Analysis

Decisions and design choices made throughout this project were based on a variety of important characteristics of the existing and future conditions. Both city-wide and site specific analyses were performed to understand what the individual opportunity parcels and greenway as a whole could support and what level of development could be accomplished. To make these decisions, a combination of field observations, site visits and Geographic Information Systems (GIS) analysis were performed. The analyses examined a combination of sociopolitical, transportation and geological information. Design decisions were made by incorporating this information with the desires and stated program of the project client, the Allen Creek Greenway Conservancy. The Allen Creek Greenway is approximately 12,000 linear feet in length, intersects or is adjacent to a multitude of different land owners and stakeholders, and represents a major capital investment. This was recognized by the practicum team early on in the design process, leading to a phased development approach that breaks the comprehensive greenway vision into incremental, manageable pieces.

Some of the land use characteristics that needed to be understood when designing and laying out the greenway included items such as: parcel boundaries, rights-of-way, existing parks, land use and neighborhood character, roads, and the exact location of the rail line. These data were acquired in multiple forms but most useful was the GIS vector and raster data form from Washtenaw County, the Michigan Geographic Library, and the City of Ann Arbor.

Using GIS to compile this data, essentially making visual overlays, made it easy to view all the inputs at one time and make comprehensive decisions. For the layout of the greenway, possibly the most critical of all these data was the railroad right-of-way (ROW). The RR ROW had previously been identified by the Greenway Task Force as the desired route of the greenway through Ann Arbor. Unfortunately, RR ROW-specific shapefiles or location data was not available. Therefore, the ROW was created based on the parcel boundaries of properties along the RR. Using these properties, a ROW was created for the stretch of the railroad running through the city. The location of the rail line itself was available through both GIS data and visual analysis of high resolution satellite imagery.

GIS Analysis

Thanks to the previous work of the Greenway Task Force, the general area and route of the greenway had already been identified. One of the project’s goals was to

Figure 17: (enlarged in Appendix VI) Example of GIS analysis:distance in ROW from active rail

look more closely at the RR ROW and actually determine where within the ROW the path should be located. This was accomplished by performing a GIS-based, least cost path analysis for the ROW and making adjustments based on field observations. The inputs or variables that were included were ROW width, distance from the center of the rail line, and topography. Using GIS, a friction (cost) surface was made for each of these inputs. The wider the entire ROW, the lower the cost, because there would be more room for the path (Fig. 17) . The closer to the rail line, the higher the cost, because there would be less room on that particular side for separation from the active rail. Topography was used to determine the steepness of slope within the ROW because building on level ground is easier than in areas with significant elevation change. These separate cost surfaces were then combined and given weighted influence on the final cost path. For instance, as the ROW width was given a greater percentage of influence, the other two cost surfaces had to decrease their influence. Combining these three cost surfaces and running a least cost path software tool, a series of cost paths were identified; this can be seen in the series crossing details showing three separate least cost paths which vary based on each factor's influence. (Fig. 19, 20, 21). The path options given from this GIS analysis were then adjusted based on judgments from the field to give the final location of the greenway path.

Identifying existing parks was important in order to show their proximity to the proposed greenway. There is a noticeable void of greenspace in the downtown area of Ann Arbor, as noted by the Greenway Task Force, and the addition of the three identified city-owned opportunity parcels and the greenway would significantly ameliorate this lack (Fig. 18).

The zoning and land use data was useful in determining the character of the areas bordering the greenway. This was particularly important when considering any type of development for the opportunity parcels. For example, it would not be sensible to locate a seven story parking structure next to a residential area. Both 415 West Washington and First and William are located more directly in the downtown core

