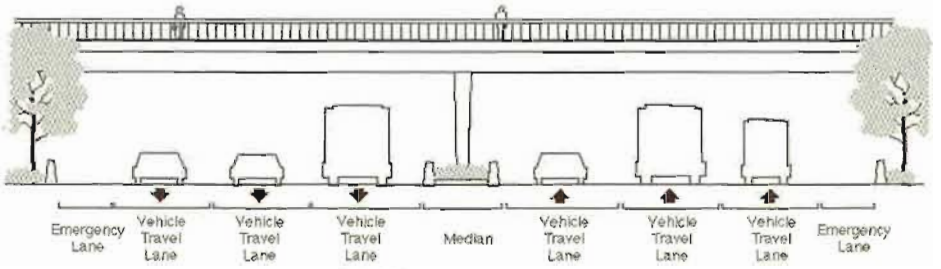
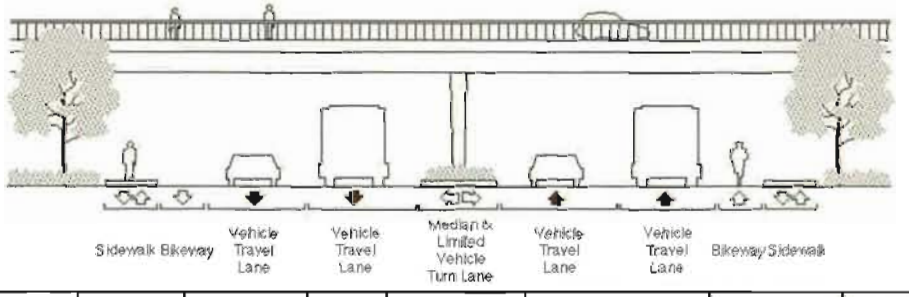
# Summary of Street Design Components



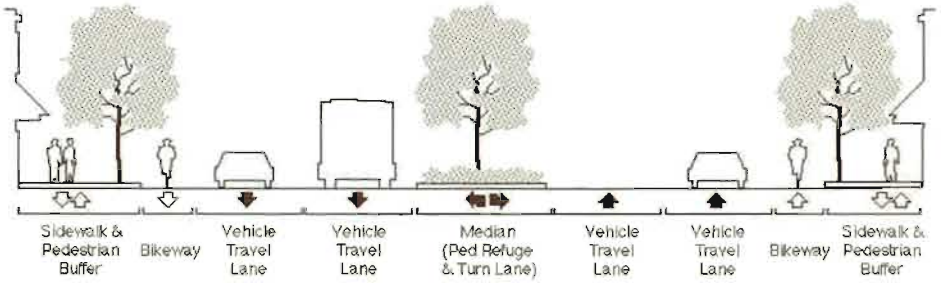

## Freeway

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Any District | Never | Usually 4-6; additional lanes in some situations | High | No | Few; always with separated grades | None | Emergency only | Through-service supported with amenities only at station areas; transit priority where appropriate at interchanges | None | On overpasses | Usually parallel | Primary freight routes |



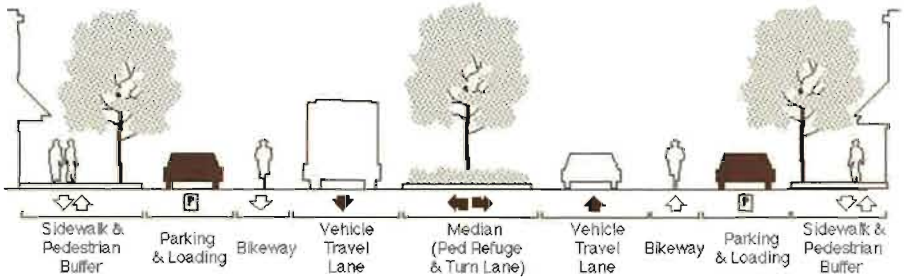

## Highway

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Any District | Never | Usually 4-6; additional lanes in some situations | High | In some locations | Few; mix of separate and at-grade | Few to none | Usually prohibited | Through-service supported with amenities only at station areas; transit priority designs where appropriate at intersections | Minimum sidewalk width with optional buffering | On overpasses and at intersections | Striped | Primary freight routes |



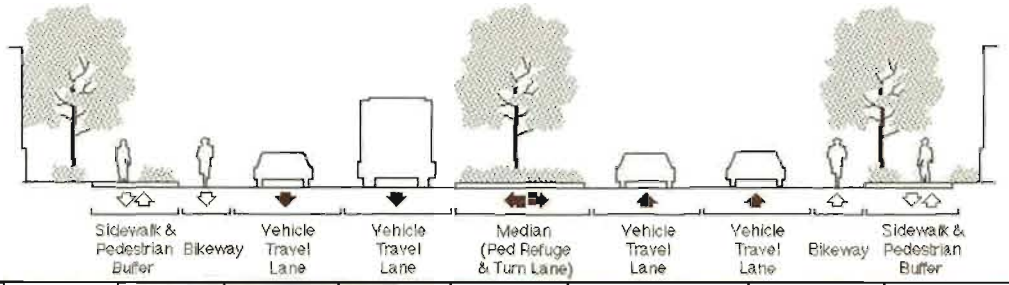

## Regional Boulevard

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Central City, Regional Center, Station Community, Some Main Streets, Town Center | Usually | Usually 4: additional lanes or couplets in some situations | Low to moderate | Yes, mix of medians and turn lanes designed as pedestrian refuge | Many | Some (combined when possible) | Usually | High-quality service supported with substantial amenities at stops and station areas | Maximum sidewalk width with buffering, special lighting and crossing amenities | At all intersections | Striped or shared | Primary freight routes; provide access to markets with loading amenities within the right of way |



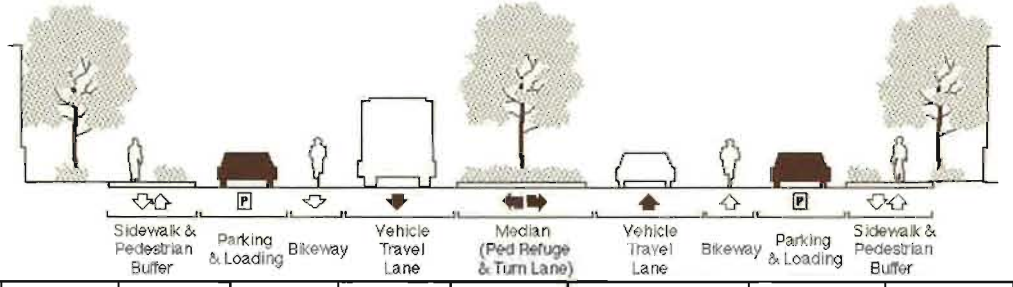

## Community Boulevard

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Central City, Regional Center, Station Community, Some Main Streets, Town Center | Usually | Usually 2: 4 in some situations | Low | Mix of medians and turn lanes that provide pedestrian refuge | Many | Some (combined when possible) | Usually | High-quality service supported with substantial amenities at stops and station areas | Maximum sidewalk width with buffering, special lighting and crossing amenities | At all intersections | Striped or shared | Secondary freight routes; provide access to markets with loading amenities within the right of way |



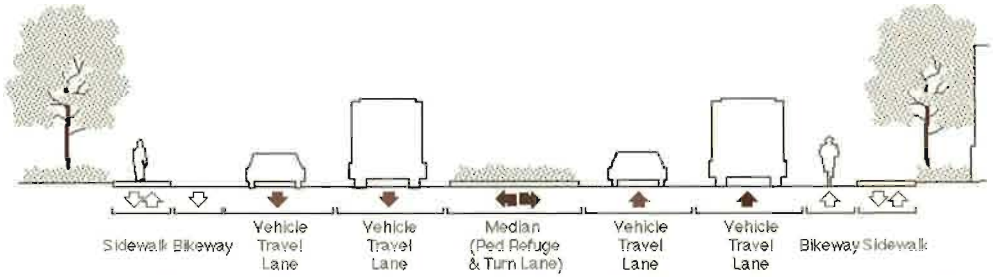

## Regional Street

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Corridor, Some Main Streets, Inner Neighborhood, Outer Neighborhood | All major intersections and transit stops | Usually 4; add'l lanes in some situations | Moderate | Mix of medians and turn lanes that provide pedestrian refuge | Some to many | Few (combined when possible) | Allowed | High-quality service supported with amenities at major stops and station areas | Moderate sidewalk width with buffering; lighting and special crossing amenities tied to major transit stops | At signaled intersection | Striped or shared | Primary freight routes; provide access to markets and may include loading amenities within the right of way |



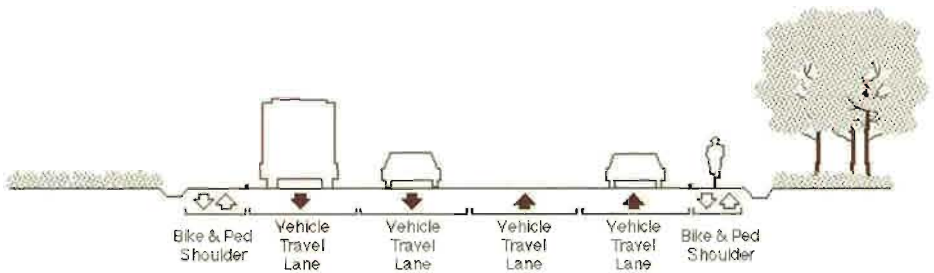

## Community Street

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Corridor, Some Main Streets, Inner Neighborhood, Outer Neighborhood | At major intersections and transit stops | Usually 4; less in some situations | Moderate | If possible, designed as a pedestrian refuge | Some to many | Some (combined when possible) | Allowed | High-quality service supported with amenities at major stops and station areas | Moderate sidewalk width with buffering; lighting and special crossing amenities tied to major transit stops | At signaled intersection and some mid-block locations | Striped or shared | Secondary freight routes; provide access to markets and may include loading amenities within the right of way. |




## Urban Road

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Employment Center, Industrial Area | Rarely | Usually 4; additional lanes in some situations | Moderate | Yes | Some | Few | Rarely | Limited service supported with limited amenities at major stops | Minimum sidewalk width with optional buffering | At major intersections | Striped | Primary freight routes |




## Rural Road

| 2040 Design District | Buildings Oriented Toward Street | Vehicle Travel Lanes | Vehicle Speed | Turn/ Median | Street Connect | Drive-ways | On-Street Parking | Transit Amenities | Pedestrian Amenities | Improved Ped Xings | Bikeways | Freight Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rural Reserve, Green Corridor | Rarely | Usually 2-4; additional lanes in some situations | Moderate | Sometimes | Some | Few | Rarely | Through-service supported with limited amenities at major stops | Bike/ped striped shoulder | None | Bike/ped striped shoulder | Primary freight routes |

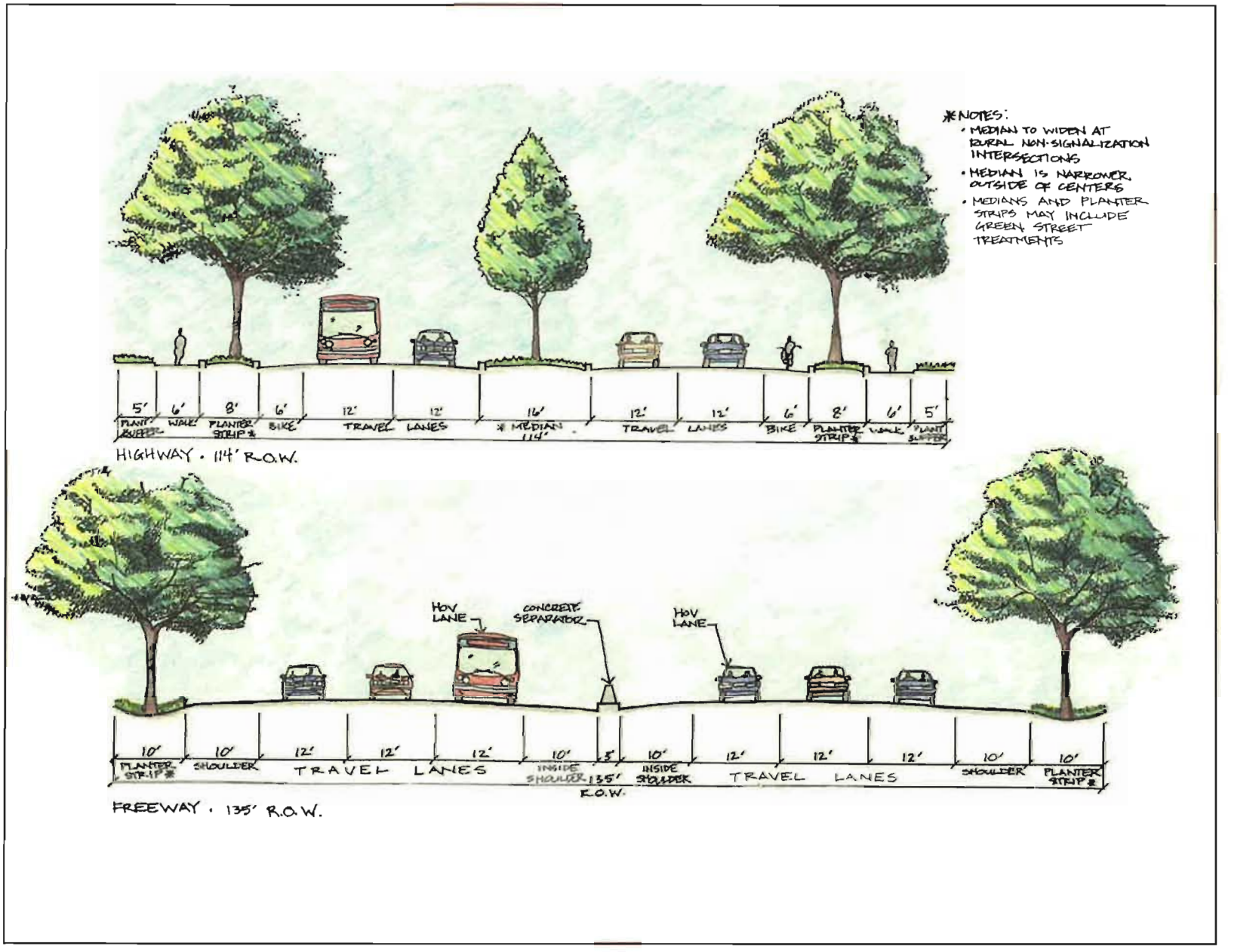



*Figure 28. Typical throughway design types: highway and freeway. These facilities are dominated by vehicles.*

## Street types

### Regional boulevard

Regional boulevards have a broad right of way consisting of four or more multi-modal travel lanes. They are located within the most intensely developed centers with development oriented toward the street. Desirable features include bike lanes and wide sidewalks.

Due to width, a higher capacity swale should be used to accommodate runoff from the larger collection area. However, secondary design solutions such as street tree wells and infiltration trenches also are useful in attenuating runoff and directing it into the swale. The swale itself should be located in either a central median or a side median adjacent to a local access lane to avoid conflicts with on-street parking and pedestrian movement. In order for a swale to be most effective, the preferred minimum length should be 250 feet (although lower residency times and lengths are acceptable for some jurisdictions) requiring a compromise between swale effectiveness and vehicle turning opportunities.

