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Background and Objective

Parks and greenways can offer many benefits to urban communities in many areas including recreational, public health, and increased land value. However, there are often few opportunities to carve out a narrow, continuous green space in the built-up parts of our cities. One prospect involves using available land in rail or utility corridors; another involves radical road diets to create space along major roads. This paper examines another approach, using the right-of-way (ROW) of local streets to transform pavement into linear parks that we call Oasis Greenways. An Oasis Greenway has ultra-low motor vehicle speeds and volumes, allowing there to be a single, narrow paved area shared by motor traffic, pedestrians, and bicycles. The resulting reduction in road footprint creates space for vegetation bordering the paved area, turning the street into a path through greenway park. This paper describes the development of an Oasis Greenway concept and its application to the Fairmount Corridor in Dorchester, a neighborhood of Boston identified as a "Greenway Desert" (Furth et al, 2013).

Paradigms Useful to Oasis Greenways

The Oasis Greenway concept draws from several paradigms of urban design:

- Pocket parks, including "Parklets" from San Francisco (Salvadori, 2013) and "Better Blocks" from Dallas (Roberts, 2012) involve repurposing parking places and leftover road space for recreation and seating.
- Road diets (Burden and Lagerwey, 1999) or rightsizing (Toth, 2012) removes lanes from roads with unneeded capacity, using the redeemed space for bike lanes, wider sidewalks, and planting strips.
- Bicycle boulevards or neighborhood greenways (Portland Greenways, 2012) are local streets that use traffic diversion and traffic calming to make them suitable through routes for bikes while keeping away all except local motor traffic.
- Courtesy streets or queuing streets allow two-way motor vehicle traffic without providing sufficient width for two travel lanes. Cars pull over in informal spaces (empty parking spots, driveways) to let opposite direction cars pass.
- Woonerfs (Williams, 2012) are shared streets that have a very small footprint due to not having sidewalks or multiple lanes. They are configured to have ultra-low traffic volumes and speeds ("walking pace"), allowing them to be used as play space.
- "Green streets" use vegetation and pavement treatments to reduce stormwater runoff and filter pollutants while making it more attractive for walking and biking.
- Permeable paving allows stormwater to infiltrate, reducing runoff and supporting groundwater recharge.
- Grasscrete (used generically) is a concrete paving layer that not only allows water to filter through, but has many small gaps that allow grass to grow through it, yielding the visual

effect of a lawn while offering a load-bearing surface for vehicles (Grass Concrete Limited, 2012). It has been used for road shoulders, fire lanes, parking areas, and even some roads.

Traffic Design for Oasis Greenways

An Oasis Greenway involves both a spatial design and a traffic design. The traffic design involves getting motor vehicle speeds and volumes low enough for shared space to be comfortable. The chosen thresholds are shown in Table 1. A volume of 900 (300) veh/day means about 90 (30) veh/h during the peak hour, or one vehicle every 40 seconds (every 2 minutes).

Table 1: Speed and Volume Targets for Oasis Greenways

Measure	Target Value
Average Daily Traffic (ADT)	900 veh/day (300 veh/day is desirable)
Traffic speed	10 mph

The most effective way to reduce speed is to install self-enforcement measures in the form of vertical and horizontal traffic calming devices. Possible measures include speed cushions, sinusoidal humps, chicanes, raised intersections, neighborhood traffic circles, and traffic diversion measures that force frequent turns, with slow points spaced close together enough to that they keep traffic at 10 mph or less. Chicanes are particularly attractive for Oasis Greenways because of their "terminal vista" effect, which lower traffic speeds and increases peripheral visual acuity.

With respect to the volume target, traffic design involves diverting traffic so that motor traffic on the greenway is limited to local access only, and keeping segments short in order to prevent a large accumulation of local traffic. Traffic diversion tools include diagonal diverters, half- and full-closures, and alternating one-way streets, a technique that has been applied elsewhere in Boston as well as in the Netherlands.