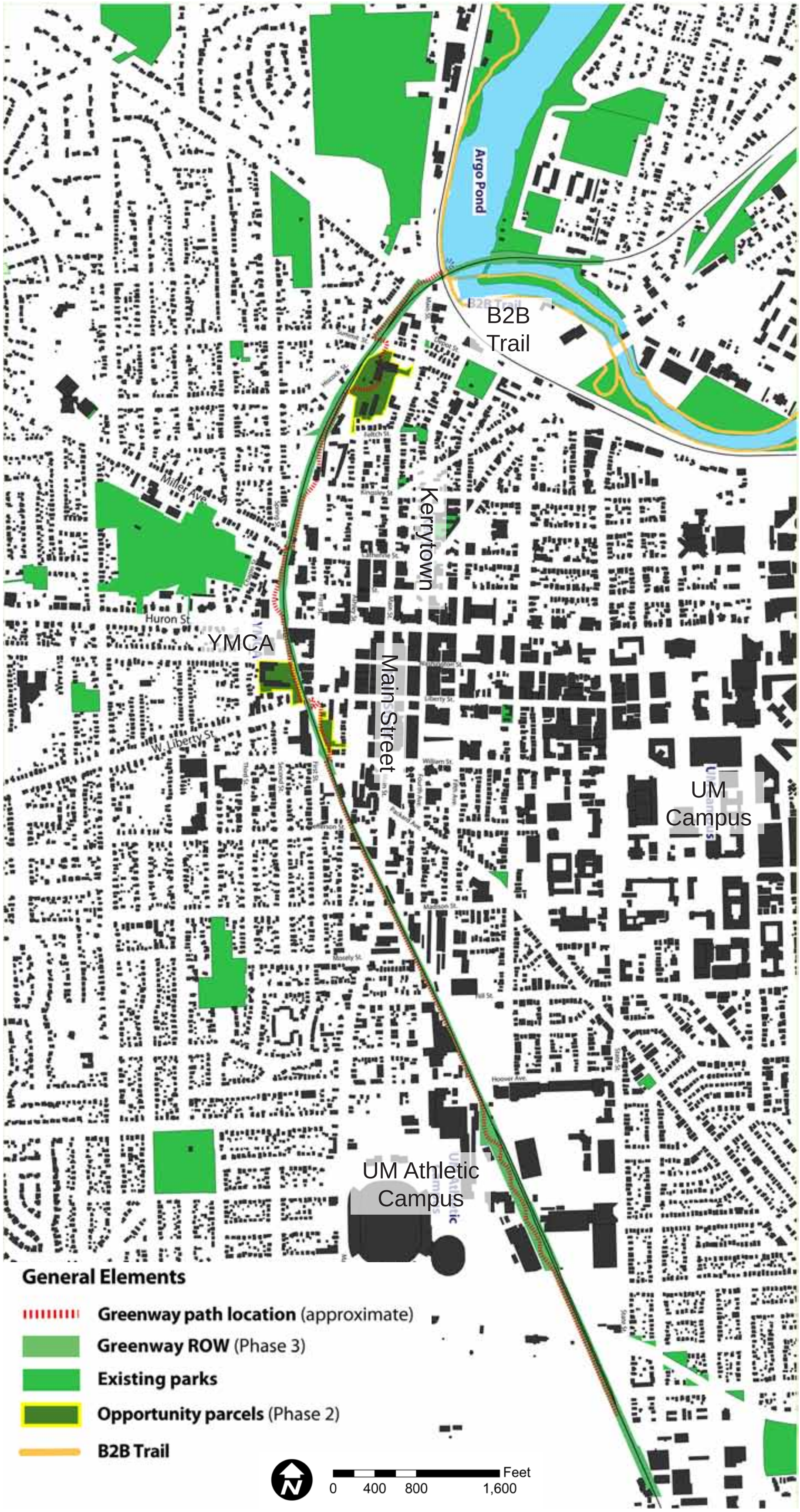


Figure 18: Location of parks in proximity to the greenway; note the lack of greenspace in the downtown core to the east of the greenway.

Figure 19: (enlarged in Appendix VI) Least cost path example from northern portion of greenway
Figure 20: (enlarged in Appendix VI) Least cost path example from downtown portion of greenway
Figure 21: (enlarged in Appendix VI) Least cost path example for southern portion of greenway

and have residential areas to their west and the downtown shopping district to their east. The northern site, 721 N. Main, is not as close to the downtown district but is also characterized by residential areas to the west (Fig. 22). While the individual owners of each neighboring parcel did not have a great effect on the team's decision making, it is important to note that there are many bordering landowners. This will mean that for easements and possible off-site connections there will need to be many separate agreements.

