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TECHNICAL MEMORANDUM

Basin Transit Services - Transit Development Plan Update

Transit Design Toolbox

Date: March 7, 2013 Project #: 12799

To: Project Management Team & Project Advisory Committee

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The purpose of this memorandum is to document transit design alternatives for Basin Transit Service (BTS). The focus of these design alternatives include:

- Transit Vehicle Guidelines
- Transit route modification thresholds and guidelines
- Transit stop criteria (location, spacing, amenities)
- Dial-A-Ride Operations
- Transit signal priority guidelines
- Transit supportive land use guidance
- Transit Facility Guidelines

The following sections address these focus areas and are intended to provide BTS with guidance for future transit system upgrades or modifications. The content of this memorandum is based on best practices observed within other transit service districts throughout the country.

TRANSIT VEHICLE GUIDELINES

The vehicle spare ratios for the fixed and DAR system should be kept at 1 spare for each 5 vehicles in regular service. The largest bus for Basin Transit Service is a 40’ long, 8.5’ wide Gillig. The physical characteristics of this bus should be considered in all transit related street design issues. Because the bus is similar to the American Association of State Highway and Transportation Officials (AASHTO) City Transit Bus (CITY-BUS) this design vehicle should be used in determining transit related geometric design requirements. Exhibit 1 depicts the front and side views of the standard bus and summarizes its’ critical dimensions and clearance requirements. The DAR vehicles are 28.75 feet long and 8 feet wide. These vehicles are much smaller than the larger buses described previously. However, route design should consider the ability for such buses to traverse the roadway network. The bus dimensions for such vehicles are shown in Exhibit 2.