If traffic can be reduced to local access, then traffic volume can be predicted using trip generation. The Institute of Transportation Engineer (ITE) publishes trip generation rates for homes (and many other land uses) based on self-report data mostly from recent projects that tend to be in suburban, auto-oriented developments. For "Single Family Detached Housing," reported rates range from a low of 4.31 daily trips to a high of 21.85 daily trips (each motor vehicle arrival or departure from a home is a "trip"), with an average rate of 9.57 (ITE, 2012). The study corridor mainly has three-decker buildings (stand-alone and detached building with three units, often with a resident owner); relevant ITE rates are 6.59 for "low-rise apartments" and 5.81 for "residential condos and townhouses." Considering the large variation in reported rates, standard rates like this should be adjusted for demographic and location factors. Because the study corridor has small, older apartments, low income, low auto ownership, and frequent bus service on multiple routes, a trip generation rate of 4 trips/day was considered appropriate.

To verify the chosen rate, volume counts were made on Maybrook Street, a short street in the corridor with 30 dwelling units that is not a convenient route for through traffic and therefore carries local traffic almost exclusively. A peak hour count found there to be 11 vehicle trips; using the standard assumption that 10% of daily trips occur during the evening peak hour, that corresponds to a trip generation rate of 11 / 0.1 / 30 = 3.67 trips/day, in close agreement with the chosen rate.

The map in Figure 1 shows the proposed traffic design for Norwell Street. It includes speed humps and chicanes (described later) for controlling speed and alternating one-way streets to divert through traffic. Traffic volume on the busiest block is predicted to be 260 vehicles per day at any point on the block, based on (1) a trip generation rate of 4 trips / day, (2) considering that on a one-way street two "trips" (one leaving, one entering) produce a single vehicle passing every point along the street, and (3) counting 50% of the trips generated on the parallel one-way street Radcliffe Street, whose residents may use the subject block of Norwell to access their homes. This figure meets the desirable volume target of 300 veh/day.