Another aspect that was analyzed was the greenway's connection to different parts of the city. There are many on-street connection opportunities such as connecting to the Main Street shopping area, UM Campus or Kerrytown (Fig. 23). Marking these routes and making them highly visible could help bring more users to the greenway. It could also work in the reverse direction as people using the trail to commute then use it to access the downtown. As important as the existing land use background information was, it was not the overarching factor when determining if and how much to develop on any of the three parcels. The more important factor was the floodway and floodplain which will be discussed in the Geological section.

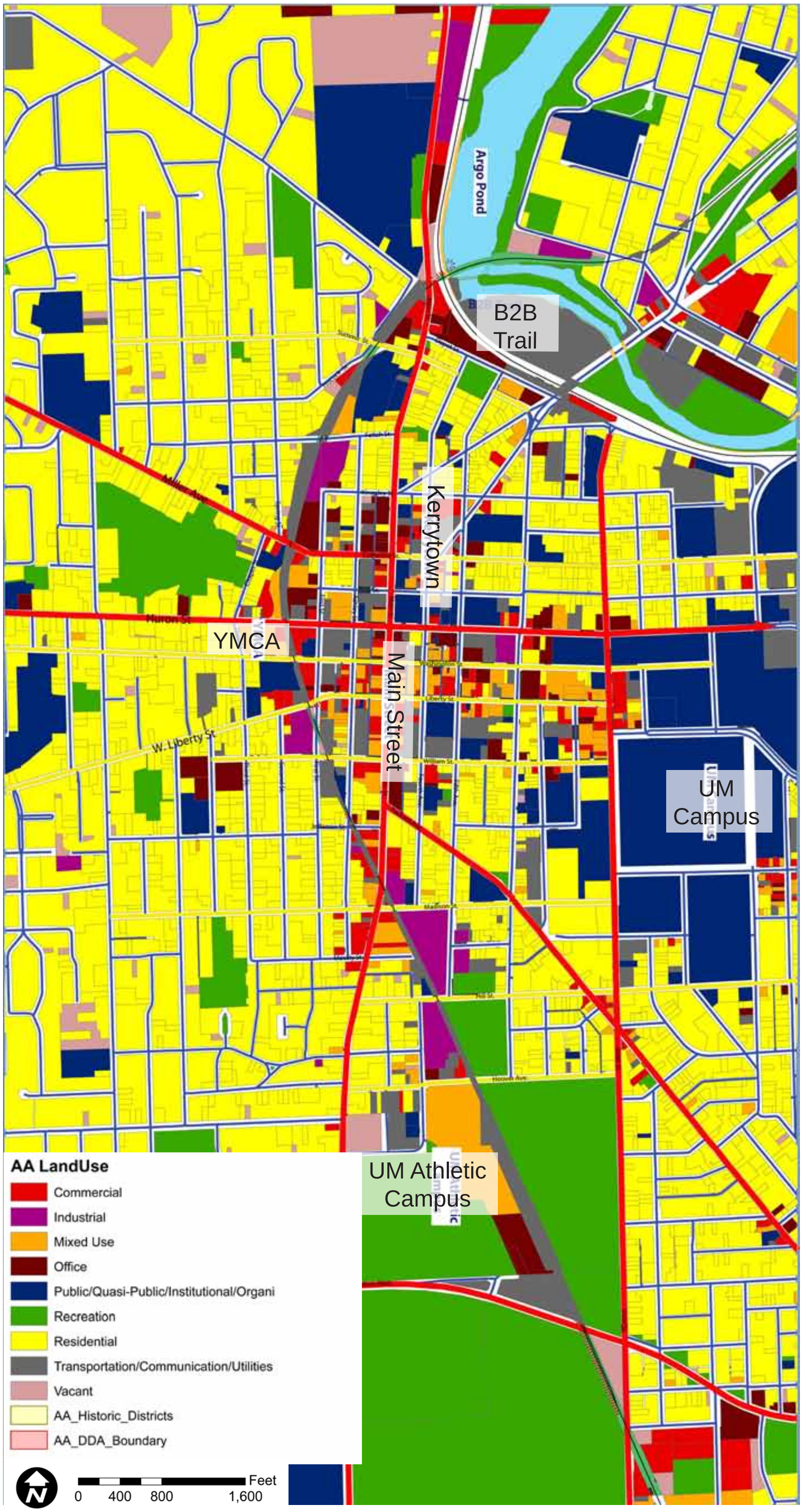
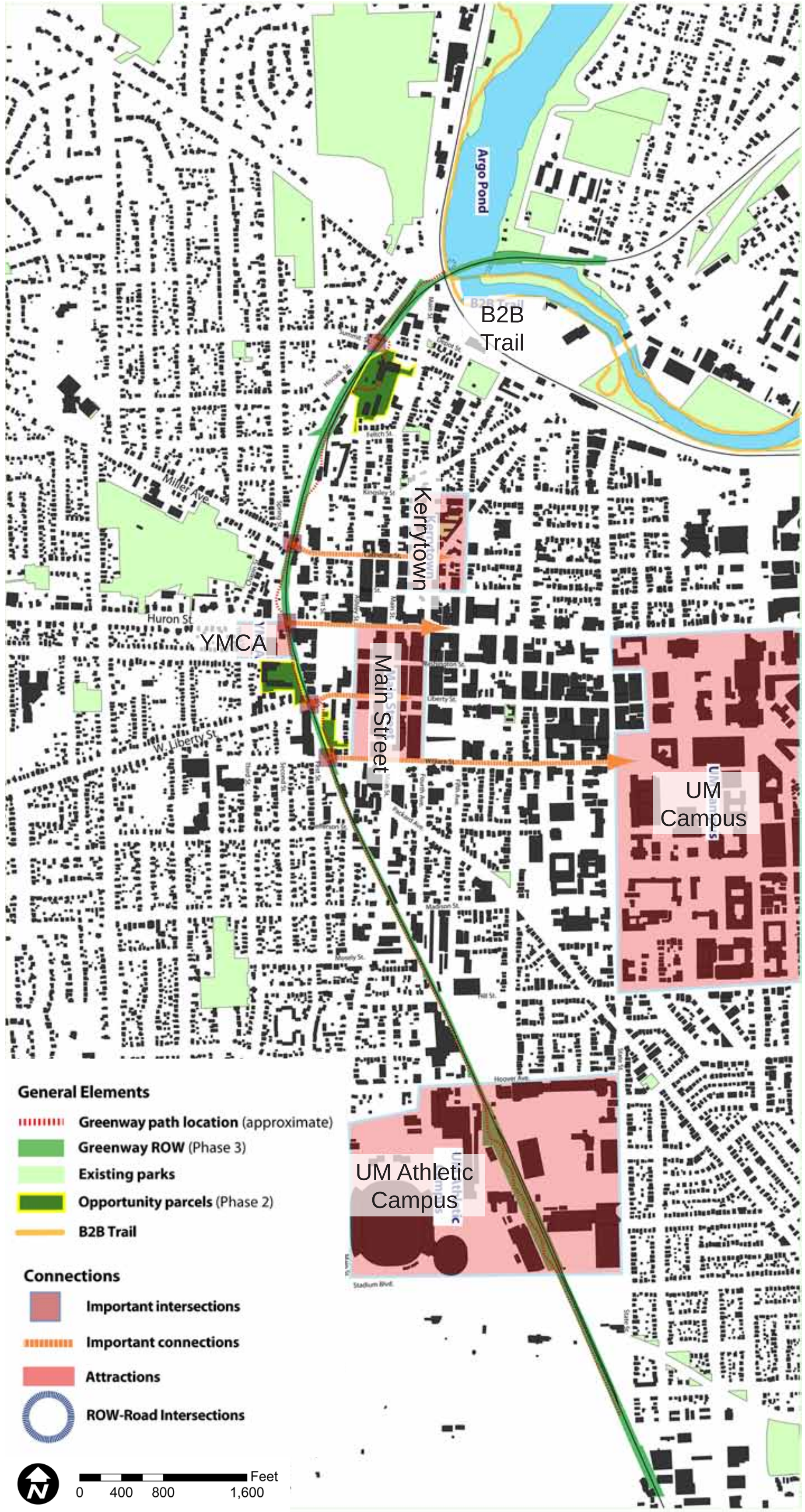


Figure 22: Aggregated Ann Arbor zoning categories adjacent to the greenway.