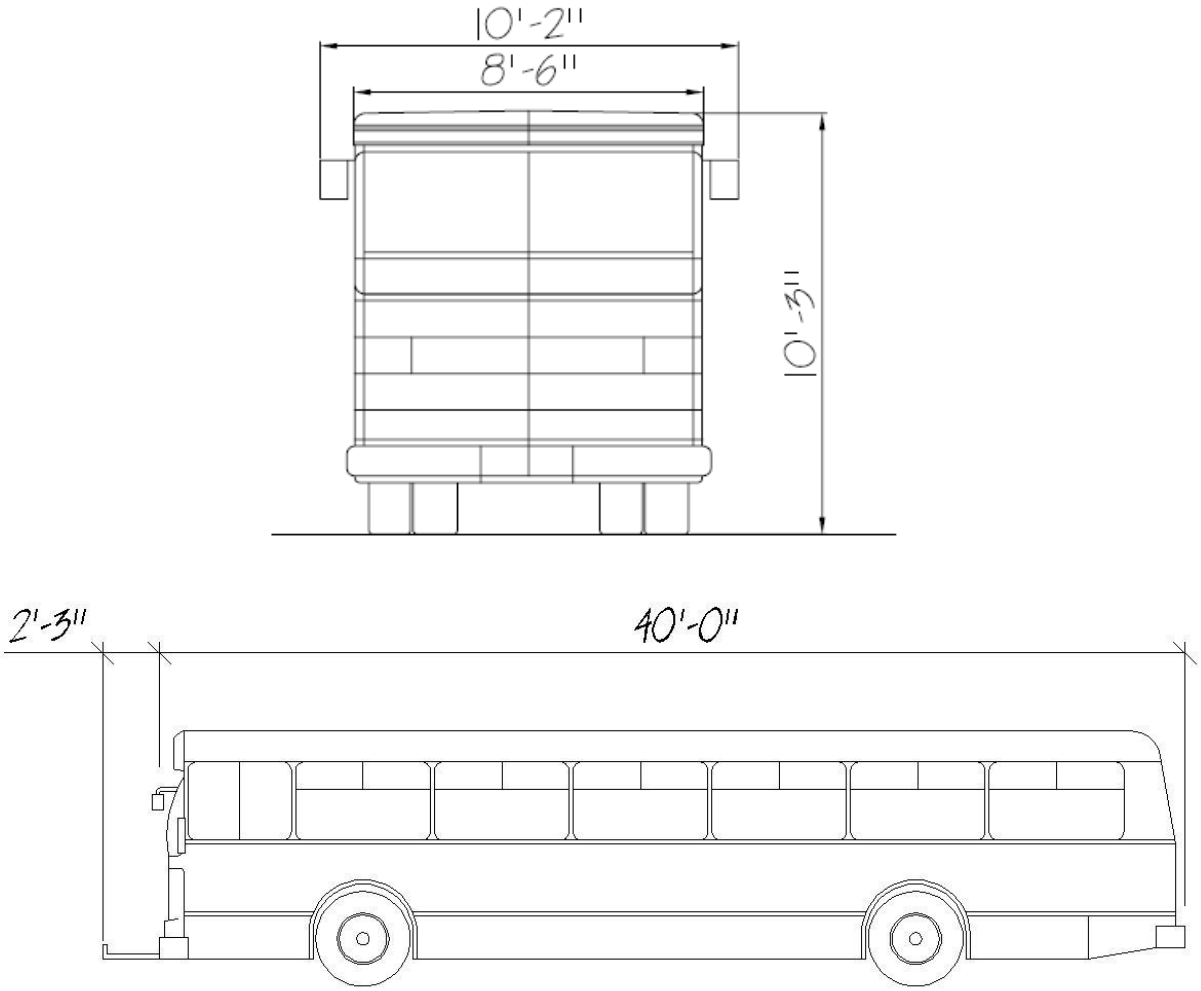

Exhibit 1: Standard 40-foot bus dimensions

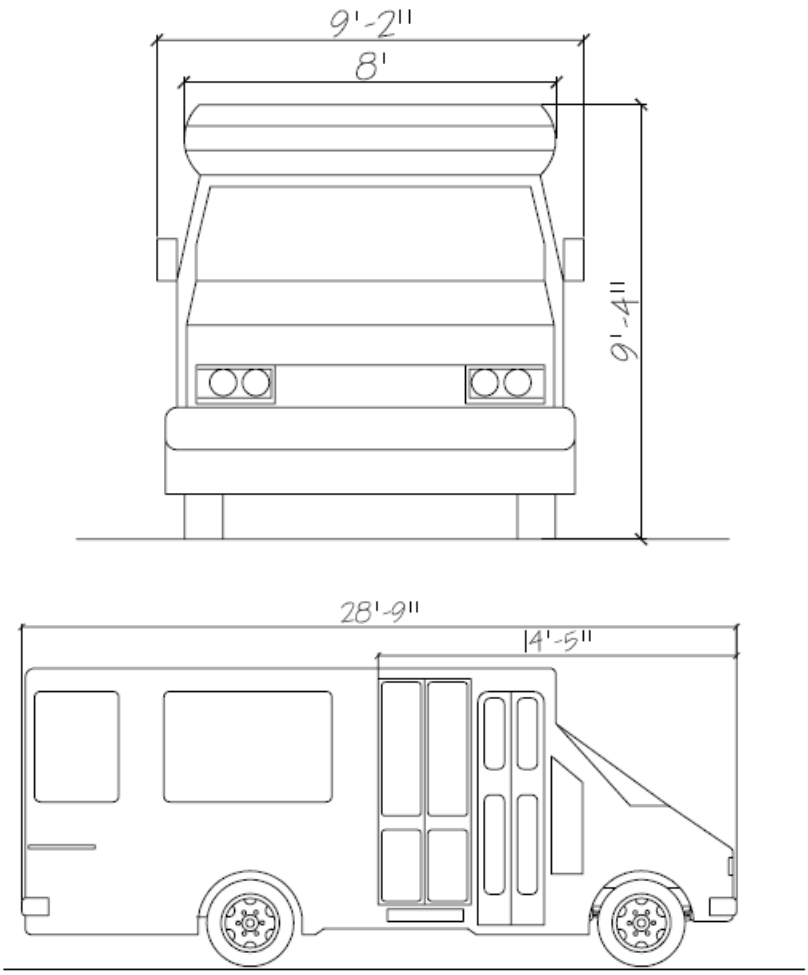

Exhibit 2: Dial-A-Ride bus dimensions

TRANSIT ROUTE MODIFICATION THRESHOLDS AND GUIDELINES

As the BTS area experiences changes to land use and population, it will be necessary to review the current fixed route buses, their frequency and schedules. A systematic review of these items should occur on a regular basis with normal schedule changes to occur not more than once every two years. This review should incorporate estimates of ridership changes in the system, a consideration of current operations for schedules and areas served, along with the ability to acquire and maintain proper equipment all within the limits of the financial capabilities of BTS.