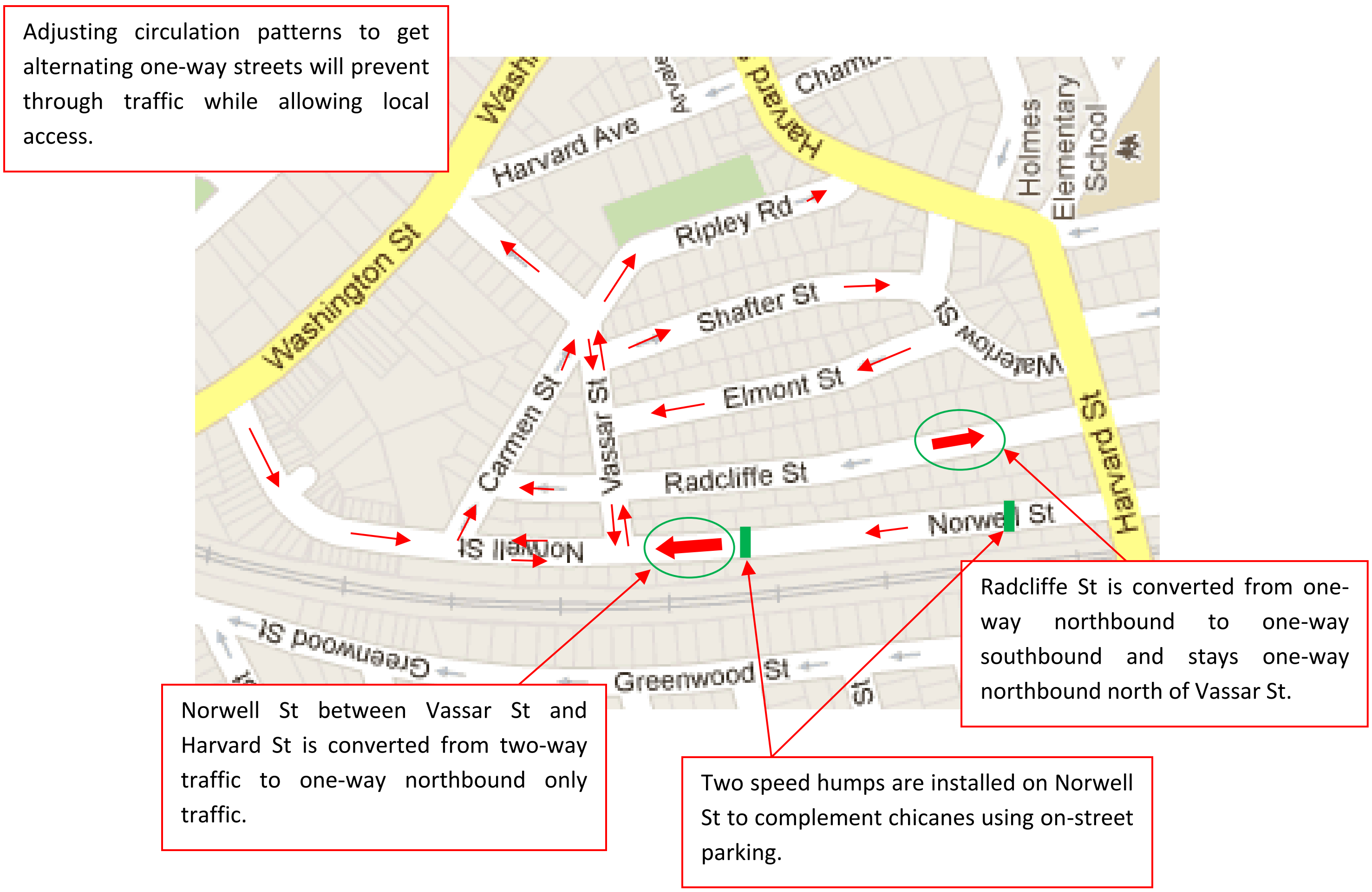

Figure 1: Proposed design for Norwell Street

Spatial Design for Oasis Greenways

A standard cross section for a 40-ft right of way is shown in Figure 2. A 14-ft wide travel zone is on one side, which will allow a slow-moving car to pass by a pair of pedestrians walking side-by-side; then, after a 2 ft buffer, the remaining 24 ft is a zone used for head-out angle parking, plantings, and parklets. Head out angled parking allows drivers pulling out to more easily see playing children and oncoming cyclists or pedestrians.The travel and park / parking zone switch sides regularly to produce a chicane effect to slow traffic and create a terminal vista. For two-way operation, the same cross-section can be used; alternatively, parallel parking can be used with a narrower park / parking zone.

In order to slow speeds and give the street a park-like look, the design uses grasscrete for the travel and parking areas except in three 5-ft no-grass strips of pavement intended to to give pedestrians and cyclists a smooth pavement surface and to allow them to avoid walking through wet grass. Two of the strips are in the travel area in order to accommodate 2-way bike traffic; the third is at the back edge of the parking zone for accessing the car trunk. Motor vehicles wheels can roll on the no-grass strips as well as on the grasscrete.

Demand for on-street parking is then determined for every block. For new apartment developments, the City of Boston recommends 1.0 to 1.5 spaces per dwelling, lowered to 0.75 to 1.25 spaces for developments within a 10 minute walk of a rapid transit station (Boston Transportation Department, 2012). This study used 1.2 spaces per dwelling as the parking supply requirement. The need for on-street parking can then be determined by subtracting off-street parking spaces, but in any event providing at least 0.2 on-street spots per dwelling for visitors (Willson 2011); the remainder of the park / parking zone can be programmed as green space. For example, on Norwell Street between Harvard Street and Vassar, the on-street parking need was determined to be 22 spots, or six for every 300 feet. Even if this supply is doubled to 12 spots every 300 feet, angle parking spaces are only 10 ft wide, leaving 180 ft in every 300 ft for trees and parklets. Some of this green space can be used to separate small groups of parked cars so that there are no long areas without trees; the remainder of the green space can be concentrated and in some cases furnished with play equipment or benches.

A plan view of an example section is shown in Figure 3. It shows the three path strips, a park / parking zone with clumps of parking spaces and clumps of trees, and a chicane where the park / parking strip is shifted to the other side of the street. Compared to the existing cross section (a 26-ft asphalt roadway flanked by a pair of 7-ft concrete sidewalks, with no vegetation in the ROW), the overall character is certainly greener and more pedestrian-scaled. More importantly, it appears that the urban greenway has been met, with a path-like shared space surrounded by a lawn and interesting planting areas offering an attractive environment for sitting, walking, cycling, and playing.

Connectivity: Routing Choices and Dog Legs

Route following residential streets often aren't naturally continuous, because residential streets are often planned with deliberate discontinuities in order to deter through traffic. Figure 4 shows an example of how Norwell Street and Eldon Street, another residential street that could be the continuation of the Oasis Greenway, both meet Washington Street (a minor arterial) at 3-way intersections, with an offset of 360 ft separating the two residential streets. Connecting those streets means that greenway route includes a 360-foot dog-leg along Washington Street.