Figure 23: Connectivity between the greenway and significant Ann Arbor features, including the downtown, Kerrytown historic district, University of Michigan, and U of M athletic campus.



Transportation

The Allen Creek Greenway is more than just a connection between parks and greenspaces: it also will be a transportation route. One of the goals for the greenway is to provide a new route for non-motorized transportation into and out of the city. This non-motorized path would serve as both a recreational amenity to local residents and as a commuter route.

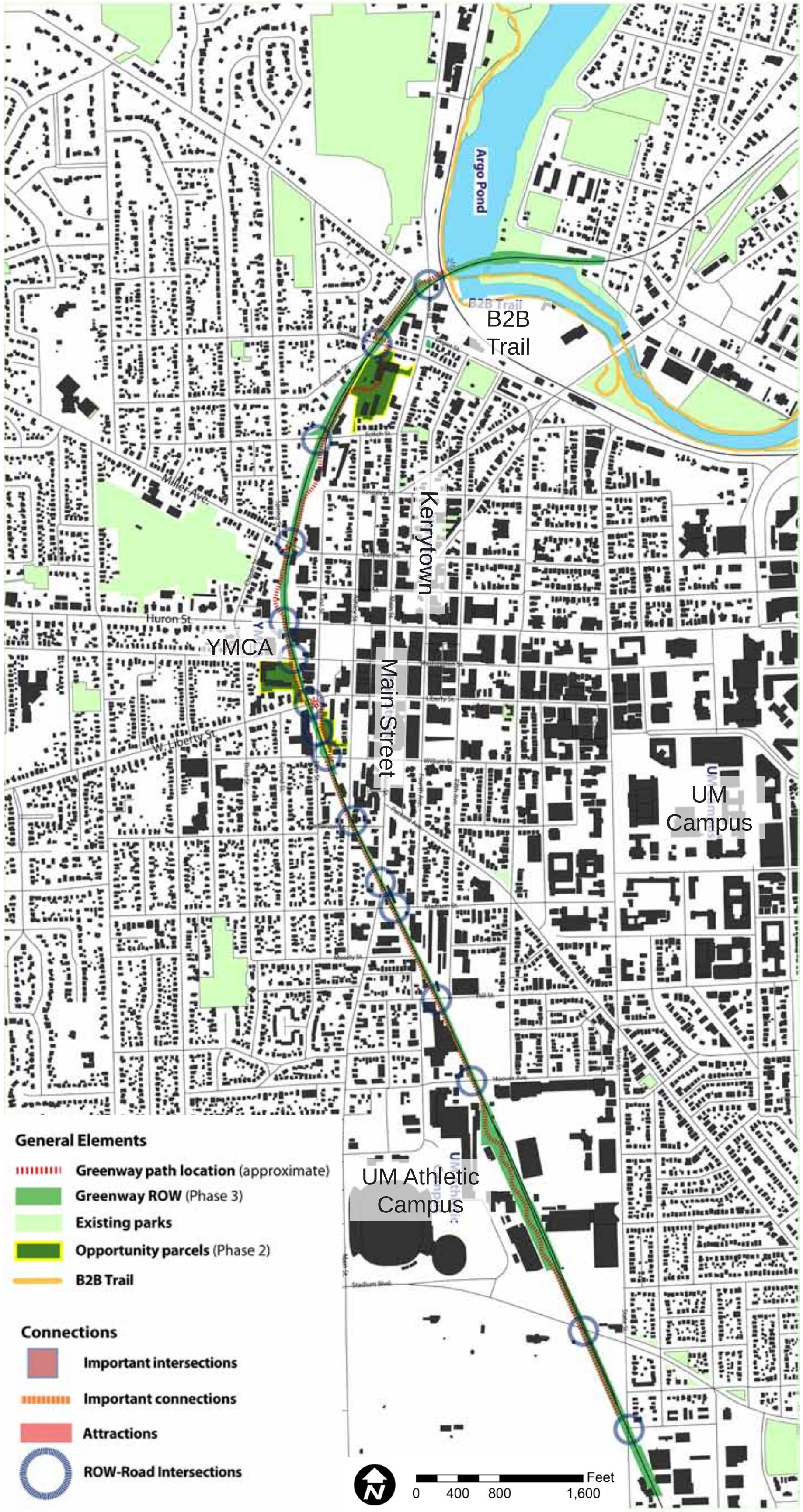
Figure 24: Downtown segment of the railroad at grade.