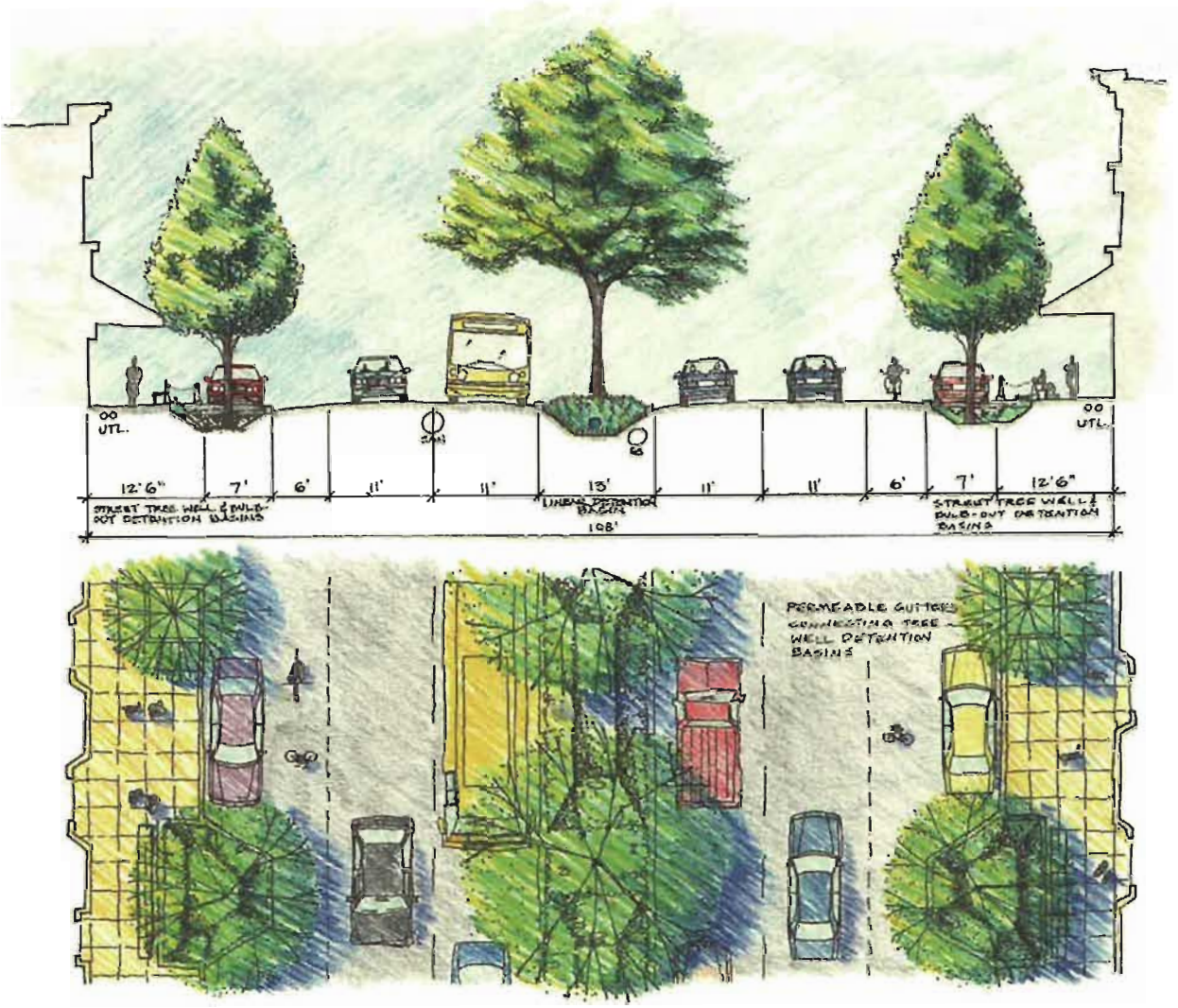



*Figure 6-1*
*Regional Boulevard with Median Linear Detention Basins*


*Figure 6-2*
*Double Median Boulevard with Bio-Filtering Swales*

- Absolute minimum width – 90 feet. At this width, the central median is reduced to 11 feet. Detention basins are still possible, but with a more limited capacity if side slopes of 3:1 are to be maintained. Greater capacity is possible with steeper slopes, but a barrier between the inside travel lane and basin may need to be constructed. This width still allows for left-turning movements, but without a central pedestrian refuge island. The reduced sidewalk width severely inhibits the planting of street trees, although grated detention basins with modest surface planting still are possible. Street tree planting is limited to bulb-outs within the parking lane. Incorporating a desired level of street tree planting may require a more significant tradeoff with on-street parking spaces.

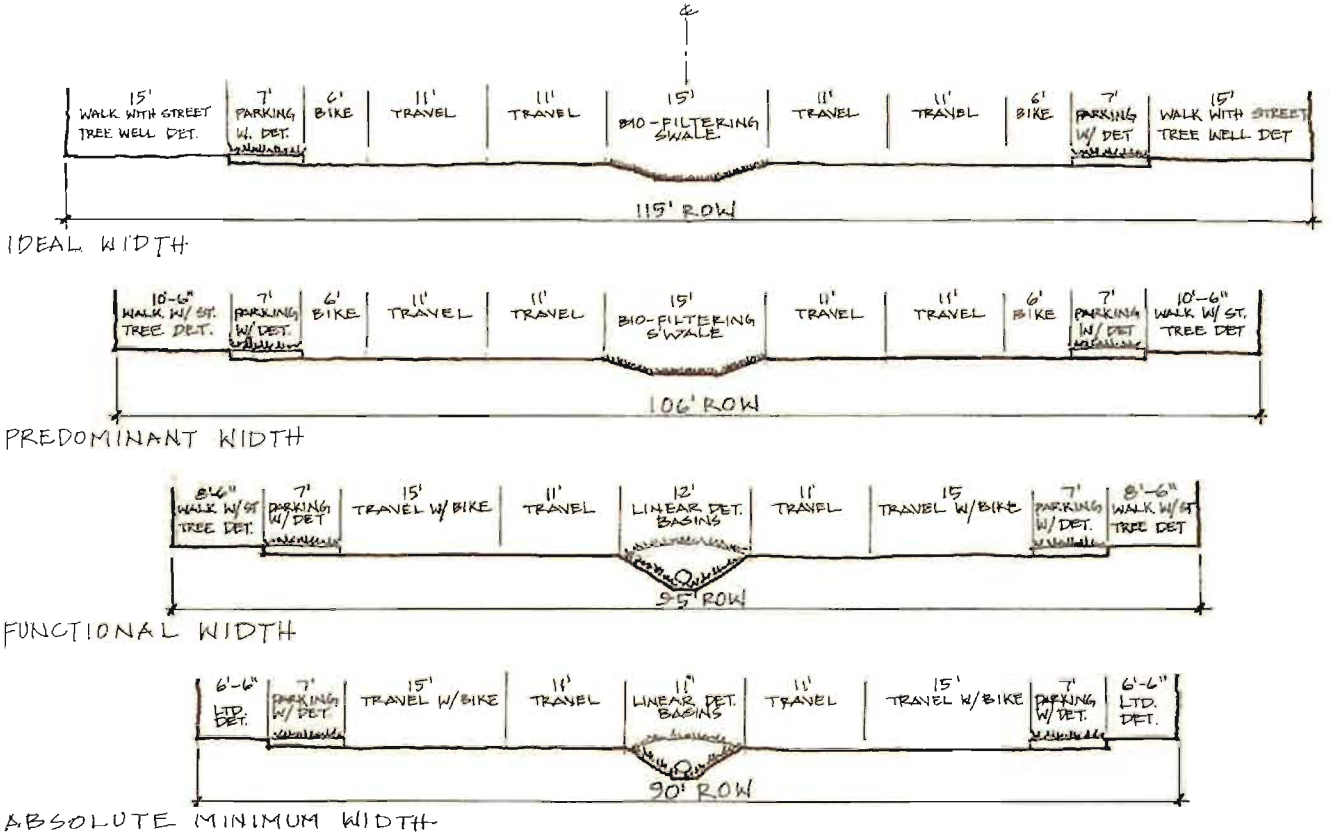



*Figure 6-9*
*Typical Regional Boulevard Cross Sections Within Various Rights of Way*

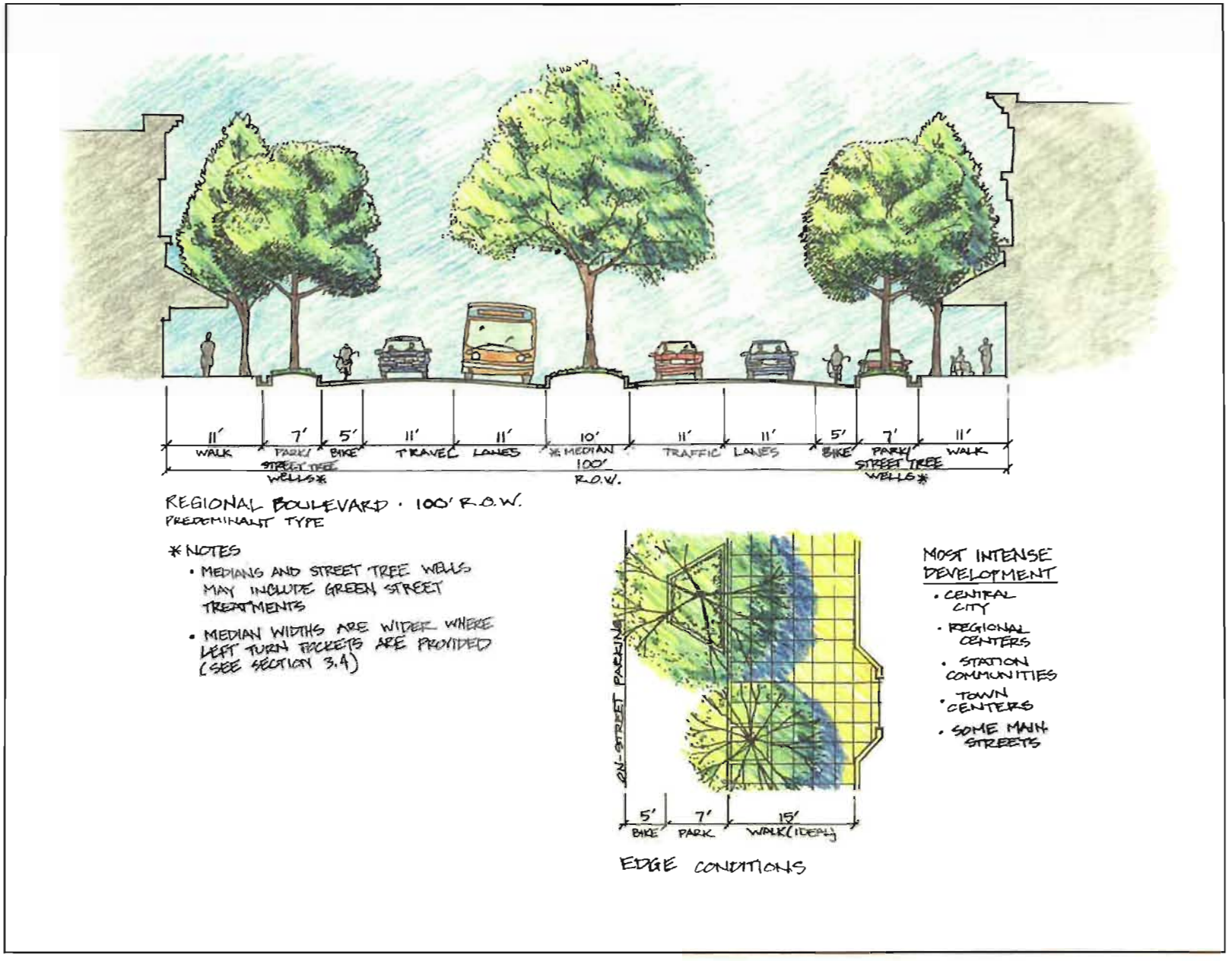



*Figure 29. Typical regional boulevard design type. These facilities emphasize bicycle, pedestrian and transit travel modes.*

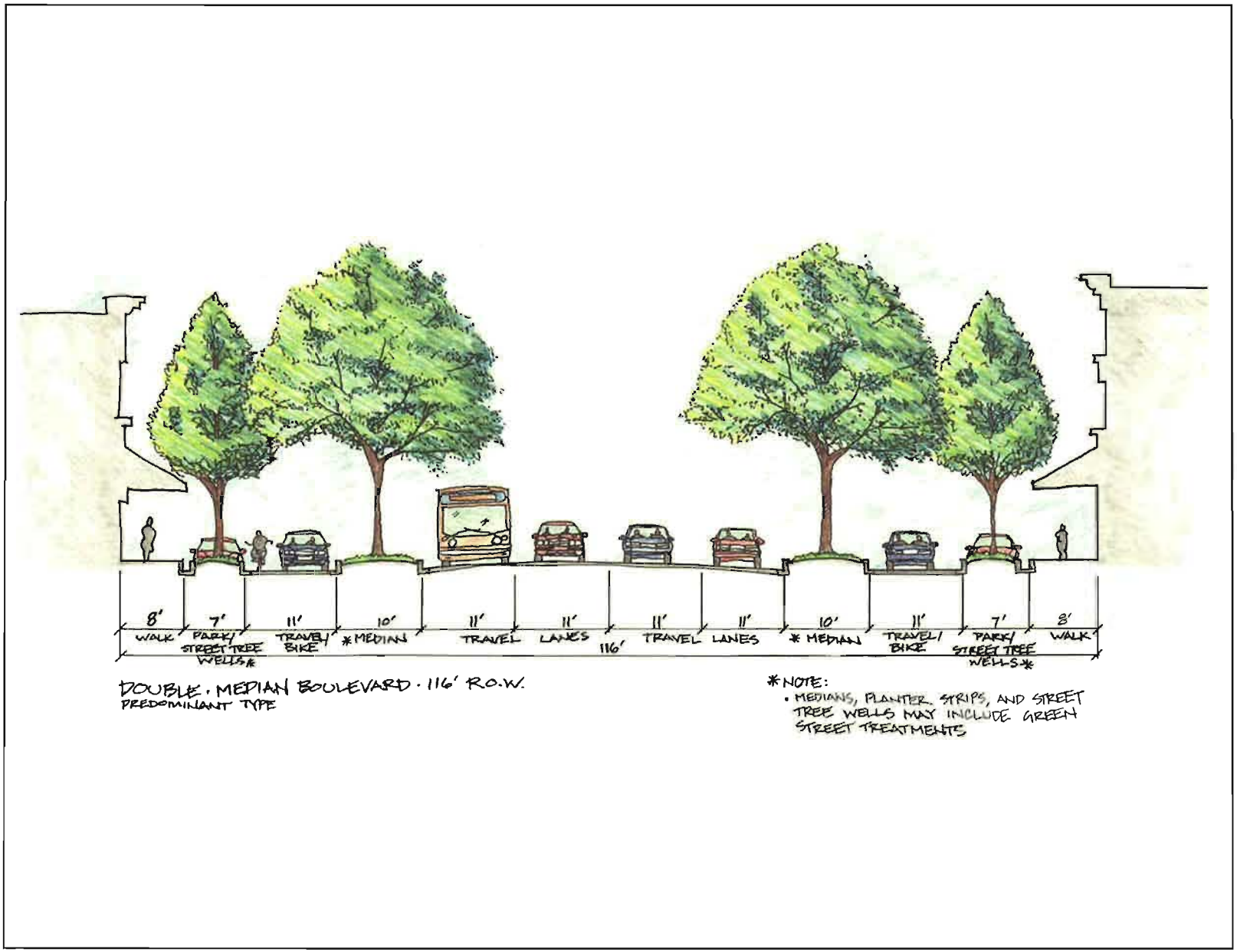



*Figure 30. Alternative form of regional boulevard design type – the double median boulevard.*