The basis for the fixed route bus review should consider the following criteria:

- Buses on those routes appearing to be overcrowded - Identify the number of the peak hours per day fixed route passenger usage is exceeding 110% of the bus seating capacity and the number of non-peak hours with greater than 95% of the seating capacity occupied

- Bus run times are exceeding schedule run times by more than 5 minutes more than 20% of the scheduled routes
- Shifting population or planned development with high residential densities or major commercial/institutional components are moving into the design and construction phases

TRANSIT STOP CRITERIA

The location and design of transit stops are essential for Basin Transit Service to efficiently and comfortably meet the needs of its passengers. The following guidelines are factors that should be considered when new transit stops are being planned or when existing stops are being relocated or modified.

Transit Stop Location

When siting potential stop locations, as much of the following criteria as possible should be met:

- The roadway design speed is less than or equal to 45 mph.
- There is adequate space in the right-of-way for the bus stop sign and the potential addition of a transit shelter or bench.
- ADA access can be provided for passengers with disabilities.
- The stop is located to adequately serve nearby trip generators with access to walking routes to facilities.
- Connections exist to pedestrian facilities.
- Pedestrian street crossing options are nearby.
- Street/bus stop lighting is provided.
- Adequate curb length is present to accommodate the bus stop zone in curb side locations

When a general location for a site has been determined, the specific location of the site should consider the following:

- Stops should be located at intersections where other traffic has the opportunity to get past a stopped bus (i.e., streets with 2 or more travel lanes in a given direction or when a bus bay is provided).
- Stops should be located so that passengers are not forced to wait for a bus in the middle of a driveway.
- The stopped bus should not block a driveway.
- Stops should be located so that patrons board or alight directly from the stop area rather than from the driveway.

- Stops should be located so that the front door ADA landing pad is located outside a driveway area.
- Consider relocating a bus stop to a downstream parcel should a corner location prove to be unacceptable.

Near-Side Stops

Near-side stops should be located at least 100 feet in advance of the intersection in order to avoid conflicts with vehicles. Use nearside stops on two lane roads, where vehicles are restricted from going around the bus, in order to prevent the stacking of vehicles in the intersection. Near-side bus stops are also appropriate:

- at signalized intersections with transit signal priority;
- when the bus must stop in the travel lane because of curb-side parking in order for the front door of the bus to access an intersection and crosswalk;
- in combination with curb extensions or bus bulbs to provide direct access from the bus to the sidewalk; and,
- in a right-turn lane if a queue jump signal is provided to allow the bus to merge back into the travel lane and if accompanied by a sign on the side of the road.

Avoid near-side stops at intersections with dedicated right-hand turn lanes where right-on-red turning is permitted.

Mid-Block Stops

Mid-block stops are generally to be avoided. They are only appropriate when:

- route alignments require a right turn and the curb radius is short; the distances between intersections is unusually long and major transit generators are located mid-block and cannot be served at the nearest intersection; and,
- a pedestrian crossing is provided, accompanied by pavement markings, signage, and road lighting.

Far-Side Stops

Far side stops can result in fewer traffic delays, provide better vehicle and pedestrian sight distances, and cause fewer conflicts among buses, cars, pedestrians and bicyclists. They are recommended for use under these circumstances:

- in areas where the right-of-way permits cars to pass the bus and especially in areas where a near-side stop will impede other motorists;

- where a route alignment requires the bus to turn left before stopping; and,
- where buses can take advantage of progression provided to general traffic (i.e., where bus stops are separated by 2 or more traffic signals).

Table 1 lists the minimum distances between the point of bus traffic re-entry and any upstream bus turning movement at various speeds.

Table 1 - Far-Side Bus Stop Placement

Design Speed (MPH)	Minimum distance between point of bus traffic re-entry and any upstream turning movement
20 - 35	75 feet
40	75 feet
45	100 feet
50	135 feet

Roundabouts should be treated similarly to conventional intersections. The goal when locating a bus stop in relation to a roundabout should be to avoid the queuing of vehicles back into the circulatory roadway. Since the bus stop should, where possible, be located on the far side of the roundabout after the exit, the stop should either utilize a bus bay or be far enough downstream from the splitter island to avoid a long queue from interfering with circulation within the roundabout.

A depiction of near-side, far-side, and mid-block stop locations is shown in Figure 2.