Figure 25: Northern segment of the railway elevated.

Another item that was considered when laying out the greenway were the existing roads, both county and city. The roads were important on two fronts. By using the RR ROW as the desired path for the greenway, the path must intersect roads (Fig. 26). This means that the interaction between the greenway and roads at intersections must be taken into consideration. When pedestrians have the potential to interact with vehicles, safety must be a priority. The varying topography of the city and the elevation change of the RR provided a variety of crossing types to examine, some crossed at grade (Fig. 24) and others running below the rails where the RR was on a bridge (Fig. 25). This means there will need to be multiple types of greenway/road intersection types. The RR ROW becomes elevated on a berm as it moves north toward the river so it can cross the river and N. Main St., creating these additional crossing challenges.

Traffic count information was also gathered from the Washtenaw Area Transit Study (WATS) for each of the roads that intersected the greenway and other major roads throughout the city. The roads were separated into 3 categories based on their

Figure 26:
Road-greenway intersections



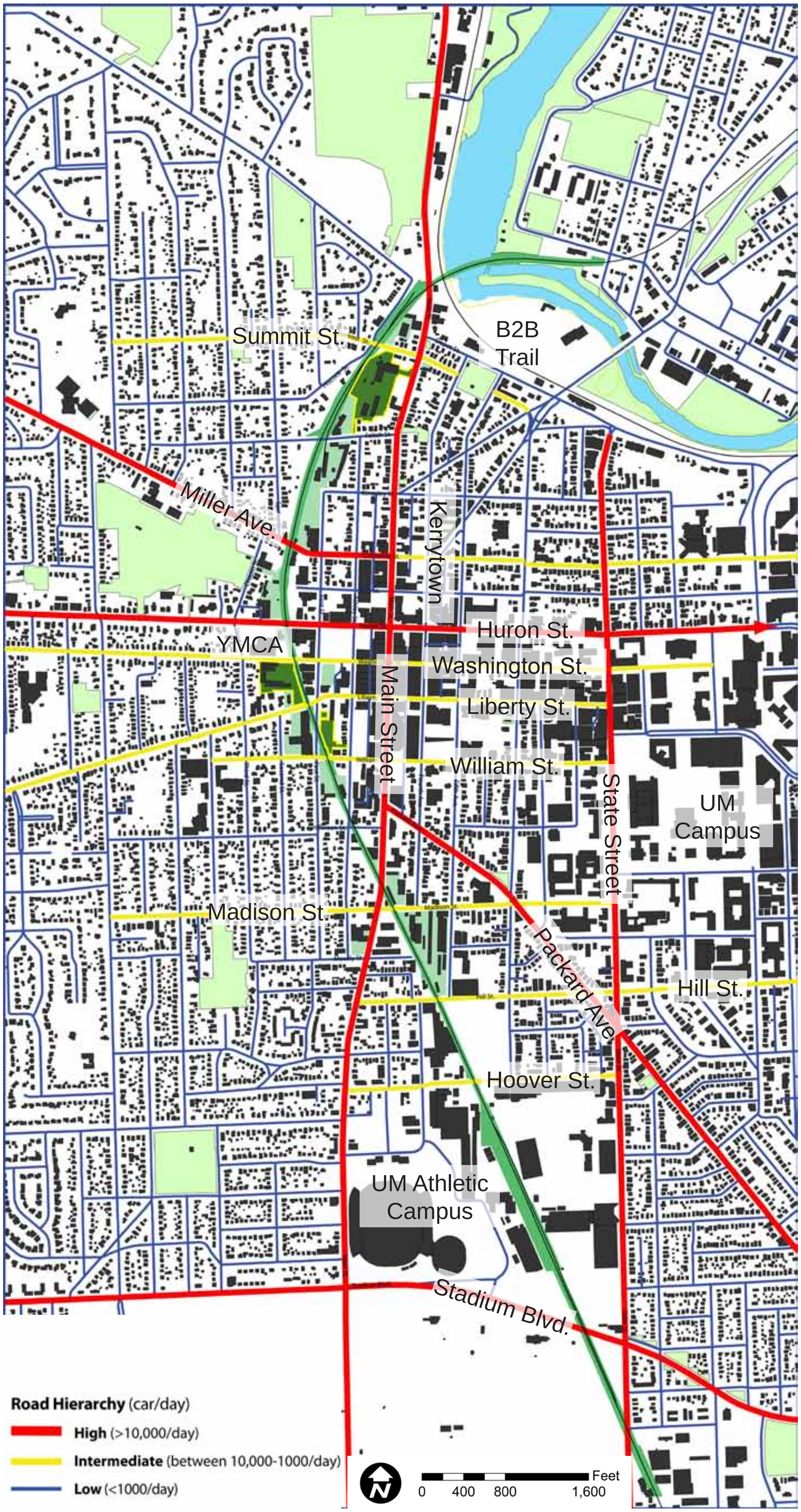


Figure 27: Diagram of road hierarchy in central Ann Arbor

traffic counts (Fig. 27). High volume roads had greater than 10,000 cars/day, intermediate roads between 10,000 and 1,000 cars/day and low volume roads less than 1,000 cars/day. This road hierarchy was important during the development of Phase 4 of the implementation plan.

The second important aspect of the roads and transportation analysis was the existing level of non-motorized traffic. Using the city's non-motorized transportation plan maps, it was easy to see the level of design and planning existing for each street and the level that is proposed. The streets vary from having bike lanes on both sides, shared use paths, signed as a bike route and still others only having sidewalks (See Appendix II for Non-motorized transportation plans).

