td>
<td>0.18</td>
<td>11.6</td>
</tr>
<tr>
<td>US 97 at Ponderosa Drive/China Hat Road</td>
<td>TWSC</td>
<td>&gt;1.50</td>
<td>&gt;150</td>
</tr>
<tr>
<td>Knott Road at SE 15th Street/Tekampe Road</td>
<td>TWSC</td>
<td>0.26</td>
<td>25.5</td>
</tr>
<tr>
<td>Brookswood Boulevard at Pinebrook Boulevard</td>
<td>TWSC</td>
<td>1.03</td>
<td>107.7</td>
</tr>
<tr>
<td>SE 3rd Street at Pinebrook Boulevard</td>
<td>TWSC</td>
<td>&gt;1.50</td>
<td>&gt;150</td>
</tr>
<tr>
<td>SE 3rd Street at Murphy Road</td>
<td>Signal</td>
<td>0.75</td>
<td>20.6</td>
</tr>
<tr>
<td>Murphy Road at Parrell Road</td>
<td>TWSC</td>
<td>0.41</td>
<td>28.2</td>
</tr>
<tr>
<td>Murphy Road at Country Club Road</td>
<td>TWSC</td>
<td>0.25</td>
<td>16.6</td>
</tr>
<tr>
<td>Murphy Road at Brosterhous Road</td>
<td>TWSC</td>
<td>0.41</td>
<td>14.2</td>
</tr>
<tr>
<td>SE 27th Street at Ferguson Road</td>
<td>TWSC</td>
<td>0.40</td>
<td>20.7</td>
</tr>
</tbody>
</table>

1 – The maximum individual lane group volume-to-capacity ratio (v/c ratio) from the intersection analysis.
2 – For TWSC or AWSC intersections, reported delay is for the highest minor street lane group delay.

Information reported in **bold** font indicates higher than acceptable levels of congestion.

The table shows that three of the thirteen intersections are currently operating at unacceptable levels. For intersections within the City of Bend’s jurisdiction, the eastbound approach of Pinebrook Boulevard at SE 3d Street currently is operating at LOS F and the westbound approach of Pinebrook Boulevard at Brookswood Boulevard is operating at LOS F also. The westbound approach of China Hat Road/Ponderosa at US 97 lies within the Oregon Department of Transportation’s jurisdiction and currently operates at LOS F. The main reason for the high v/c ratios on these approaches is the difficulty in stopped vehicles finding a gap in the main street’s traffic stream. Therefore significant delay occurs on these approaches.

**Queuing Analysis**

The vehicle queue lengths at an intersection can impact overall operations by delaying and restricting the corridor’s ability to function adequately. Significant queues lengths can result in spillback into the main roadway section, thereby blocking side-street private driveways and hindering through traffic from proceeding even if that movement has a green signal, or blocking an upstream intersection from operating appropriately. Additionally, if the stop-controlled approach only provides one lane, traffic turning left can delay right-turning vehicles while they wait for a safe gap in the uncontrolled traffic stream to turn.
The existing vehicle storage length and 95th percentile queue\textsuperscript{10} length during the PM peak hour is reported for all stop controlled approaches at unsignalized intersections and for all approaches at the signalized SE 3rd Street at Murphy Road intersection. The Synchro software package was used to provide the queue lengths for all intersections except at US 97 at China Hat Road/Ponderosa Drive intersection where the Synchro/Simtraffic traffic simulation software package was used to abide by ODOT guidelines for intersections that operate over a v/c ratio of 0.70 (see Appendix D).

There are no queues that exceed past the pocket length. The intersections of US97/China Hat-Ponderosa, 3rd/Pinebrook, 3rd/Murphy, and Brookwood/Pinebrook all have at least one lane group that has a 95th percentile queue that exceeds 200 feet. Potential areas of concern for these intersections are with safety issues associated with the long queue or spillback of the queue to the previous intersection.

**Existing Utilities**

This section describes existing utilities within the Murphy Road Corridor. For the purposes of discussion, the corridor has been organized into the following four segments:

**Cascade Natural Gas**

Cascade Natural Gas is the utility service provider for the Murphy Road corridor. All of Cascade’s facilities are located underground and therefore will have minimal impacts while roadway improvements to Murphy Road are being constructed. Except for Segment 1, no new easements or right of way acquisition will be needed to remove/replace Cascade Natural Gas facilities.

- **Segment 1** – Along Segment 1, Cascade Natural Gas has an existing 2” gas main running along the south side of Murphy Road from SE 3rd Street to Parrell Road. Residential services are provided off of this 2” main. The eminent realignment of Segment 1 means consideration will be needed to determine the future location of this utility between SE 3rd Street and Parrell Road. The City of Bend will need to either have Cascade remove and relocate their existing gas main to Murphy’s new alignment or maintain an easement for their utility in its current location. Residential services will also need to be restored if the relocation of the main is decided upon.