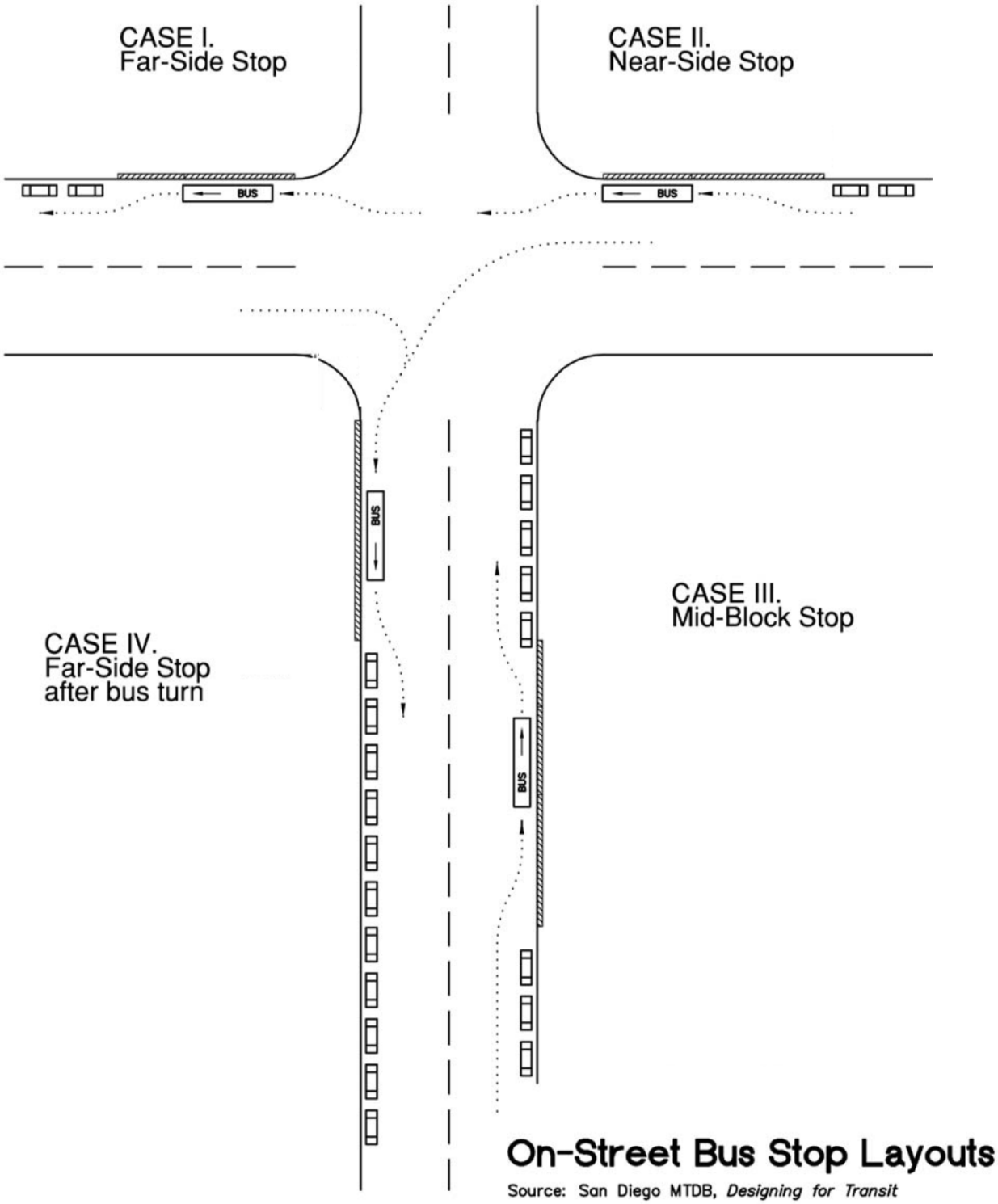

Figure 2: Bus Stop Layout Example

Special Consideration for Schools

Transit facilities near schools should have the following safety related measures:

- near primary schools, stops should be placed in an area where they can be visually monitored by school personnel and/or crossing guards to increase security; and,
- mid-block stops near schools are not recommended.

Transit Stop Spacing

Bus stop spacing should be related to the ridership density with stops being close together at major commercial areas (i.e. Central Business District) and farther apart in the outlying areas. Increasing the density of stops can lead to a more accessible system for users; however, increasing stop density too much can lead to slower service, schedule reliability issues, and excessive maintenance costs.

Table 2 shows observed spacing ranges for four different area types based on two research reports conducted by the Transit Cooperative Research Program (TCRP) and National Cooperative Highway Research Program (NCHRP). Given that the areas surveyed typically have higher density and more transit demand than the Klamath Falls area, BTS should expect that an appropriate stop spacing density for its system would be near the upper ends of the ranges shown below. However, if a particular service area has increase ridership demand, land use density, or both, higher transit stop density should be considered.