Land Character (Greenway)

As the general location of the greenway was predetermined before this project, the geological information gathered was more for general knowledge than influences on the design decisions. The soil maps for the area mainly show urban soils, which means in many cases there is likely to be some level of contamination. This is also because the greenway is proposed as being within the RR ROW, where exhaust, oils and pesticide spray are likely to have been used. However, because the designs use a paved path, contamination is not a huge concern. Native plants and other special plant types could also be used along the trail to mitigate limited contamination.

The topography of the area was of interest for the greenway design because the steeper the slopes, the more difficult to traverse and to build on. These changes in elevation are why the RR becomes elevated on a berm as it moves north. This is also mentioned in the GIS analysis section.

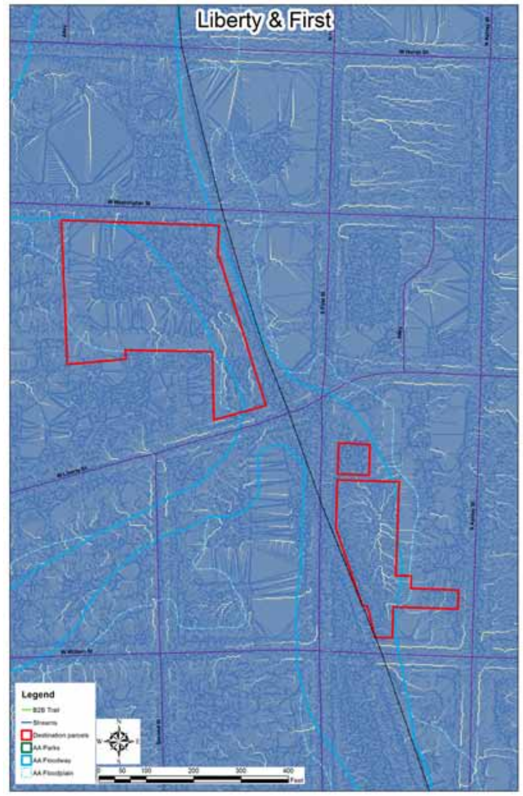
As has already been described in the Watershed Character section, the Allen Creek is significantly prone to flooding. This is important because, as previously described, the Allen Creek is diverted under the city in a culvert which roughly follows the RR ROW through the Allen Creek Valley, meaning that it is also prone to collecting more rainwater than other parts of the city. This also means that the floodway and floodplain expand from this area. According to current federal regulations, any development that is within a floodway must not increase flood height (FEMA, 2010). This restriction means that the only structures permitted are commercial day-use buildings on stilts. However, an engineering analysis should be conducted in most instances. As is evident from the review of the City Flood Management Plan, (see previous water quality section) the desired route of the greenway along the RR ROW falls almost completely within the floodway. This is particularly important to the