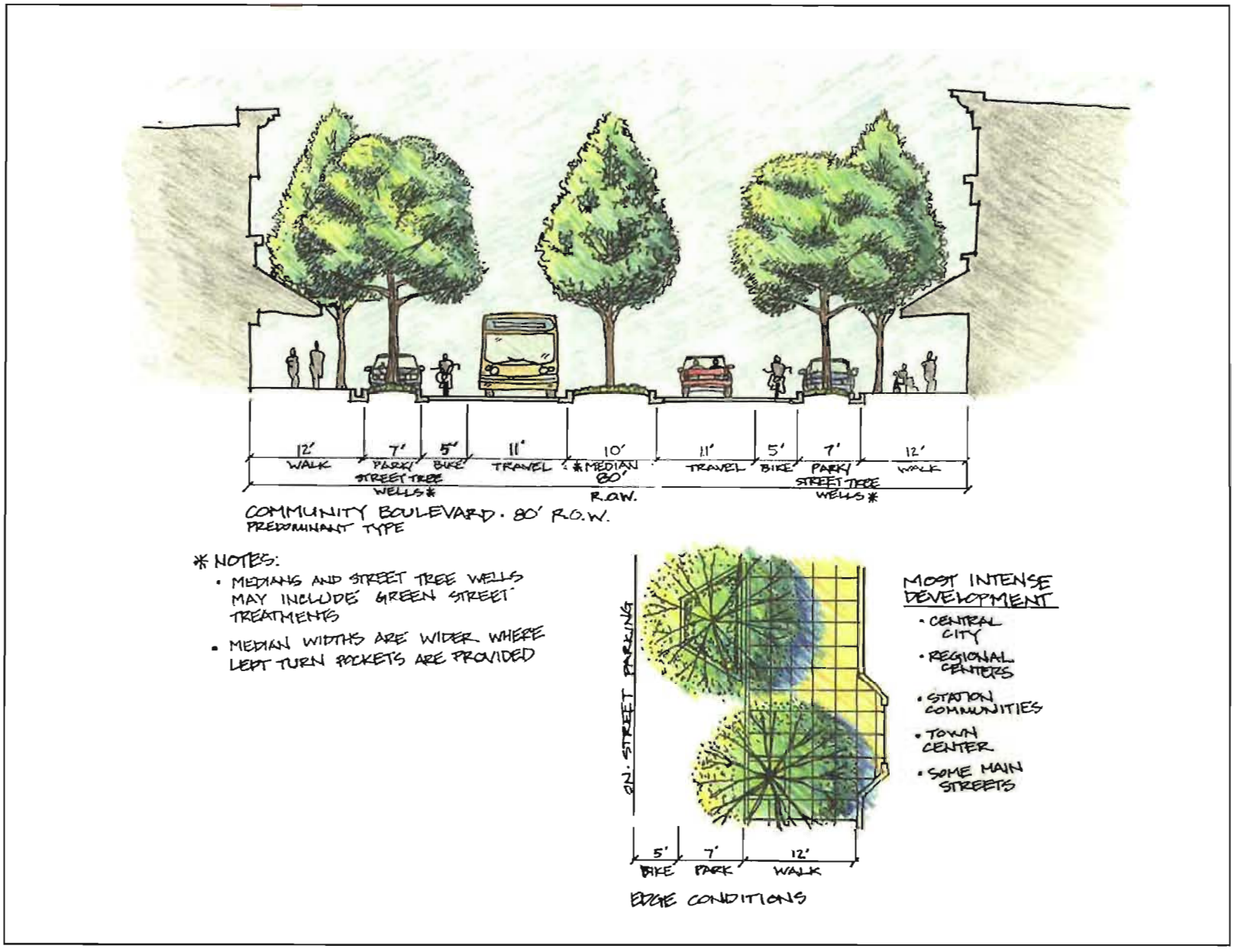



*Figure 31. Typical community boulevard design type. These facilities emphasize bicycle, pedestrian and transit travel modes.*

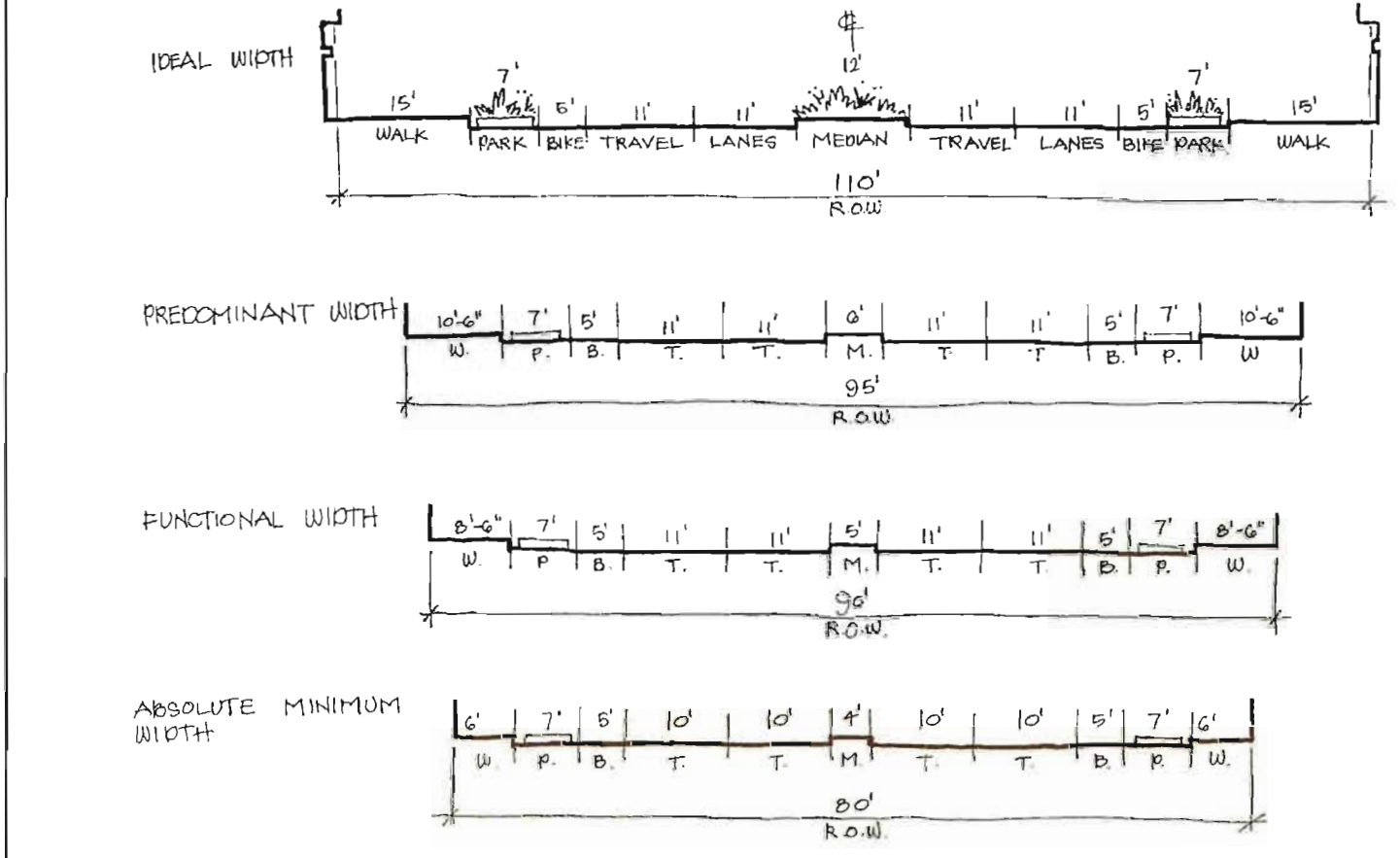



*Figure 38. Typical regional boulevard cross sections within various rights of way.*

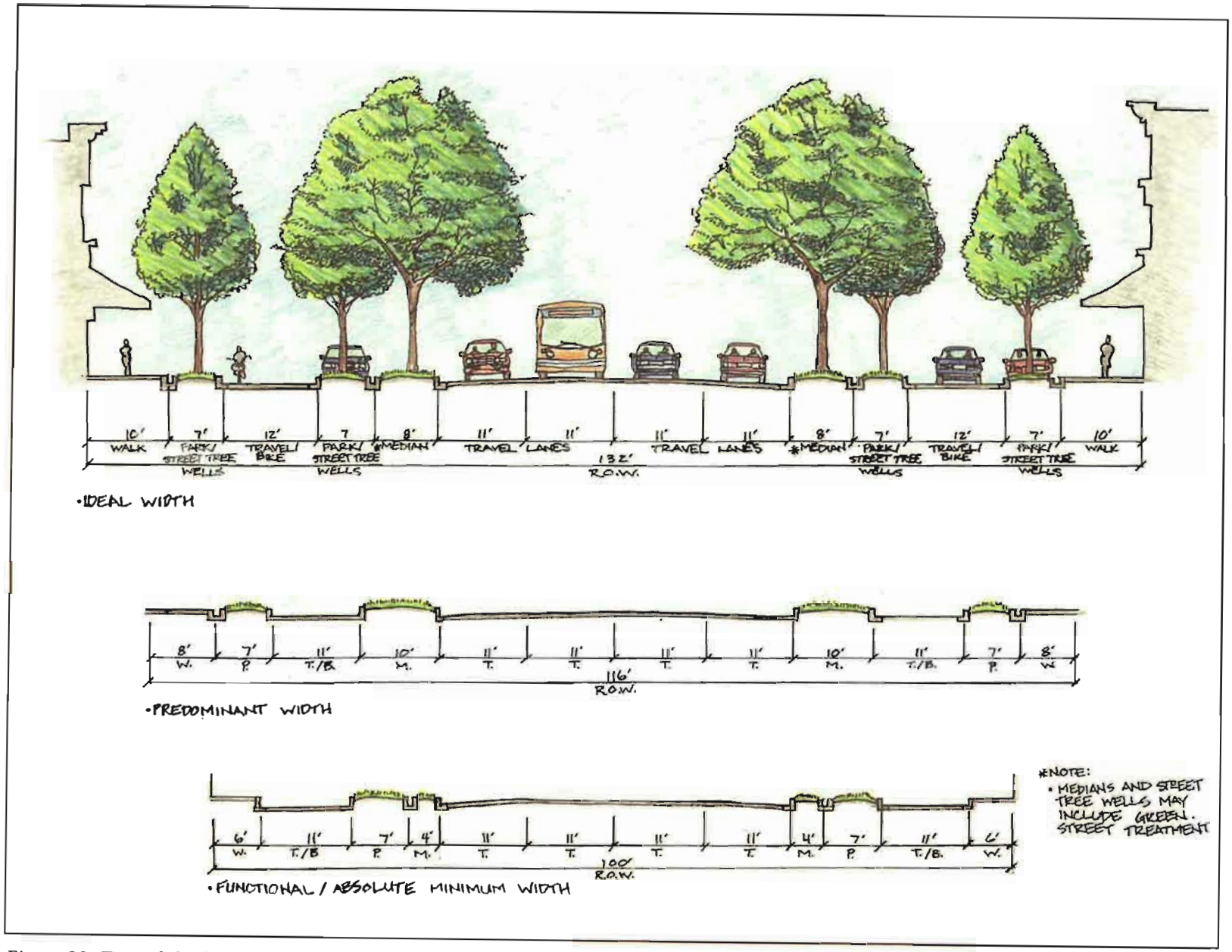



*Figure 39. Typical double-median boulevard cross sections within various rights of way.*

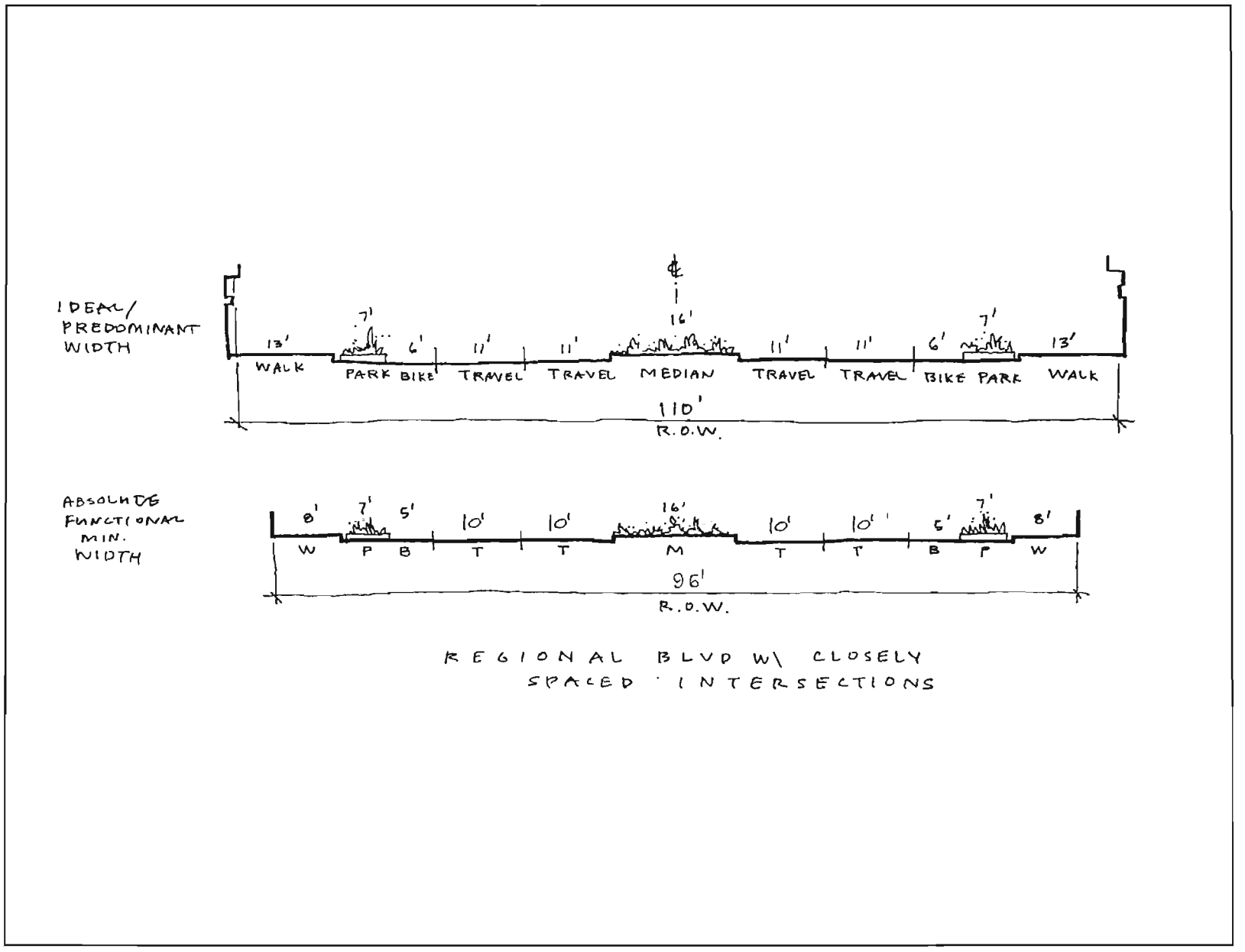



*Figure 40. Typical regional boulevard cross sections with wider raised medians.*

## Community boulevard

Community boulevards consist of four or fewer multi-modal travel lanes. They are located within the most intensely developed centers with development oriented toward the street. Desirable features include bike lanes and wide sidewalks.

The narrower width provides somewhat more flexibility in the green streets design solution used. A central median swale is most desirable. However, a combination of infiltration trenches beneath the parking lane and street tree wells (which will convey runoff to a treatment facility) also are appropriate.