- **Segment 2** – The 2” gas main continues into Segment 2 along Murphy Road’s south side to about Mel Court. Starting from about Mel Court east to Paulina Lane the 2” main changes over to a 4” main and runs along the south side of Murphy Road. Several residences and local cross streets are serviced off of these mains. Existing facilities like meters, for example, will need to relocated/adjusted to fit within the Murphy Road improvements.

- **Segment 3** – There are no existing gas facilities located in Segment 3, except for a 6” high-pressure main on SE 15th Street. The 6” main runs north to south along the west

\textsuperscript{10} The 95th percentile queue is defined as the queue threshold where 95% of queues experienced at a particular lane group are less than.
side of SE 15th Street. Coordination between proposed utilities and this gas line will be needed to minimize potential conflicts.

- **Segment 4** – In Segment 4, Cascade Natural Gas provides residential services from its 2” main, running under the neighborhood streets in the neighborhood just south of Ferguson Road. There is also a 2” and 4” main running north to south on SE 27th Street. Some work will be needed by the gas company to accommodate the location of the new Murphy Road alignment.

**Pacific Power**

Pacific Power is a power service provider for the majority of the Murphy Road corridor; their service area includes all of Segments 1, 2, and 3. Facilities along Murphy are located both above ground on poles and underground. Their utilities will probably have the largest impact to the proposed roadway improvements. The right of way acquisition needed to make Murphy Road meet city requirements should be adequate to provide Pacific Power room to relocate their utilities.

- **Segment 1** – Power lines run along the south side of Segment 1 on power poles spaced at about 225 feet apart. The eminent realignment of Segment 1 means consideration will be needed to determine the future location of this utility between SE 3rd Street and Parrell Road. The City of Bend will need to either have Pacific Power remove and relocate their existing power poles to Murphy’s new alignment or maintain an easement for their utility in its current location. There are also large transmission line towers running north to south along the eastside of SE 3rd Street. The towers along SE 3rd Street are spaced about 200 feet apart and consideration will be taken to avoid these towers, if possible, when new alignments for Murphy Road are discussed.

- **Segment 2** – The power poles continue along Segment 2 and are on the south side of Murphy Road from Parrell Road to Mel Court, from there the poles move over to the north side of the road. Also at various locations along this segment there are underground service lines, which cross over Murphy to serve residencies on the other side of the street. At Country Club Road the power poles cross over Murphy and run south along Country Club Road. From Country Club Road east along Murphy Road to Paulina Lane there are no existing power facilities except for a utility vault, which will need to be relocated to fit the roadway improvements. From Paulina Lane east to Brosterhous Road power poles are located on the south side of Murphy Road and are spaced at 215 feet apart. The power lines on Murphy then join lines running north to south along the west side of Brosterhous Road.

- **Segment 3** – There should be no conflicts with Pacific Power’s existing or proposed facilities along Segment 3’s roadway construction. The proposed development south of the proposed Murphy Road alignment will be serviced by Pacific Power via underground lines. Coordination between proposed utilities and underground power lines will be needed to minimize potential conflicts.

- **Segment 4** – There are no existing or proposed Pacific Power facilities located in Segment 4. This segment is Central Electric’s service area.
Central Electric

Central Electric is the power service provider for Segment 4 of the Murphy Road corridor. Their service area includes everything east of SE 15th Street within the project area. Their facilities along Segment 4 are both above ground on poles and are also underground sporadically around the area of interest. The right of way acquisition needed to help Murphy Road meet city requirements should be adequate to provide Central Electric room to relocate their utilities.

- **Segment 1** – There are no existing or proposed Central Electric facilities located in Segment 1. This segment is part of Pacific Power’s service area.
- **Segment 2** – There are no existing or proposed Central Electric located facilities in Segment 2. This segment is also part of Pacific Power’s service area.
- **Segment 3** – There are no existing or proposed Central Electric facilities located in Segment 3. This segment is also a part of Pacific Power’s service area.
- **Segment 4** – Central Electric is the power service provider for Segment 4 and has sporadic facilities in the area of interest. The neighborhood south of Ferguson Road is served off of transmission lines running along Ferguson. The majority of facilities in this neighborhood are underground lines servicing the residents, but there are also some various locations with overhead lines. Central Electric also has underground lines on the east side SE 27th Street running south from Ferguson to serve the Public Works building and to serve the local middle school.

USWEST/QWEST

USWEST/QWEST has facilities located along the majority of Murphy Road. There are telephone pedestals and utility locator poles at various locations along the road, which will need to be relocated to fit within the roadway improvements. The impacts to USWEST/QWEST facilities cannot be fully determined until more information is provided by USWEST/QWEST. The right of way acquisition needed to help Murphy Road meet city requirements should be adequate to provide USWEST/QWEST room to relocate their utilities.