Table 2 - National Transit Stop Spacing Averages

	TCRP Report 19	NCHRP Report 69
	Range (feet) (typical spacing)	Range (feet)
High Density Residential Areas, CBDs, and Major Employment Centers	300-1000 (600)	440-528
High Density Residential/Employment Centers	500-1000 (750)	660-880
Suburban Residential Areas	600-2500 (1000)	1056-2640
Rural Areas	650-2640 (1250)	1320-2640

For the BTS area the suggested bus stop spacing is as follows:

Major Commercial area (i.e. CBD)	500 – 800 feet (appx. 6-10 stops per mile)
Urban Area	700 – 1,000 feet (appx. 5-7 stops per mile)
Outlying/Rural area	1,200 – 1,800 feet (appx. 3-4 stops per mile)

Transit Stop Amenities

The provision of bus stop amenities can range from a simple bus stop sign to a full shelter treatment. The type of bus stop improvements is usually based upon the number of persons using the stop or if it is a transfer point between routes. Requests for bus stop improvements should be documented including the results of the review.

Bus Stop Sign - At a minimum, each bus stop should have a bus stop sign facing the approaching direction of bus travel. For bus driver recognition in dark service times, the signs should be printed on a high intensity reflective sign material. The design of the sign should include the standard bus stop logo and if a transfer location the numbers of all bus routes serving that location. For Transfer points, it is critical to provide bus route signage that shows where the transfer buses will be stopping. This reduces passenger confusion and allows for better coordination between routes.

Bus Stop Pads - Bus stops that have accessible pedestrian access should include a surfaced bus stop pad meeting ADA criteria. The pads provide a clear waiting area out of the dirt and mud, provide a base area for the deployment of the bus ramp/lift access and promotes a good image to the ridership.

Stop Benches or Seats - The placement of bus stop benches or seats should be based upon the number of boarding passenger per day and should be considered when these numbers are greater than 10 passengers per day. There may also be special circumstances when passengers with special needs need a bench or seat while waiting.

Bus Shelters – Shelters should be used at transfer points when the daily passenger boarding's approach 20 passengers per day. Due to the high maintenance cost of shelters (cleaning, vandalism, lighting, etc.) the placement of shelters must be carefully reviewed. Shelters should be designed to allow good driver visibility of the interior of the shelter as the bus approaches. The shelter should be covered and provide wind breaks.

Bus Stop Lighting – It is very important that bus stops and shelters be located so the bus stop area has lighting provided by a light at the stop or an adjacent street light. This is important for safety concerns, driver recognition of passengers waiting, and roadway drivers seeing the waiting passengers. All transfer centers must have lighting providing access roadway lighting along with shelter lighting.

Trash Containers – Providing trash containers helps to keep a clean stop appearance. However, the maintenance costs for pickup and cleaning of the trash is a concern. BTS should consider a volunteer program in which the adjacent property owner empties the trash on a regular basis. This has been successful in other locations as adjacent property owners typically desire a well maintained stop with a clean appearance. It is very important to service trash containers on the buses to help reduce the trash collection at the stops. At a minimum, trash containers must be provided at transfer points.

Bus Stop Schedules and Route Maps – Providing visual information at each stop showing the bus route and the schedule times is a definite service to the traveling public. At a minimum, all bus schedules and maps need to be displayed at any transfer point. The maintenance of the schedules is critical and BTS should develop a plan to implement the placement of bus stop schedules at all stops over a five year period.

Americans with Disabilities Act (ADA) Guidelines

ADA standards ensure that public facilities are accessible for all users. Specific requirements of this act apply to the construction or alteration of transit stop amenities. The following guidelines should be considered when new or modified transit stops are being constructed.

- New or altered transit stop at a location where an existing (possibly non-ADA compliant) sidewalk exists:
    - Provide a minimum 5-foot by 8-foot clear paved landing pad at the stop and, if necessary, a paved connection to the sidewalk that meets the PROWAG width/grade/surface requirements for a pedestrian access route (R302). No modification to the existing sidewalk is required, but would be desirable to maximize the stop's accessibility (see the discussion of agency coordination below).
    - A bench and/or shelter can be provided, provided that the landing pad and sidewalk are not obstructed and that the required clear area(s) and an accessible route to the boarding area are provided.
- New or altered transit stop at a location without sidewalks and local design standards call for sidewalks when the road is modernized.
    - Provide a minimum 5-foot by 8-foot clear paved landing pad at the stop.
    - Provide a compliant sidewalk connection to the nearest intersection, including a curb ramp. *This provides a street connection as required by R308.1, as any informal pedestrian path that may exist at the site is highly unlikely to meet the "pedestrian circulation path" requirements for firmness, slip-resistance, smoothness, etc. In addition, court cases have held that even though transit agencies are not the lead agency for providing sidewalks, a pattern of installing stops at inaccessible locations violates the "equal access" provisions of the ADA*

and transit agencies have been required to fund access improvements to stops. Furthermore, installing a bench or shelter at an existing stop would also violate the "equal access" provision, as a new facility has been provided that is not accessible by all. The stop is recommended to be located as close to the intersection as practical, both to reduce construction costs and to encourage passengers to cross the roadway at the intersection.