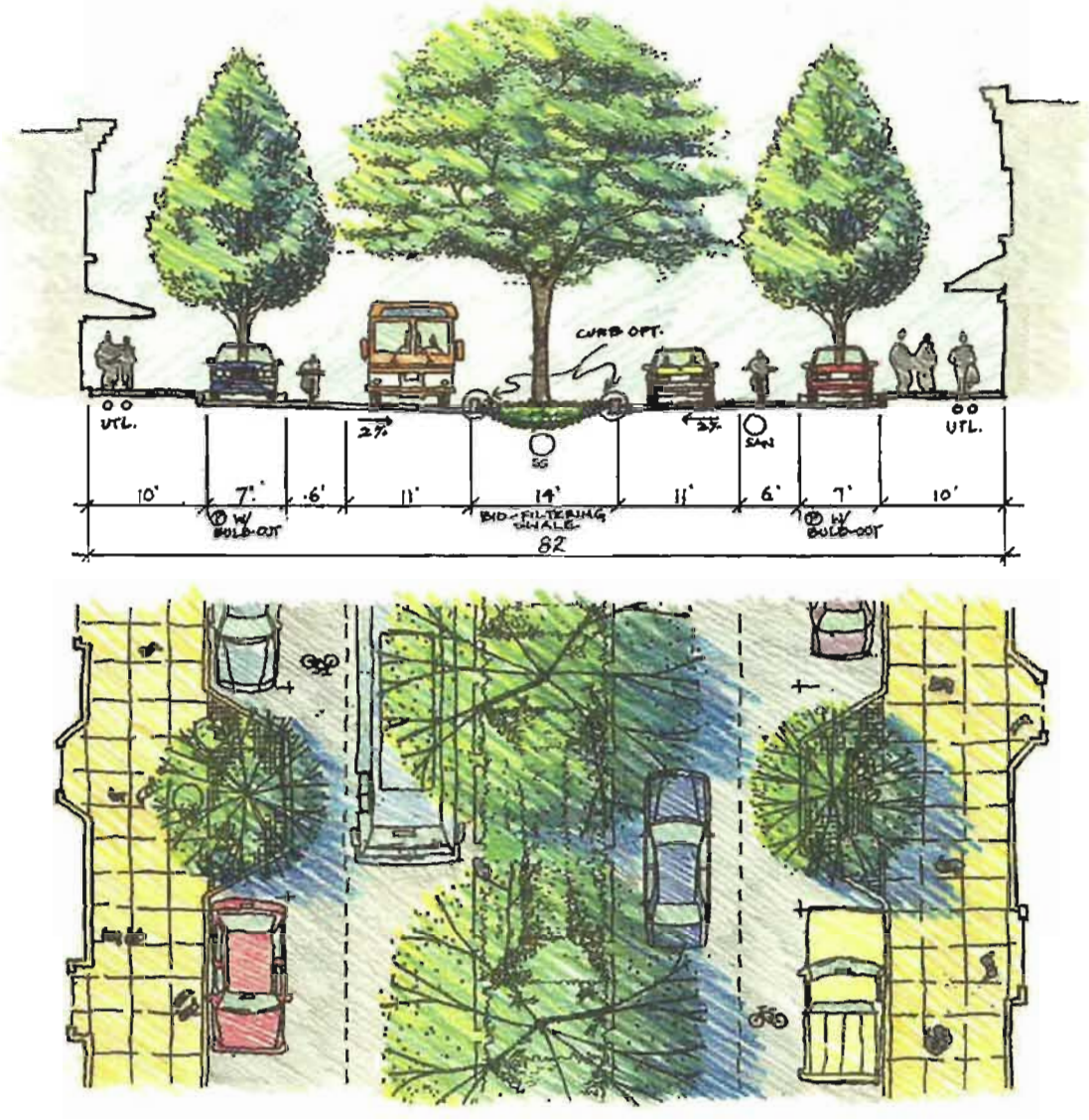



*Figure 6-3*
*Community Boulevard with Median Bio-Filtering Swale*


*Figure 6-4*
*Community Boulevard with Street Tree Wells*

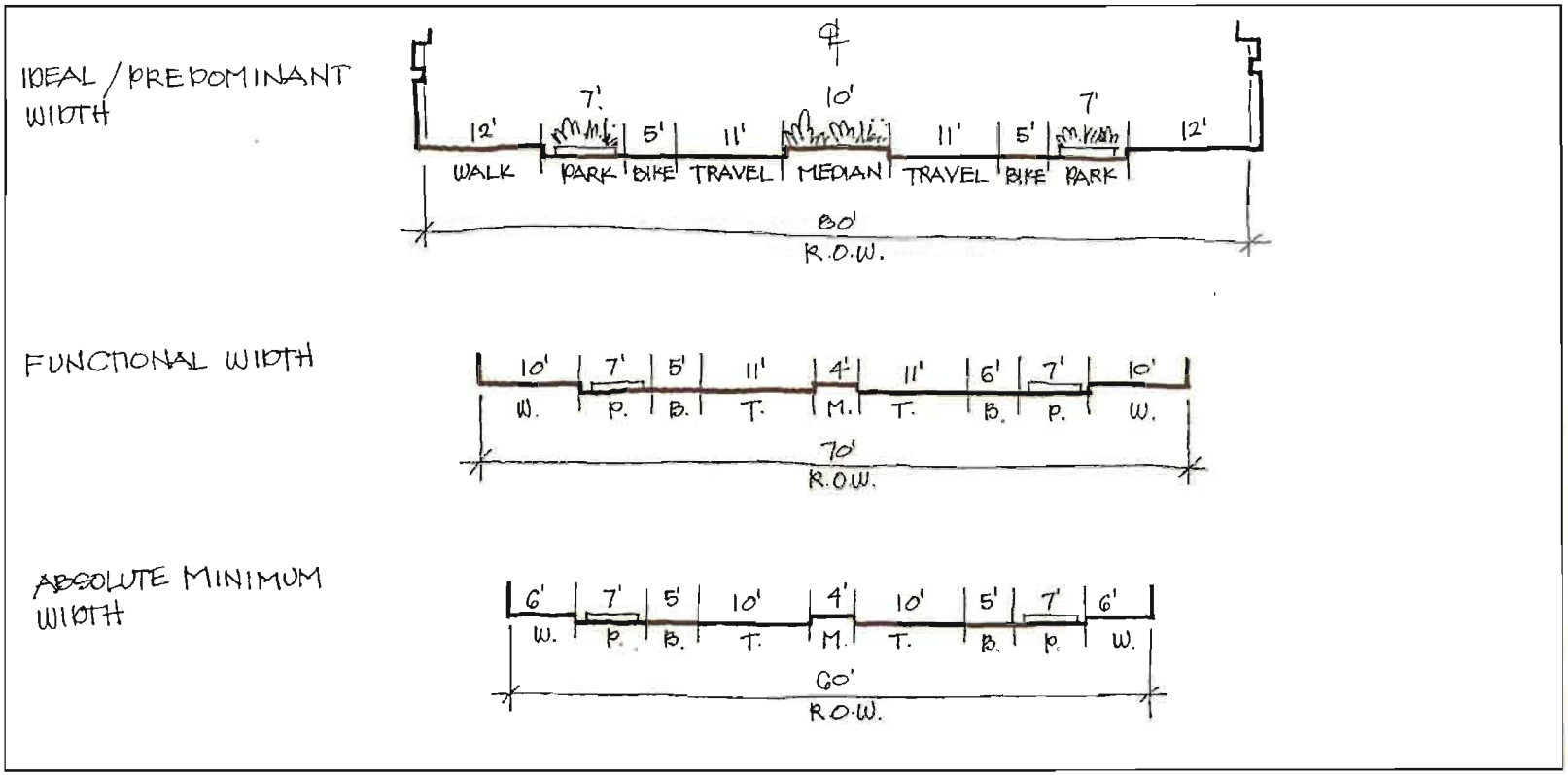



*Figure 41. Typical community boulevard cross sections within various rights of way.*

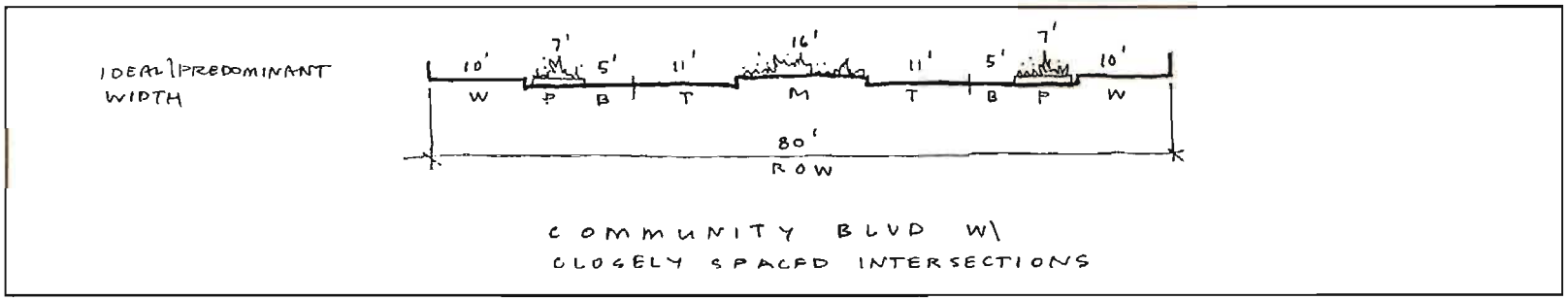



*Figure 42. Typical community boulevard cross section with wider raised median.*

## 5.3 Regional Streets

Regional streets are major arterial streets. They are distinguished from other regional design types by requiring at least four travel lanes, bicycle lanes, sidewalks for transit access, pedestrian landscape buffers and no on-street parking.

### *Widths*

- Ideal/predominant width – 97 feet. At this width, all design elements can be accommodated: four 12-foot travel lanes, 6- foot bicycle lanes, 6-foot sidewalks and 5-foot landscaped pedestrian buffers. The 15-foot-wide median can accommodate a raised median with 11-foot left-turn lane and 4-foot-wide extended median nose. The design elements of this type of street at the ideal width are primarily vehicle-oriented, and provide the highest capacity facility of the street and boulevard classifications.

- Functional minimum width – 90 feet. At this width, two travel lanes are reduced to 11 feet, the bicycle lanes are reduced to 5 feet, and the median reduces to 14 feet. This width of street continues to provide a high-capacity facility.

- Absolute minimum width – 84 feet. If the bicycle and outside travel lanes share a 15-foot width, the right of way of a regional street can be reduced to 88 feet. If the inside travel lanes are reduced to 11 feet, the width can be further reduced to 86 feet. With narrower 4-foot pedestrian landscape buffers, the width can be further reduced to 84 feet, the absolute minimum width that defines a regional street. The median two-way left-turn lane remains at 14 feet, the absolute minimum width used in this handbook.

Figure 43 illustrates the widths of regional streets.

### *Tradeoffs*

At greater than 97 feet, wider landscaped pedestrian buffers can be provided. At 119 feet, an additional travel lane can be added in each direction, creating a six lane cross section. At less that 84 feet, bicycle lanes are eliminated (assuming bicycles can travel on a parallel route), which allows the width to be reduced to 74 feet. At 74 feet, four travel lanes and a median with turn pockets at intersections can be accommodated.

At less than 74 feet, a regional street would have fewer than four travel lanes, and the section becomes a community street.

### *Regional street priorities*

#### Higher priorities

- Number of travel lanes
- Pedestrian sidewalks with transit access and buffer strip
- Medians for access management and pedestrian refuge
- Bicycle lanes

#### Lower priorities

- Width of travel lanes
- On-street parking

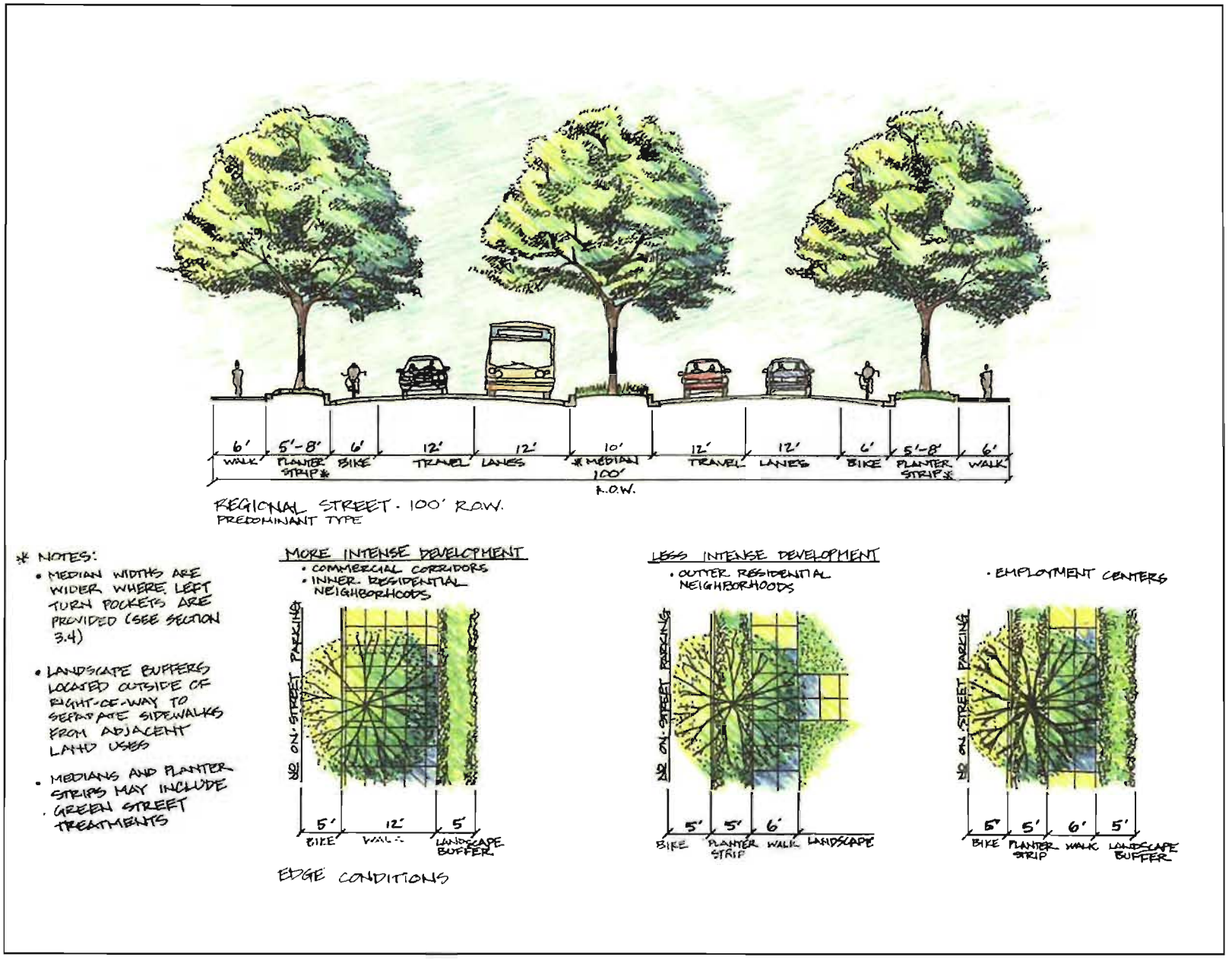



*Figure 32. Typical regional street design type. These facilities provide a balance of all modes of travel.*