- **Segment 1** – There is a utility locator pole marking the presence of underground utilities on the south side of Murphy Road about 2 feet behind the curb. The eminent realignment of Segment 1 means consideration will be needed to determine the future location of this utility between SE 3rd Street and Parrell Road. The City of Bend will need to either have USWEST/QWEST remove and relocate their existing underground utilities to Murphy’s new alignment or maintain an easement for their utility in its current location.
- **Segment 2** – There are several telephone pedestals/vaults and locator posts spaced along the north side of Murphy Road. Their utility features and lines will need to be relocated to fit the proposed roadway improvements. More information from USWEST/QWEST is needed to determine their extent of underground facilities.
**Segment 3** – There is no presence of there being any existing USWEST/QWEST facilities along Segment 3. Verification will need to be made on the location of existing utilities, if any exist.

**Segment 4** – There is no presence of there being any existing USWEST/QWEST facilities along Segment 4. Verification will need to be made on the location of existing utilities, if any exist.

**Avion Water**

Avion Water is the water service provider for Segment 4 of Murphy Road’s improvements and currently has no existing facilities in any of the other segments. Their service area includes the area east of SE 15th Street up to and including land east of SE 27th Street. Impact to their facilities from roadway construction should be minimal. The right of way acquisition needed to extend Murphy Road to SE 27th Street should provide room for Avion Water to relocate their utilities within the right of way.

**Segment 1** – There are no existing or proposed Avion Water facilities located in Segment 1. This segment is Roats Water service area.

**Segment 2** – There are no existing or proposed Avion Water facilities in Segment 2. This segment is Roats Water and City of Bend Water Department’s service area.

**Segment 3** – There are no existing or proposed Avion Water facilities in Segment 3. This segment is part of City of Bend Water Department’s service area.

**Segment 4** – Avion Water is the water service provider for all of Segment 4. They have a 12” water main running north to south along SE 15th Street and also have 8” water mains running under most of the streets in the neighborhood south of Ferguson Road. An 18” main also runs north to south in the field east of the neighborhood and there is also a 10” line on SE 27th Street. Some work maybe needed to accommodate the location of the new Murphy Road alignment.

**Roats Water**

Roats Water is the water service provider for Murphy Road’s Segment 1. Their service area also includes the area east of Parrell Road along Murphy Road to Country Club Road. The impacts to Roats Water facilities cannot be fully determined until more information is provided. The right of way acquisition needed to meet city requirements should provide room for Roats Water to relocate their utilities within the right of way.

**Segment 1** – Roats Water provides water service to all residents and businesses along Segment 1 of Murphy Road. The locations and sizes of water mains to be affected by Murphy Road improvements have not been determined at this time. The eminent realignment of Segment 1 means consideration will be needed to determine the future location of this utility between SE 3rd Street and Parrell Road. The City of Bend will need to either have Roats Water remove and relocate their existing underground utilities to Murphy’s new alignment or maintain an easement for their utility in its current location.

**Segment 2** – Roats Water also provides water services to a portion of Segment 2. They provide water service to all residences west of Country Club Road. Water service east of
Country Club Road is provided by the City of Bend Water Department. Water main location and sizes have not been determined at this time.

- **Segment 3** – There are no existing or proposed Roats Water facilities in Segment 3. This segment is part of City of Bend Water Department’s service area.

- **Segment 4** – There are no existing or proposed Roats Water facilities in Segment 4. This segment is part of Avion’s water service area.

### City of Bend Water Department

The City of Bend is the water service provider for a portion of Segment 2. Their service area includes everything along Murphy Road east of Country Club Road to SE 15th Street. The impacts to the City’s Water facilities cannot be fully determined until more information is provided. The right of way acquisition needed to meet city requirements should provide room for the Water Department to relocate their utilities within the right of way, if needed.

- **Segment 1** – There are no existing or proposed City Water facilities in Segment 1. This segment is part of Roats Water service area.

- **Segment 2** – The City of Bend and Roats Water provides water service to Segment 2. The City of Bend provides water to residences east of Country Club Road. The size and locations of existing water mains have not been determined at this time, but the impact to their facilities should be minimal.

- **Segment 3** – It has been determined that the City of Bend has existing water facilities located in Segment 3 from the presence of utility locate poles in the grass field west of SE 15th Street. These utility locate poles are used as a warning to existing underground facilities in the area. The size and depth of this existing main is still to be determined.

- **Segment 4** – There are no existing or proposed City of Bend water facilities in Segment 4. This segment is part of Avion’s water service area.

### Next Steps

The next task will explore how expected residential and employment growth in Bend will impact the Murphy corridor over the next 20 years. Potential improvements to rectify current deficiencies and accommodate future growth will be developed and tested, with the objective of identifying one preferred set of improvements to recommend in the corridor study.