- A bench and/or shelter can be provided, provided that the landing pad and future sidewalk are not obstructed and that the required clear area(s) and an accessible route to the boarding area are provided.

- New or altered transit stop at a truly rural location where no sidewalks would be installed when the road is modernized and a paved shoulder or low-volume intersecting road is intended to serve as the pedestrian route.
  - Provide a minimum 5-foot by 8-foot clear paved landing pad at the stop. Connect the landing pad to the roadway (or the intersecting roadway) via an accessible route and ramp.
  - A bench and/or shelter can be provided, provided that the landing pad and accessible route between street and boarding area are not obstructed and that the required clear area(s) and an accessible route to the boarding area are provided.
- If none of the above can be met a different location for the transit stop should be considered.

BTS should coordinate with the city and county when programming stop alterations to take advantage of possible capital cost savings when both the transit stop and connecting sidewalk/curb ramps are upgraded at the same time. Providing accessible routes to transit stops can potentially reduce paratransit operating costs, as persons with disabilities can better use the lower-cost fixed-route system, as well as make the transit service more convenient (and attractive) to all users.

DIAL-A- RIDE (DAR) OPERATIONS REVIEW

The ADA required Dial-A-Ride operation is a key component of the BTS package of transportation services. Due to the much higher DAR cost per passenger versus the fixed route service, a continuous monitoring of the DAR effort is critical. Currently BTS uses the fixed route, the DAR and the hybrid "Extended Service" which combines rides on the fixed route with van service to reach areas not directly served by the fixed route service.

Key elements that would trigger an operational analysis and review should include:

- Subscription service requests regularly exceeding the 50% maximum subscription trip usage

- Additions/deletions in the fixed route bus operation that affect the DAR schedule
- Requests for the extended service

TRANSIT SIGNAL PRIORITY GUIDELINES

One of the methods to improve transit route times is through transit signal priority. As traffic volumes grow over time, congestion increases causing a general slowing of traffic speeds which affect the bus speeds. A large number of cities around the nation have installed traffic signal preemption systems to enhance emergency vehicle response throughout their area. This technology has been adapted in a number of locations to allow for transit vehicles to get a lower-priority extension of the green signal or an earlier return to green if the signal is already red. The ability to use the signal pre-empt relies upon the signal operator to allow the installation of both the high and low priority connections. While not an issue at this time, BTS should monitor proposed signal changes with the signal operators for any opportunity to include low priority transit signal pre-emption.

TRANSIT SUPPORTIVE LAND USE GUIDANCE

Similar to the issues identified in the BTS goals and objectives, a key to future changes in the service deal with how new residential and commercial/institutional development design is accomplished. A review of the current relationships between BTS and their planning and public works partners at the City of Klamath Falls and Klamath County show this effort works well and needs to be on-going. Transit access and ridership is improved through development design when 1) at least one potential through transit street, 2) physical pedestrian access links between all parts of the development area and the transit street, 3) pedestrian access links from the commercial development directly to the transit roadway/bus stop constructed as part of the development.

TRANSIT FACILITY GUIDELINES

In addition to providing for the review of the vehicles and their operations, BTS needs to maintain a long-term facilities plan to ensure they continue to have proper maintenance and administrative facilities available. The current location includes a combined administrative, operations and maintenance facility along with some vehicle storage on adjacent lots. A long-term facilities plan would address the specific needs to handle the projected growth in the system. The plan should include the building and equipment needs for administration and operations along with maintenance areas. Typical items would look at the need to acquire additional land adjacent to the current site to allow for growth of the system, any changes to the communications system, updated maintenance equipment, vehicle storage areas, transit and employee parking areas, and other needs.

The long-term facilities plan should also include sections on bus stop improvements, transit center upgrades as needed, along with improvements to the fare collection and data gathering systems. Continued advances in the type and complexity of these ITS systems will work to improve the system information and help BTS make system decisions based upon good information.