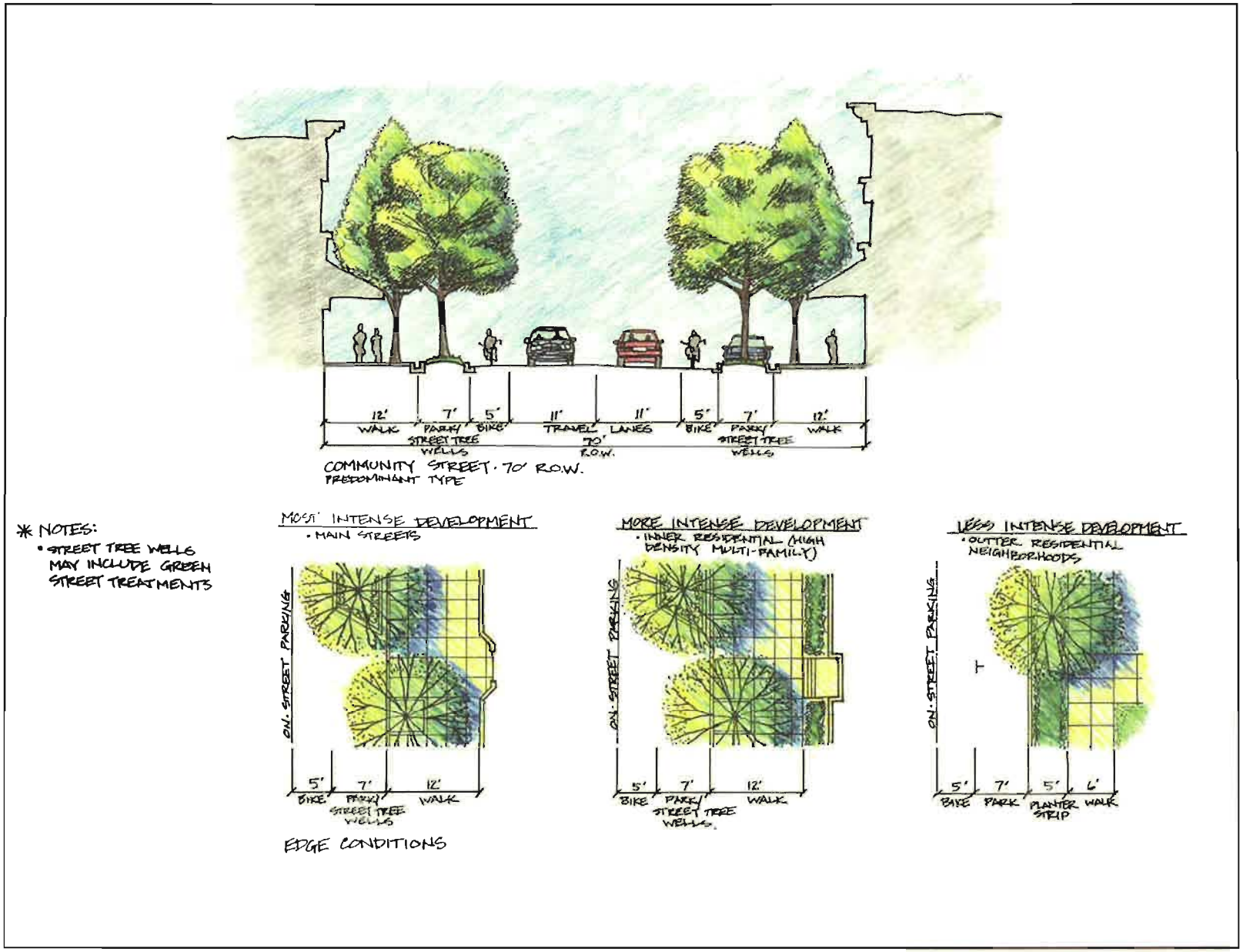



*Figure 33. Typical community street design type. These facilities provide a balance of all modes of travel.*

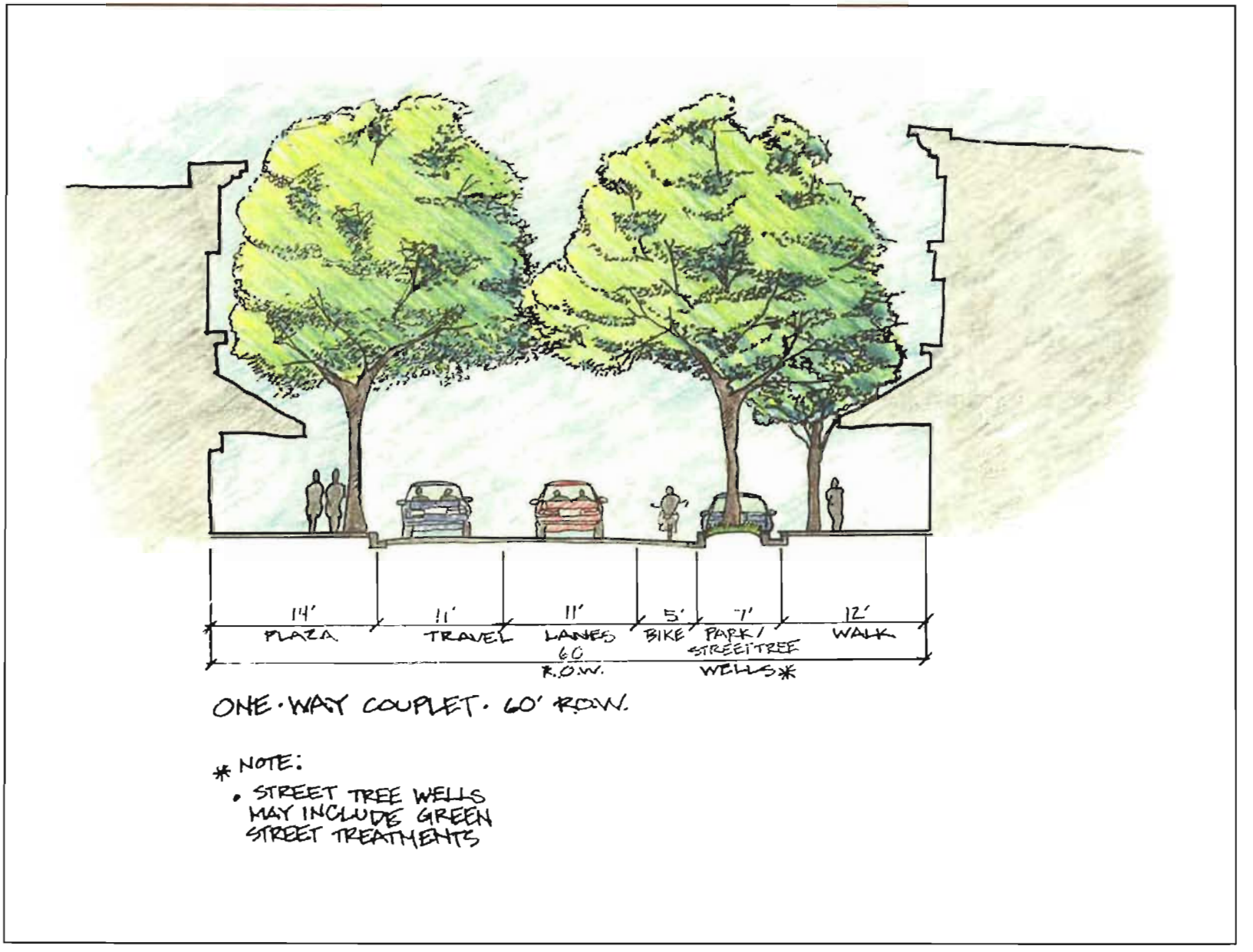



*Figure 34. Another form of community street, the one-way couplet.*

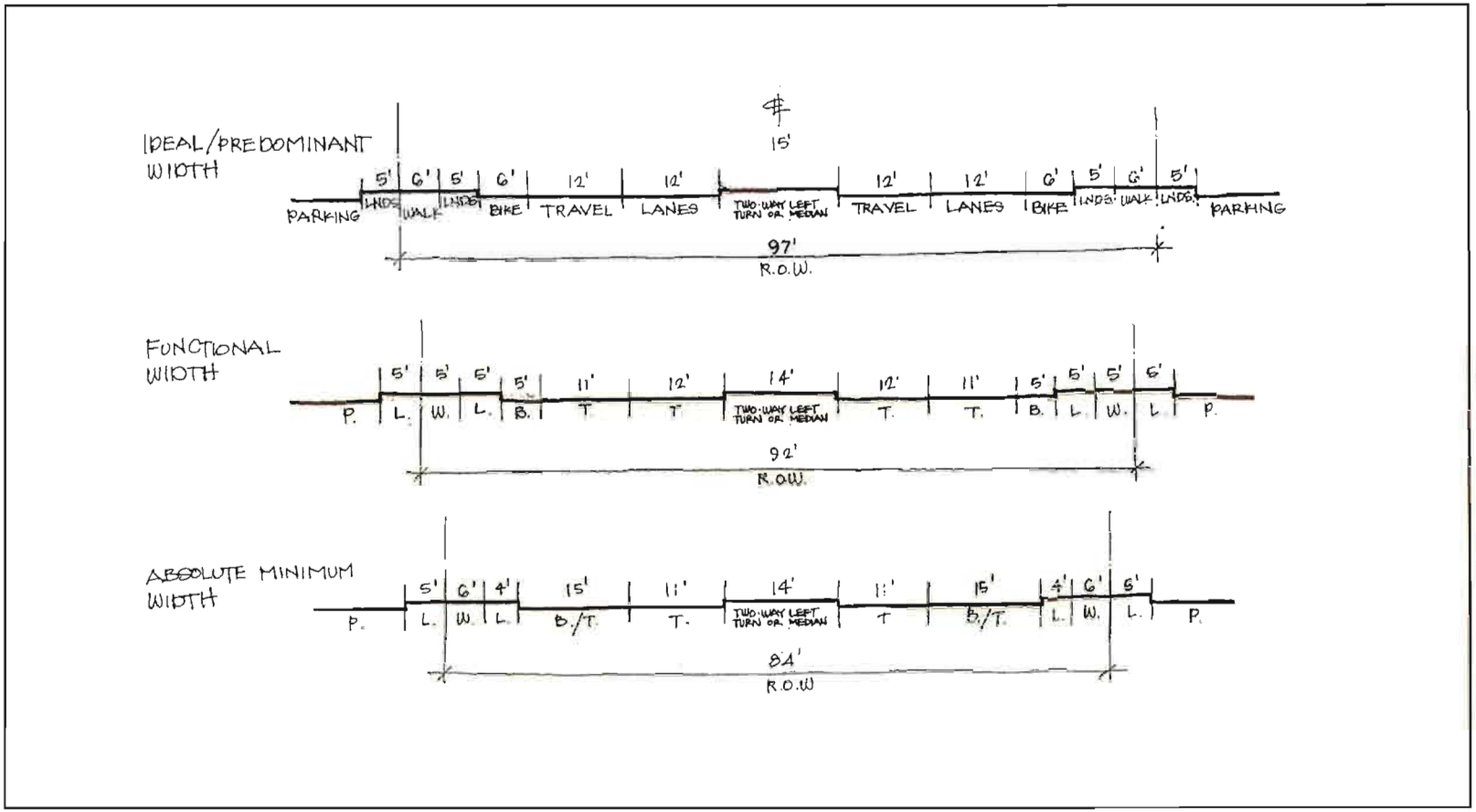



*Figure 43. Typical regional street cross sections within various rights of way.*

## Regional Street

Regional streets typically are more vehicle-oriented and less pedestrian-oriented than boulevards. They are four or more multi-modal travel lanes in width and are located within low-density residential neighborhoods. Development is typically set back from the street but may front the street within main street districts. There is limited on-street parking.

Due to width, a higher-capacity swale should be used to accommodate runoff from the larger collection area. The swale should be located in either central median, a side median adjacent to a local access lane, or between the outside travel lane and the sidewalk (assuming no on-street parking). In order for a swale to be most effective, the minimum length should be 250 feet requiring a compromise between swale effectiveness and turning opportunities. Secondary design solutions such as street tree wells and infiltration trenches also are useful in attenuating runoff and directing it into the swale.

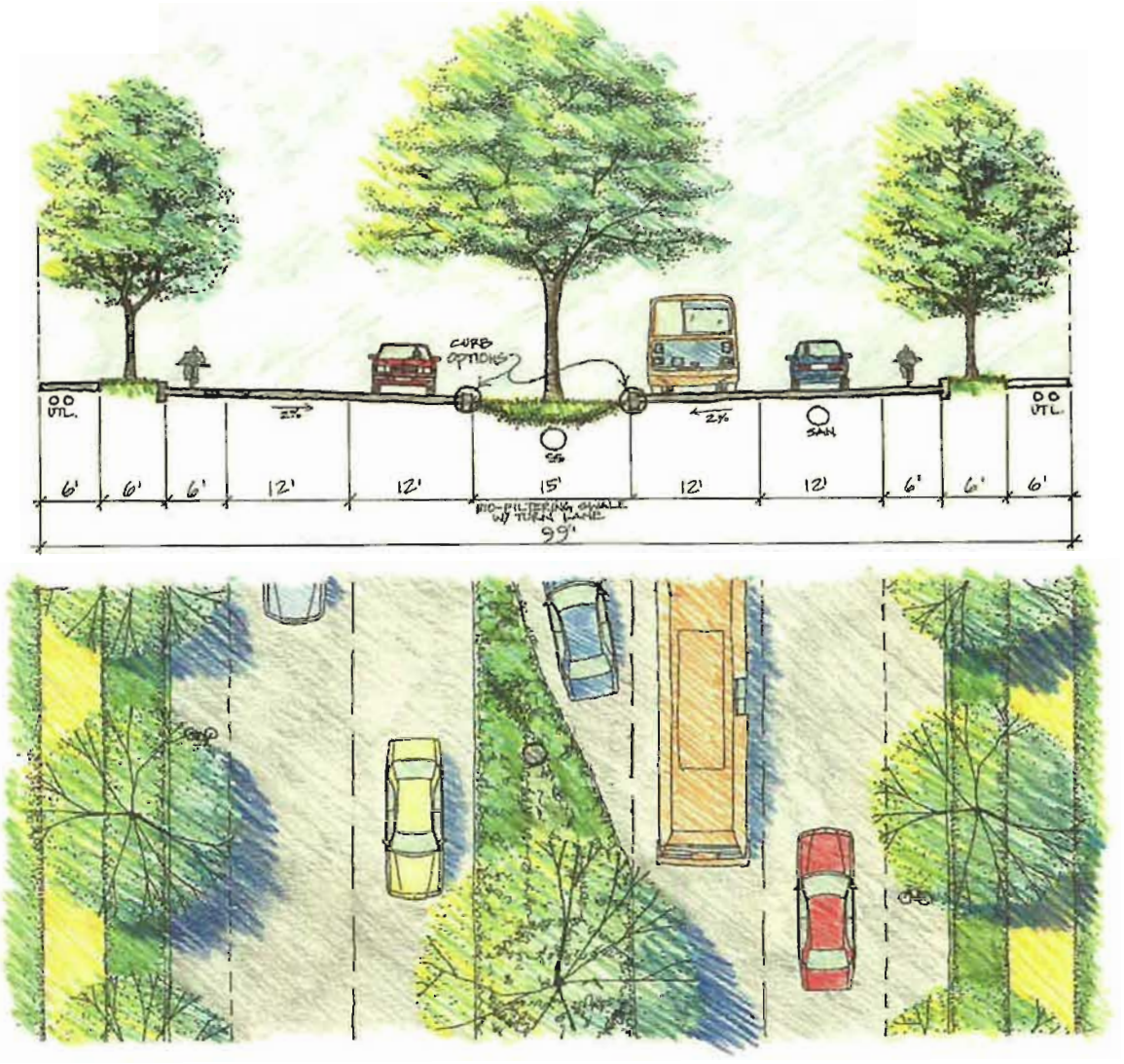



*Figure 6-5*
*Regional Street with Median Bio-Filtering Swale*

### Regional street

- Ideal width – 99 feet. This provides a generous dimension accommodating all desired design elements, including four 12-foot travel lanes and a 6-foot striped bicycle lane. A 15-foot central median, if constructed with a preferred uninterrupted length of a minimum of 250 feet (shorter lengths may be acceptable in jurisdictions allowing lower residency times for water in the swale) and a longitudinal slope between 2 percent and 6 percent, can incorporate a bio-filtering swale and significant street tree planting. Linear detention basins can be incorporated if longitudinal lengths or slopes are not appropriate for a swale. The median also provides a 14-foot left-turn lane. Maintaining an effective linear length for the swale will possibly require limiting the frequency of left turn movements. A 6-foot landscape strip provides enough space for tree planting and possible street tree detention wells.