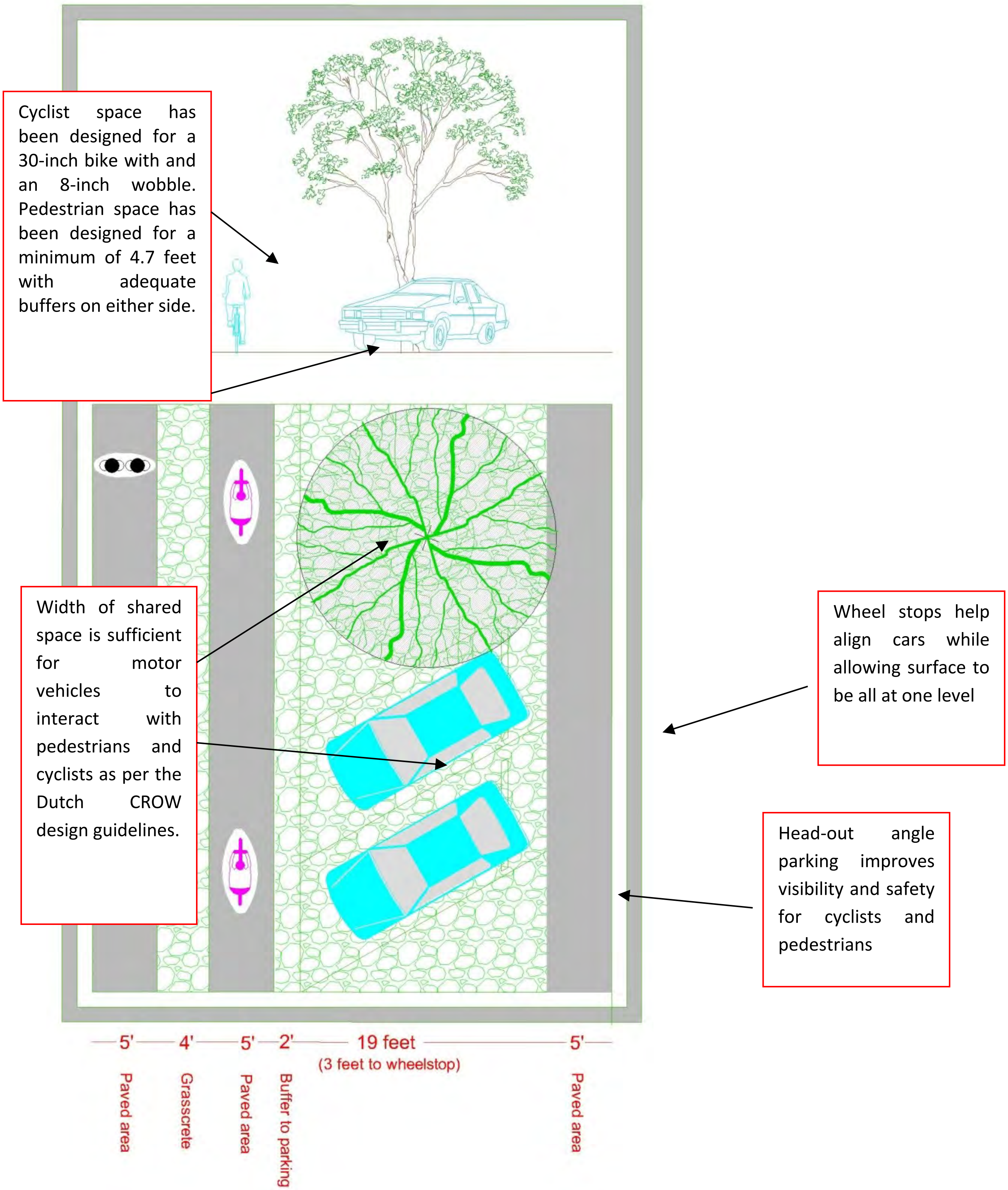

Figure 2: Cross-section and close-up Plan-view for a generic Oasis Greenway

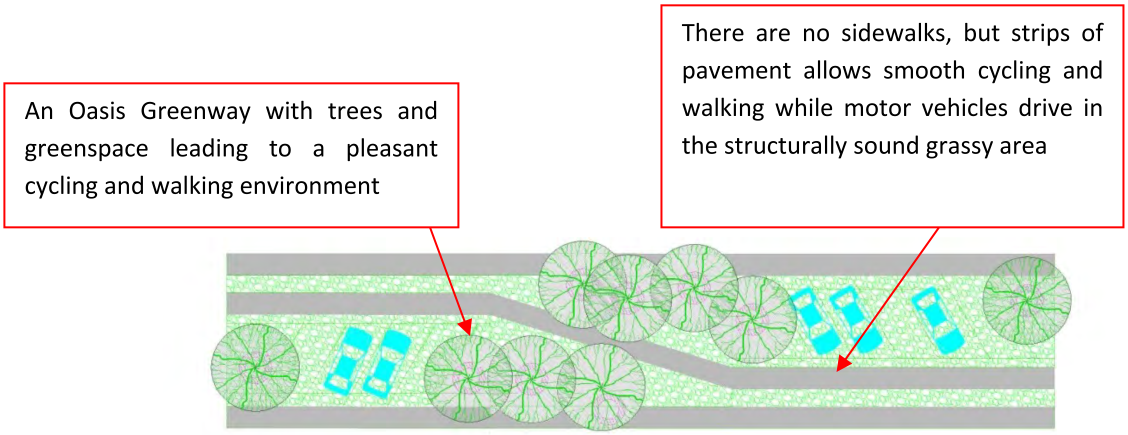

Figure 3: Example Plan for an Oasis Greenway

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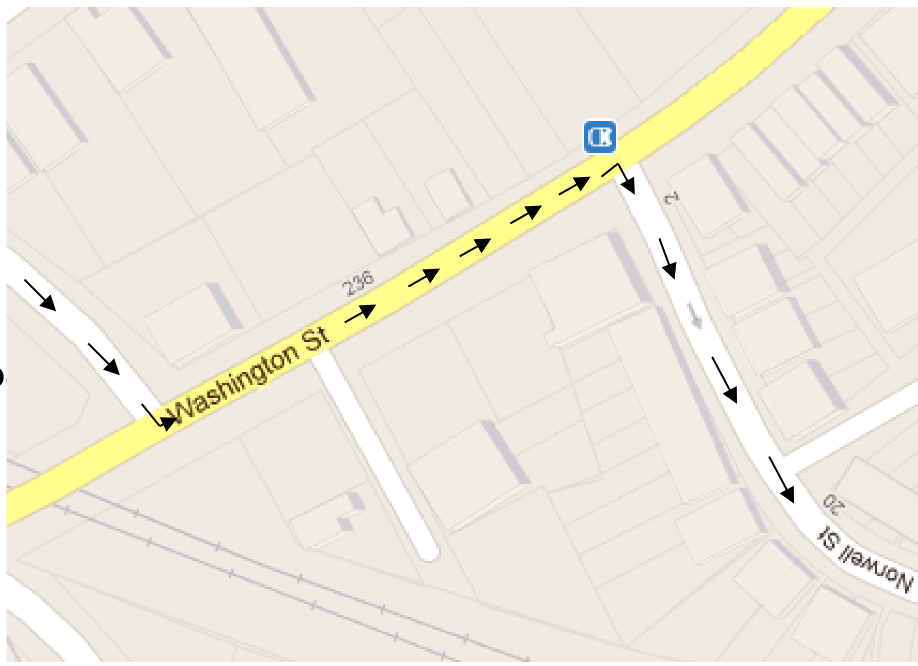

Figure 4: Dog-leg Intersection separating Oasis Greenway Streets

Because sidewalks are available along Washington Street, such a dog-leg is not a substantial deterrent to walking; however, because the sidewalks are too narrow to be shared for cycling and the road carries heavy motor traffic, dog leg intersections can be major obstacles for an Oasis Greenway to serve as a low-stress and continuous bicycling route, unless a low-stress bicycling facility is provided the length of the dog-leg. Figures 5 and 6 show a possible design for a "dog-leg cycle track," a short section of cycle track connecting a pair of offset residential streets. Its design assumes the removal of a parking lane for the dog-leg section, replacing it with a bike path. An existing example of a dog-leg cycle track can be found in Portland, where a short section of sidewalk-level bike path along NE 33rd Avenue connects two offset segments of Going Street, a "neighborhood greenway" offering low-stress bicycling. Unlike Going Street, this proposed jog cycle track includes street trees in order to continue the green character of the route.