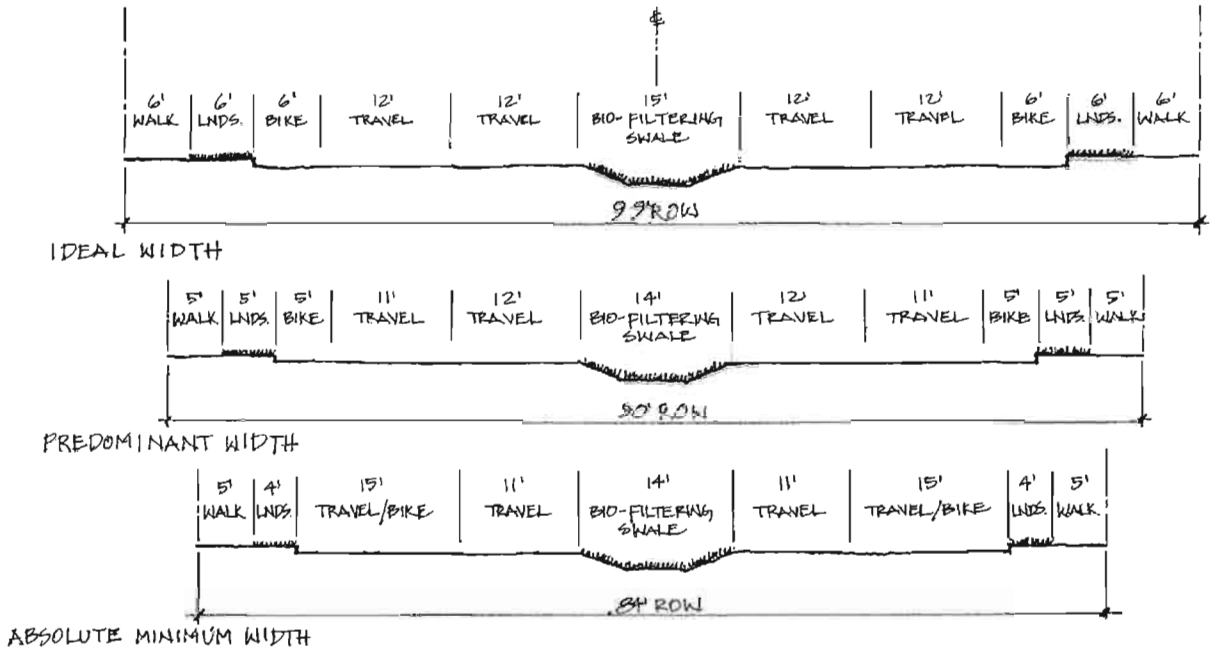



*Figure 6-10*
*Typical Regional Streets Cross Sections Within Various Rights of Way*

## Community street

Community streets consist of two to four multi-modal travel lanes and are located within inner and outer residential neighborhoods and commercial corridors. Although they provide a higher level of local access than regional streets, site access requirements may vary greatly. The community street has the greatest flexibility in cross sectional elements and a range in median conditions.

The inherent flexibility in the role of the community street also is reflected in the green streets design solutions available. The overall narrower width and presence of medians lends itself to a combination of solutions that will attenuate and/or treat runoff.

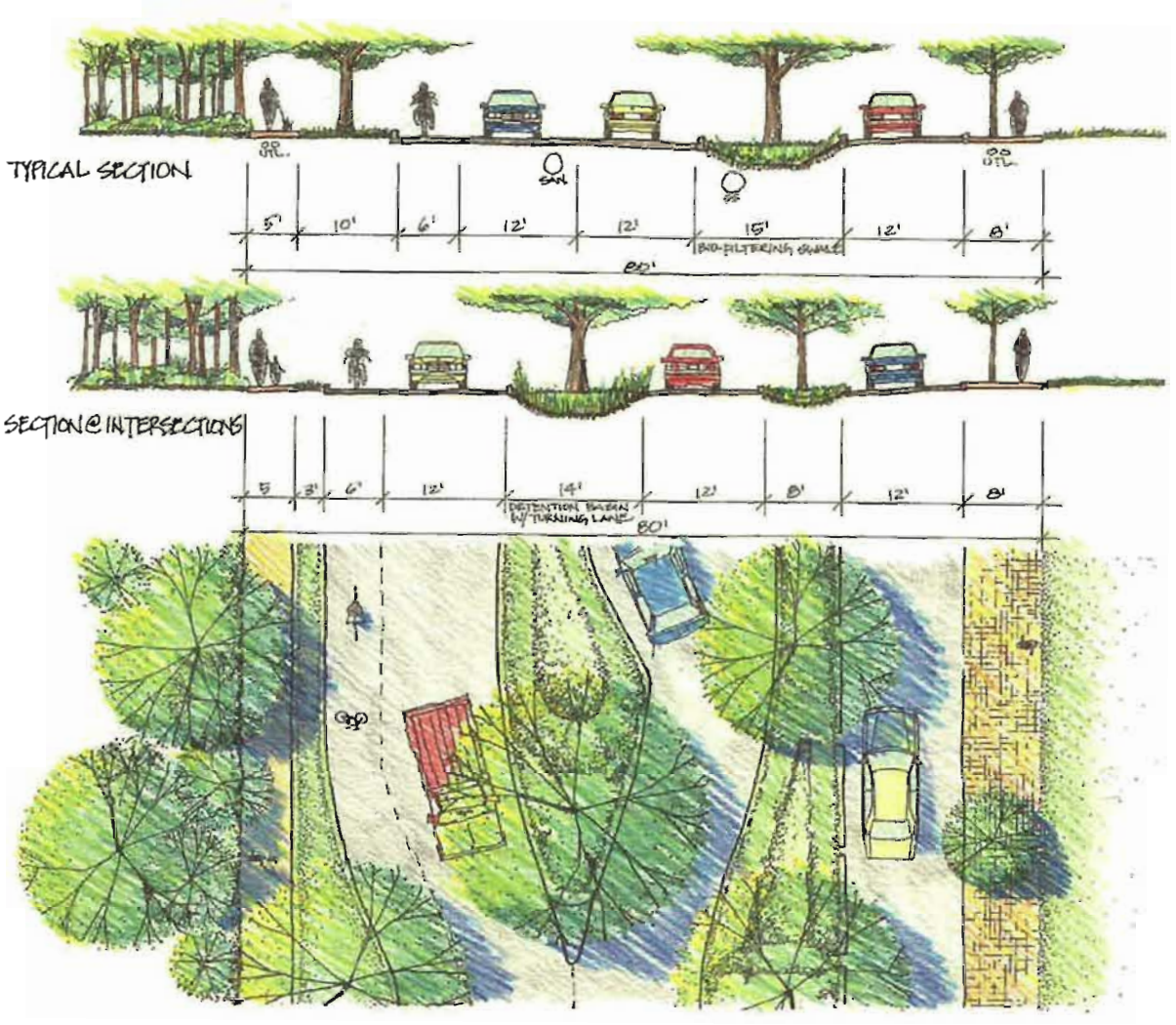



*Figure 6-6*
*Community Street with Bio-Filtering Swale and Local Access Road*

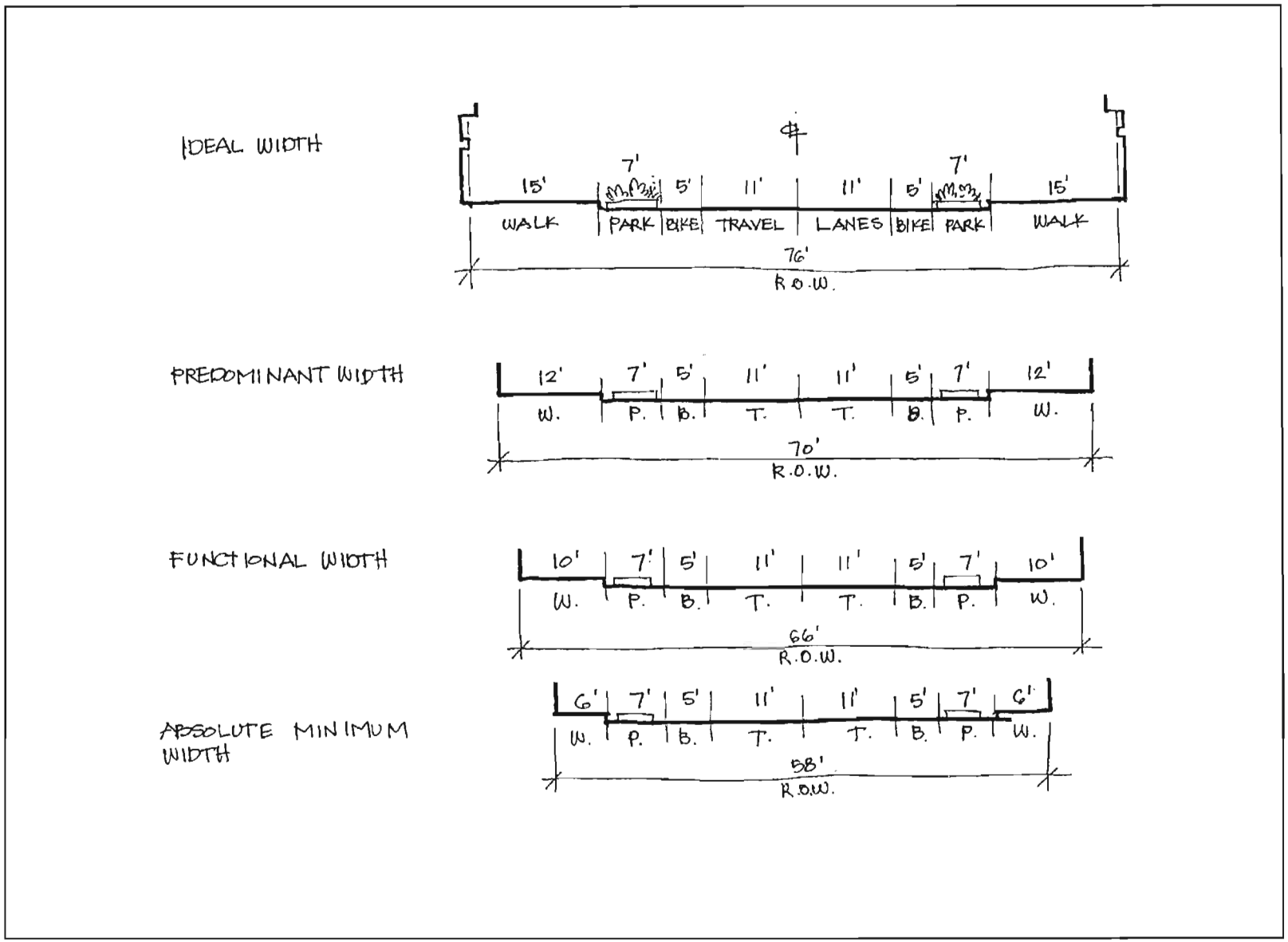



*Figure 44. Typical community street cross sections within various rights of way.*

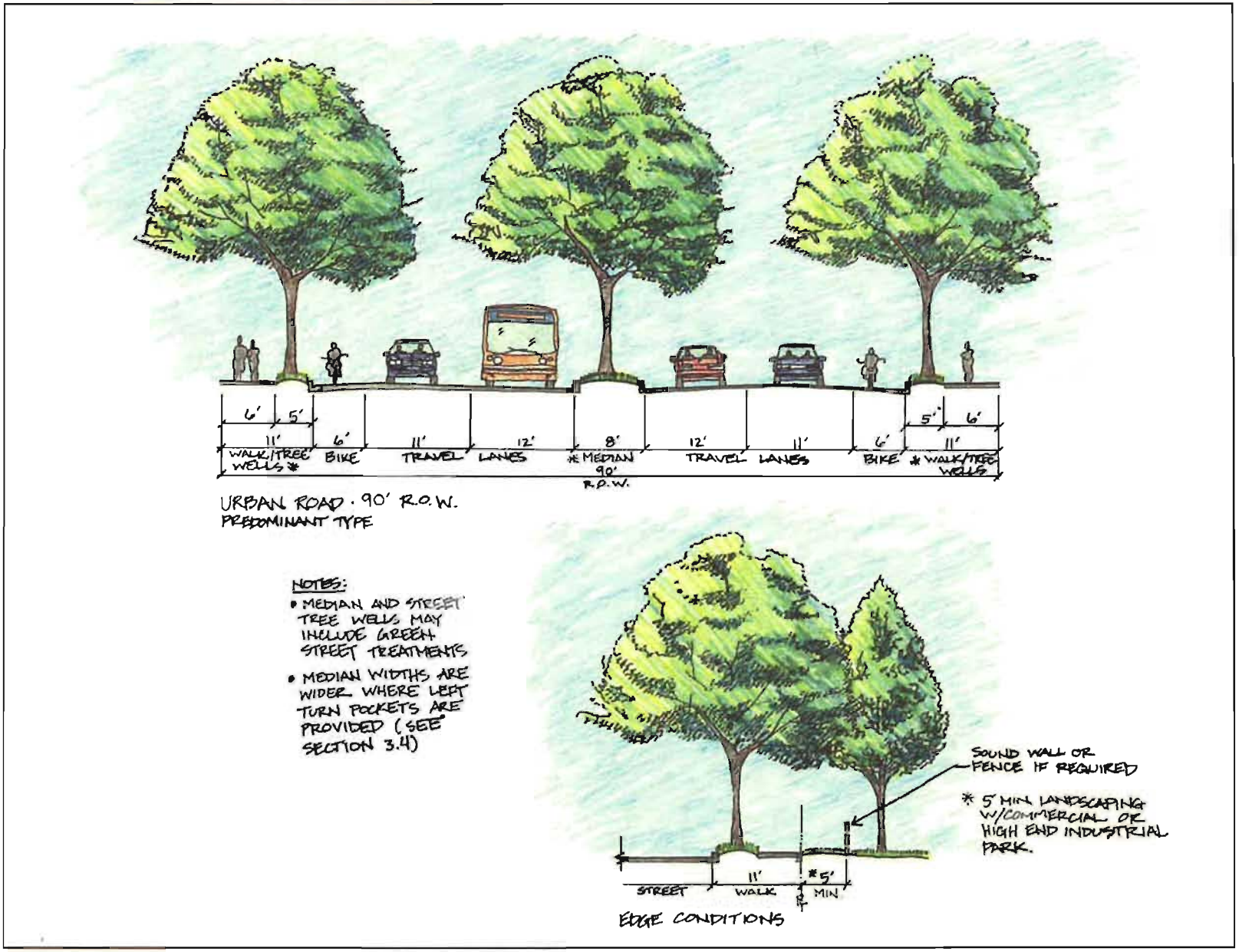



*Figure 35. Typical urban road design type. These facilities serve all modes of travel but emphasize vehicular travel.*

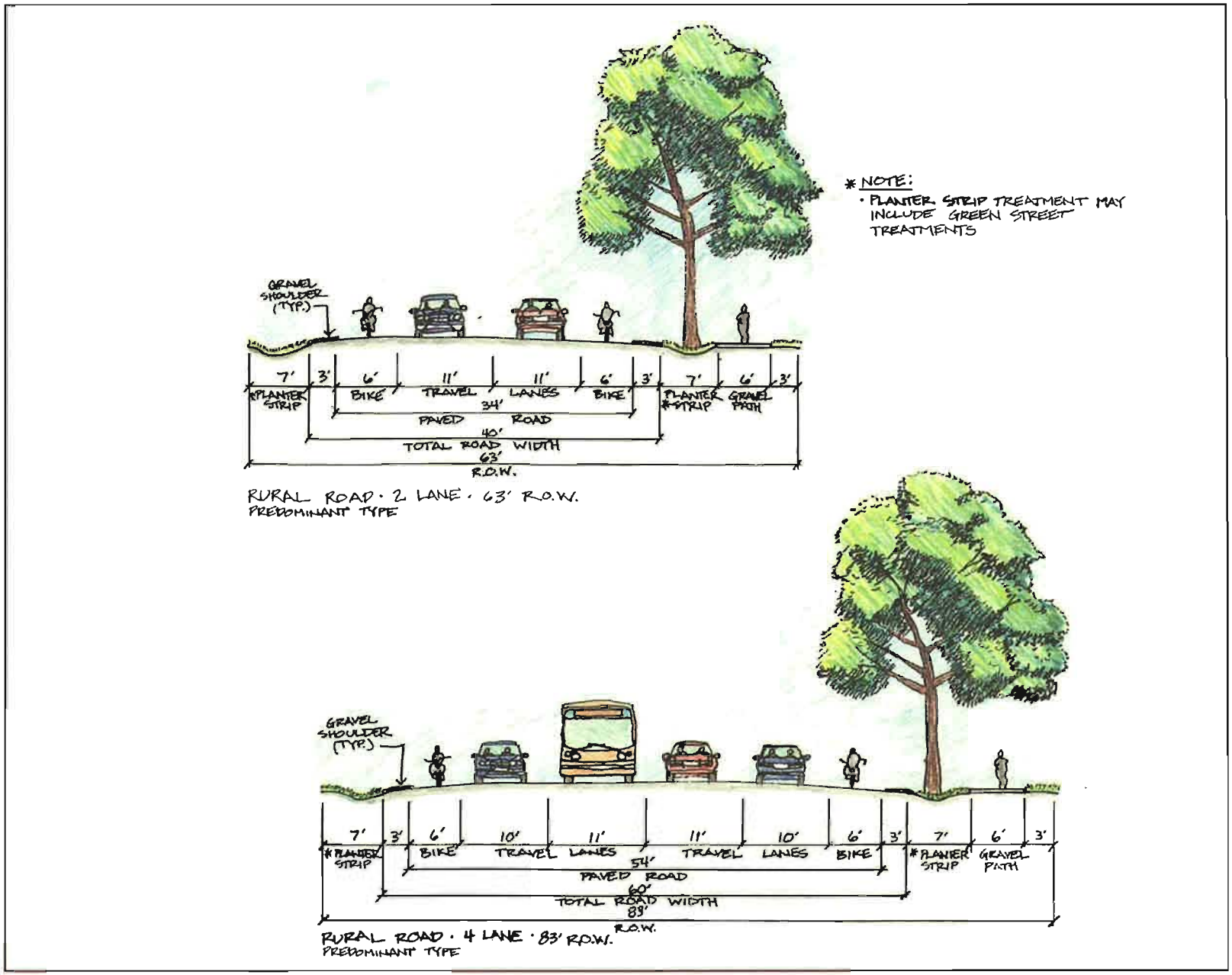



*Figure 36. Typical two- and four-lane rural road design types. These facilities are designed for high speeds and are important freight routes.*

## Urban road

Urban roads carry significant vehicle traffic while providing for some transit, bicycle and pedestrian travel. They are generally four lanes although additional lanes are appropriate in some locations. Urban roads serve industrial areas, intermodal facilities and employment centers where buildings are seldom oriented to the streets. Urban roads rarely include on-street parking. A center median serves to reduce conflicts and restrict turning movements except at intersections.

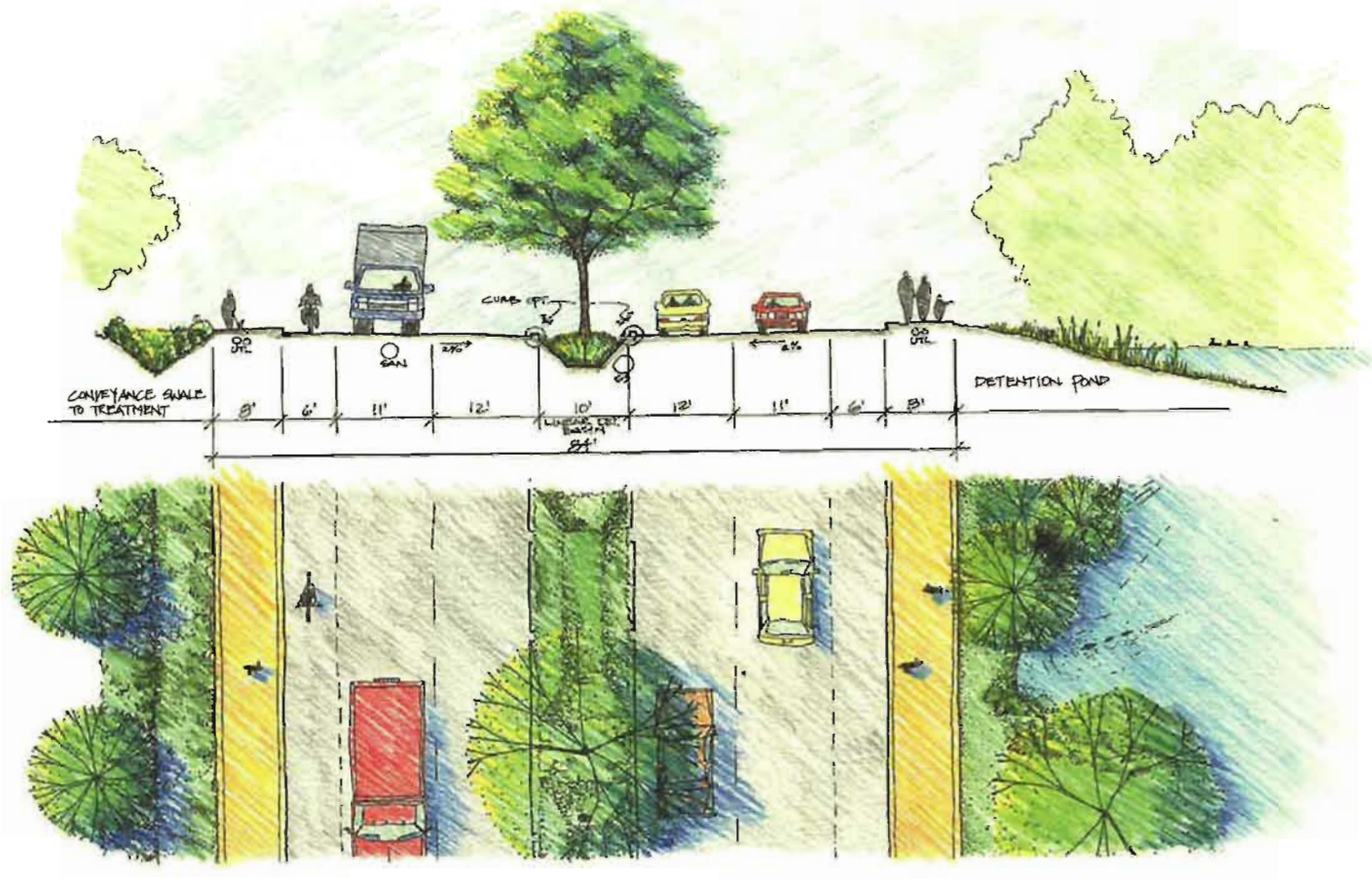



*Figure 6-7*
*Urban Road with Conveyance Swale and Detention Basin*

The characteristic of the adjacent land use (i.e., wide setbacks) provides opportunities for locating shared off-site treatment facilities such as detention ponds and constructed wetlands. Conveyance swales feeding into these shared facilities could be incorporated into the right of way and serve to collect drainage from the roadway. Alternatively, the conveyance swales could be outside the right of way with a swale or linear detention basin collecting drainage from the roadway within the central median.

### 3. Plant long-lived trees

Large trees with long life spans are preferred because they provide economic, environmental and societal benefits that increase with age. The first three years after planting are essential to the tree's long-term health. Trees need plenty of space for their roots and their canopies, good soils and appropriate drainage in order to live to full maturity.

When selecting trees for longevity, it is important to consider their ability to tolerate local climate conditions – wet winters and dry summers. Native trees are adapted to these conditions, many nonnative species have naturalized under local conditions and can be used when appropriate. It is important that organic matter such as leaf debris be mulched in around trees to improve nutrient availability and reduce moisture loss. This natural cycle of decomposition and recycling of nutrients not only helps trees grow stronger, but can improve the consumption of pollutants such as synthetic pesticides, suppress soil-borne diseases and build disease resistance in the trees themselves.[3]

### Trees and perforated pipes

Green streets designs that incorporate infiltration trenches with perforated pipes may be problematic. Trees with noninvasive root systems are preferred, however, the integrity of the design may be compromised by a tree as its roots seek out available oxygen and moisture in the pipe, particularly if the soil conditions are poor. Typically root systems stay within the top 18 inches of soil, unless the area is designed to encourage deep roots. The perforated pipe should be placed deeper than 18 inches and as far away from the tree as possible.

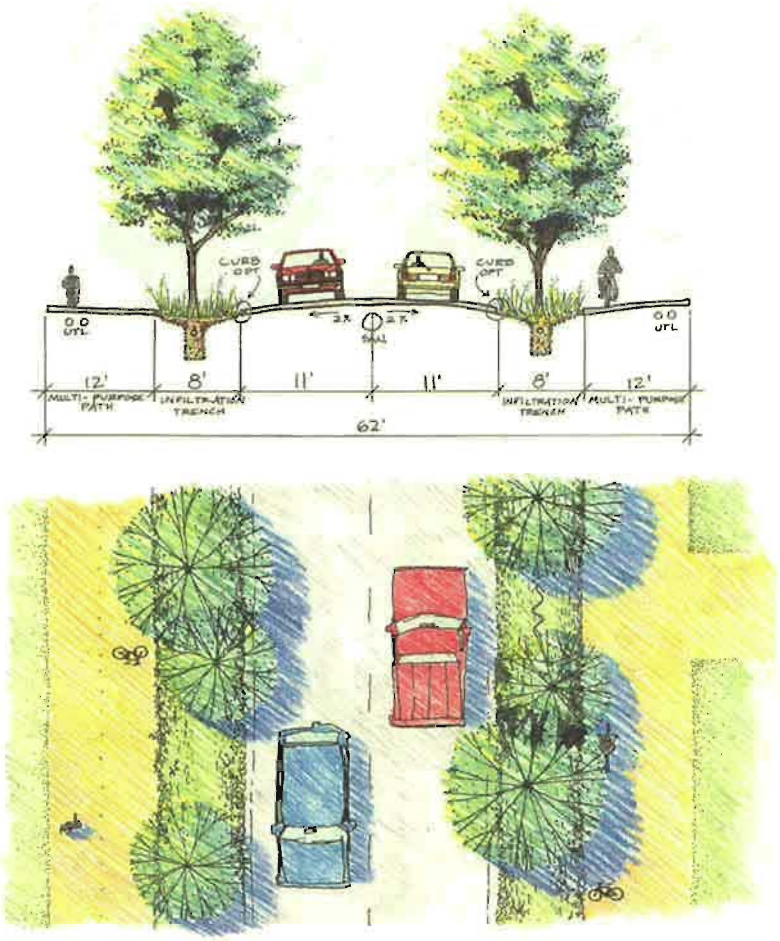



*Figure 7-17*
*Residential Street with Infiltration Trenches*

## 7.7 Local Streets and Roads

Chapter 6 "Designing Major Streets" illustrated street sections for major streets. Local streets and roads, however, are the predominant road types within communities and have a substantial impact on the quality and quantity of runoff, as well as community character. Just as they play a vital role in the roadway system, they are also crucial to the green streets system. Lower traffic volumes and speeds enable the streets to be more flexible in incorporating a variety of green streets solutions.

[3] Elaine Ingham, 2001

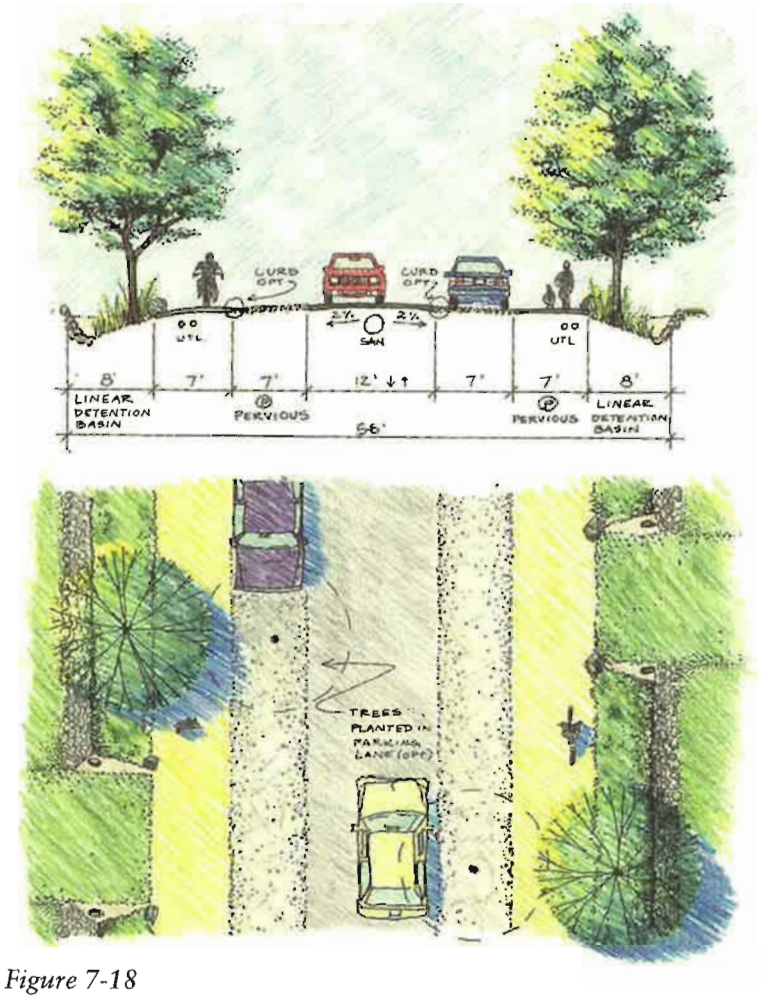



*Figure 7-18*
*Residential Street with Linear Detention Basins*
*(56-foot right of way)*

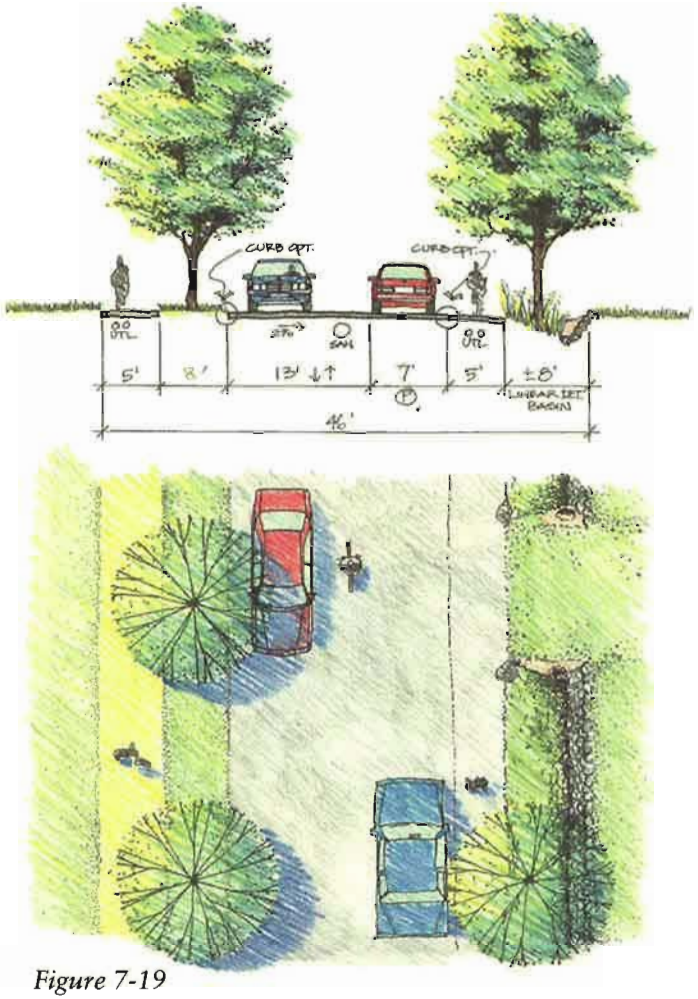



*Figure 7-19*
*Residential Street with Linear Detention Basin*
*(46-foot right of way)*

This section features illustrations of residential streets using different green streets design elements and right of way widths. These illustrations demonstrate that green streets design elements can be incorporated into many different right of way designs. This flexibility allows green streets design elements to respond to other factors effecting right of way design such as the volume of traffic, neighborhood aesthetics, available right of way and maintenance strategy.