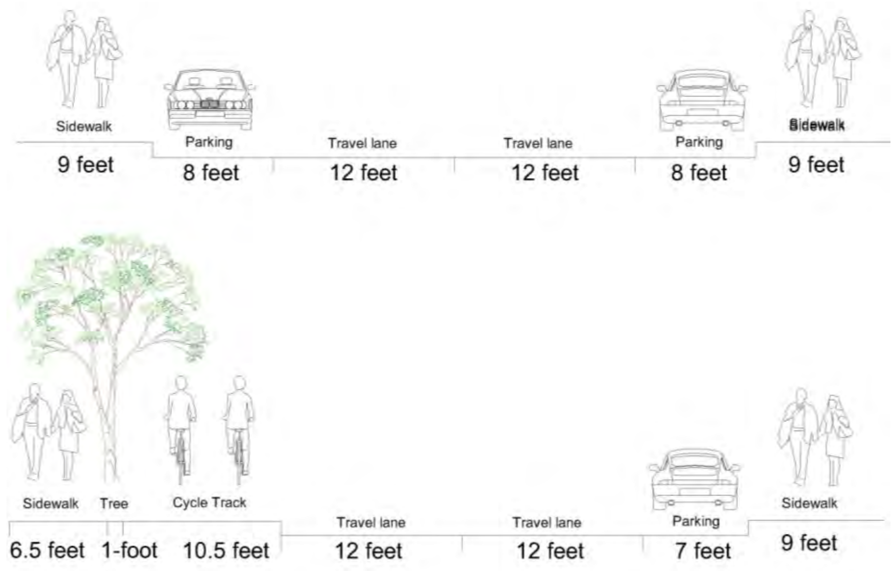

Figure 5: Existing and proposed cross-sections for a Dog-Leg Block on Washington Street

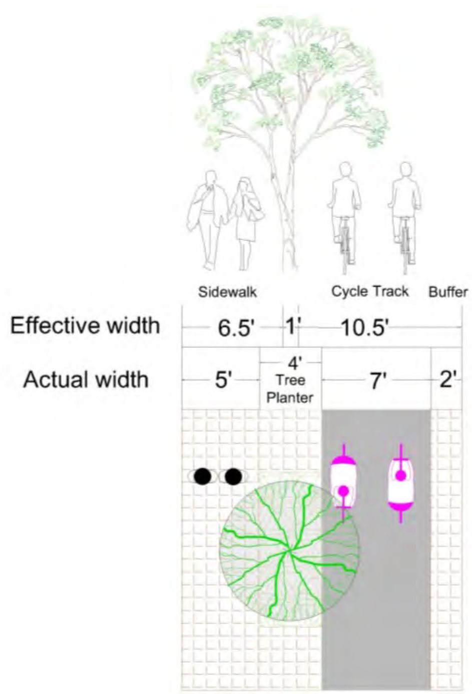

Figure 6: Physical and Functional Dimensions for Jog Cycle-Track Sidewalk Area

Connectivity is also an important consideration in route selection, trying to finds residential streets that can be strung together in a way that minimizes inconvenience and loss of greenway character where the route transitions from one street to the next. For example, in the Fairmount corridor there is a choice between Greenwood Street and Norwell Street, residential streets lying on opposite sides of the railroad tracks between Harvard Street and Washington Street. Both are amenable to Oasis Greenway treatments based on traffic and space criteria. The choice between them therefore depends more on connectivity. At the northern end, Norwell requires a larger jog cycle track to reach Eldon Street than would Greenwood, involving additional parking removal and road construction expense; however, at the southern end, Norwell connects directly to another local street across Harvard Street, while Greenwood Street would require another jog cycle track.

Conclusions

Oasis Greenways have been proposed as a way to create a greenway in a dense urban area using the right of way of local streets. Combining paradigms including the woonerf, bicycle boulevard, parklet, and green street, an Oasis Greenway aims to provide a continuous path in a park environment while preserving access to people's homes. Application to a short section of the Fairmount corridor in Boston's Dorchester neighborhood demonstrates the concept, with solutions that address the traffic, space, and connectivity needs inherent in the concept.

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