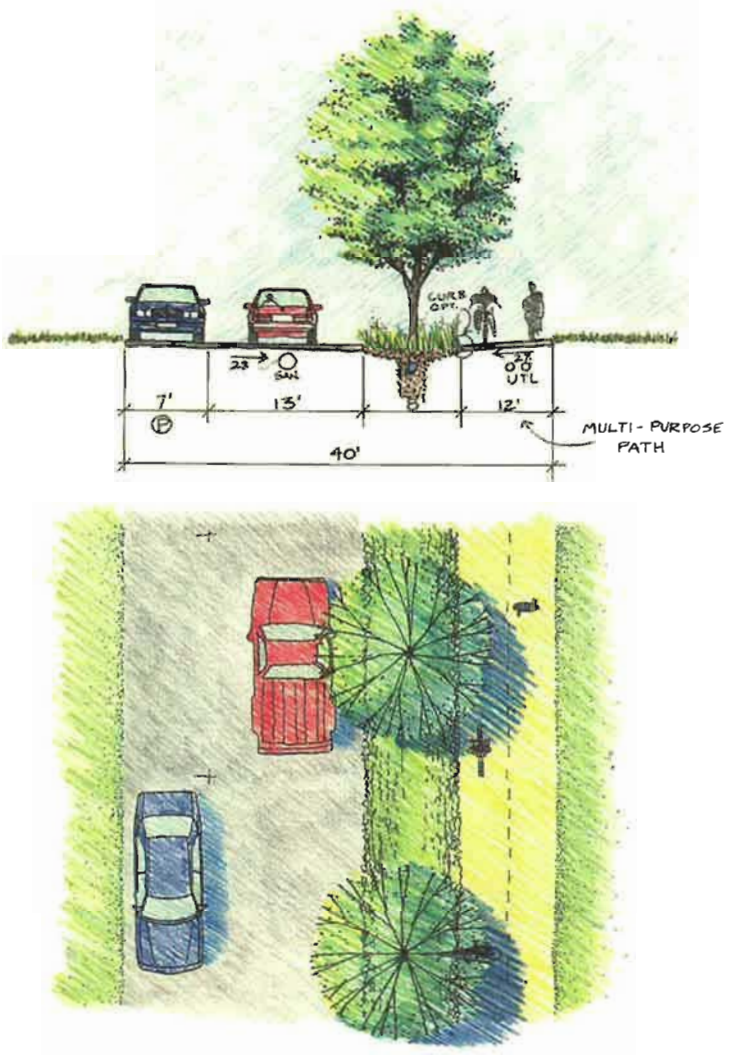



*Figure 7-20*
*Residential "Queuing" Street with Infiltration Trench*

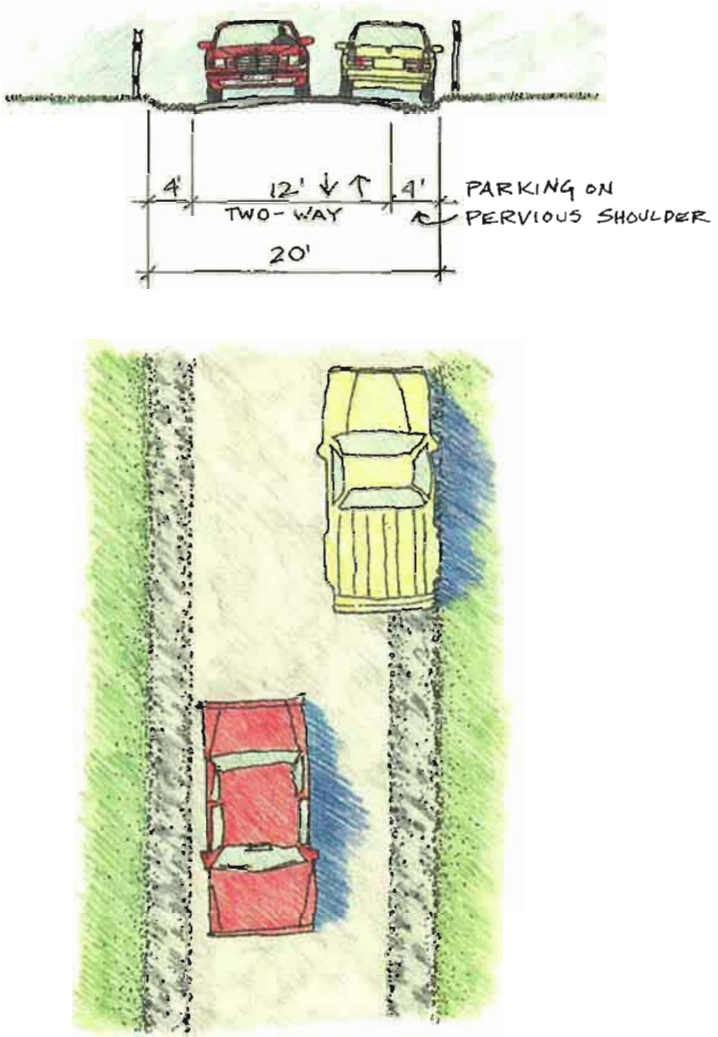



*Figure 7-21*
*Residential Alley*

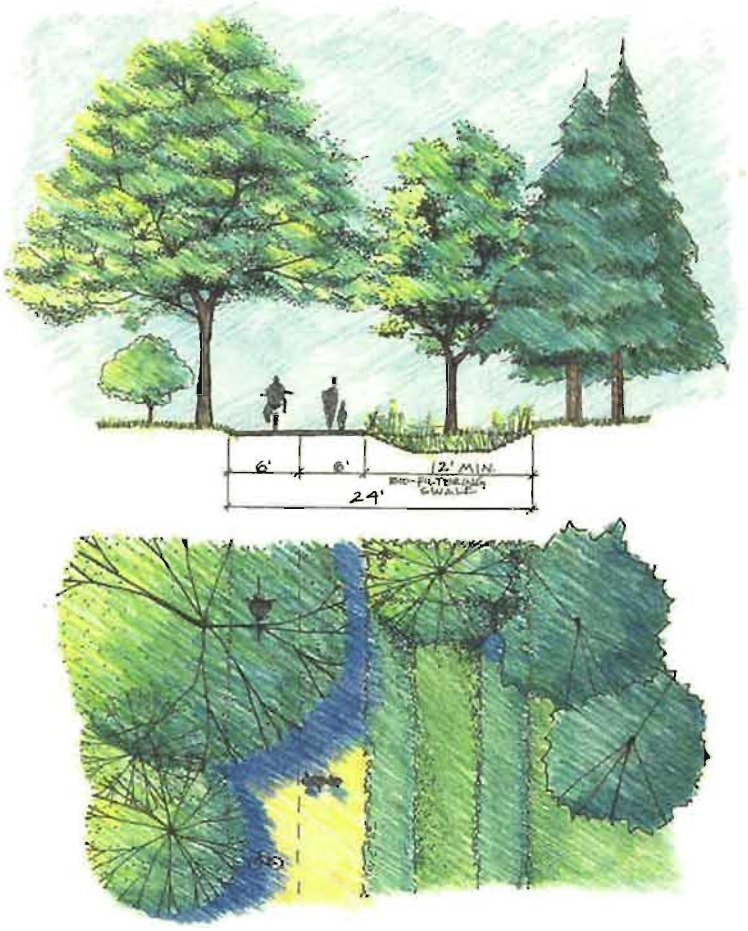



*Figure 7-22*
*Multi-purpose Path*

- Multi-purpose pedestrian/bike paths can be used where vehicular streets are undesirable or unnecessary.
- Swale is unnecessary for treatment of only path runoff if path is adjacent to vegetated areas.
- Right of way for multi-purpose paths allow opportunity to incorporate detention basins and biofiltering and/or conveyance swales for runoff collected elsewhere.
- Pedestrian/bike paths should adhere to local design guidelines although tradeoffs should be considered whether the paths are deemed recreational or transportation facility, and whether the path crosses an environmentally sensitive area.

## 7.8 Creating "Pipeless" Local Streets

In Section 8.4 Costs of Chapter 8 "Making Green Streets Happen," a discussion deals with the need for a piped storm sewer system on major streets and arterials. It is possible, with public and political will, to build less expensive "pipeless" streets on the local street system.

In order to assist local officials to explore the possibility of constructing local streets without traditional piped storm sewer systems in their community, the following preliminary list of issues to address has been created. This list addresses the lessons learned at the "pipeless" Amble Greene development in Surrey, BC, and Brookswood Development in Langley, BC (see p. 126 and 129).

Issues to address include:

- Amend development codes to keep building foundation slabs above the elevation of the conveyance system.
- Approve a standardized sump pump detail for deeper basements.
- Amend development codes to allow approval of pipeless street design when site conditions are favorable for stormwater infiltration.
- Adopt design guidelines or standards for pipeless street facilities.
- Educate and train local staff and contractors of proper construction techniques for new devices.
- Develop city code language or purchase insurance to indemnify city engineers from negligence claims (see "Tort liability" p.25-27).
- Amend development codes to encourage "skinny" street designs in residential and mixed-use areas.

- Minimize impervious surface on public facilities and elsewhere in the environment.
- Avoid concentrating stormwater flows.
- Maximize retention and infiltration on-site through code amendments, incentive programs and utility pricing structures.
- Retain native topsoils, aerate lawns and maximize soil density and organic material content in yard and culvert soils.
- Use mixed yard debris compost (a recycled material) on a major scale for erosion control (especially at construction sites) and as a soil amendment instead of bark dust.
- Keep construction silt out of the impervious stormwater devices. Provide cleanouts and bioremediation by delivering stormwater into grassy areas prior to infiltration (to trap silts).

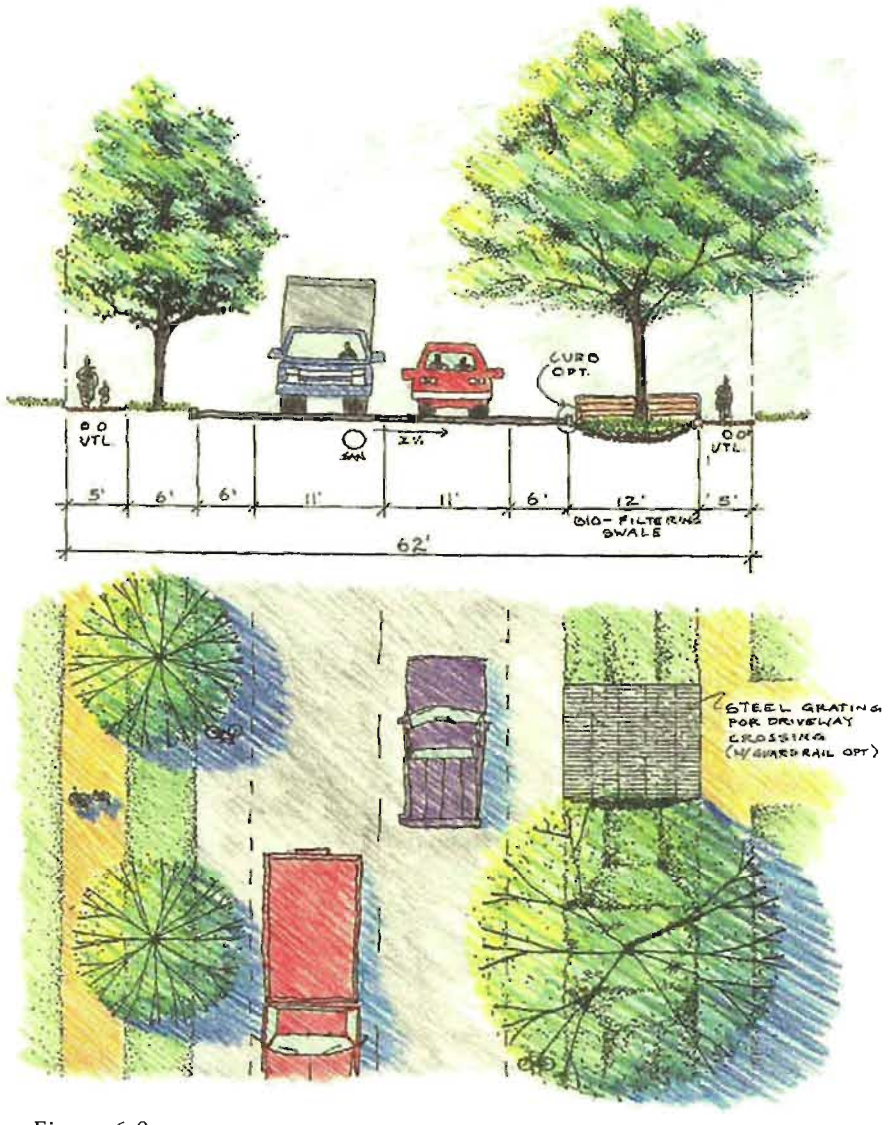



*Figure 6-8*
*Rural Road with Bio-Filtering Swale*

### Rural road

Rural roads carry rural traffic while accommodating limited transit, bicycle and pedestrian travel. These facilities allow moderate to high vehicle speeds and usually consist of two to four travel lanes. Rural roads have some street connections and few driveways. On-street parking occurs on an unimproved shoulder and is usually discouraged.

The characteristic of the adjacent land use (i.e., wide setbacks and rural character) provides opportunities for locating shared off-site treatment facilities such as detention ponds and constructed wetlands. Conveyance swales feeding into these shared facilities could be incorporated into the right of way and serve to collect drainage from the roadway.

### Local street/road

Local streets and roads are illustrated in Chapter 7 "Planning New Neighborhoods."

In summary, local streets and roads are the predominant road types within communities and therefore have a substantial impact on the quality and quantity of runoff. Just as they play a vital role in the roadway system, they also are crucial to the green streets system.

Due to lower traffic volumes and speeds, they are the most flexible in incorporating a variety of green streets solutions.