Conservancy because of the aforementioned restrictions on structures in the floodway. If the City chooses the more ecologically solvent plan of keeping the floodway portions greened, this corridor can significantly contribute to the City's network of greenspaces. The presence of connected green corridors is considered essential for the maintenance of a healthy urban ecosystem (Opdam & Steingröver, 2008). Besides gaining ecological equity, a greened floodway would also increase the land values adjacent to it (Searns, 1995, p. 77).

Land Character (Opportunity Parcels)

When looking at the three opportunity parcels, there were several types of data that were useful. The topographic information was necessary for site design and developing waterflow analysis for the sites. Using a digital elevation model (DEM) obtained from the Michigan Geographic Library, the topography was created. Both First and William and 415 W. Washington have areas with significant grade change that had to be dealt with. On First and William, the area extending to the east towards South Ashley Street is very steep and needed to be designed as a set of switchback ramps in order to be fully accessible to people with disabilities. On 415 W. Washington, the southwest corner of the site had a great deal of grade change that needed to be managed and several of the design options used this area as an amphitheater.

Using the DEM, a hydrologic flow analysis was performed for each site which showed where most of the water was



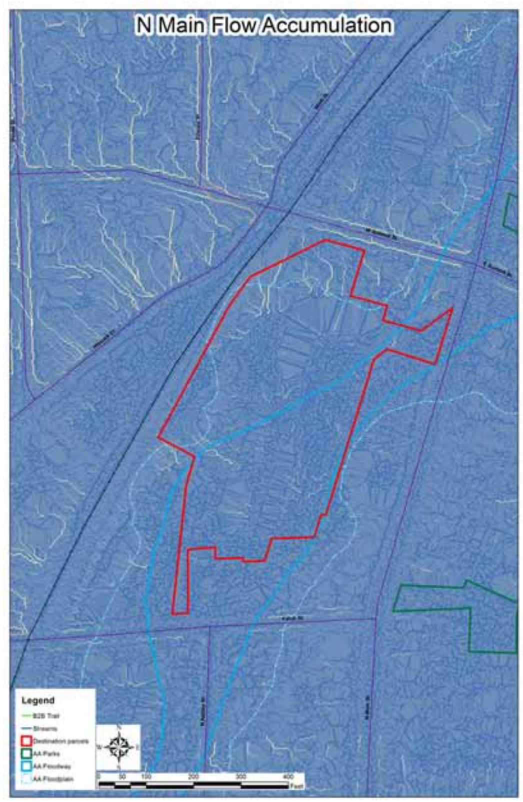


Figure 28: (enlarged in Appendix VI) Hydrologic flow diagram for downtown parcels

Figure 29: (enlarged in Appendix VI) Hydrologic flow diagram for northern parcel

accumulating on site (Figs. 28, 29).The lighter colors and white are areas that accumulate the most water. It was also important to note where the floodway was on each site as this determined the level of development that could occur. First and William and 415 W. Washington are, respectively, completely and partially within the floodway, an area that cannot accommodate new structures unless stilted. . However, because 415 W. Washington has existing buildings, those buildings could be reused, and several of the design alternatives explored keeping some of the buildings. The 721 N. Main site is not completely in the floodway, which means that the designs could propose a structure in the development of the parcel. This parcel is also the largest of the three, potentially having room for a mixed-use structure to the west edge, which is out of the floodway. Because of its size, it could still provide open space to the east.

Contamination of these three sites was also a concern and had been previously studied by the greenway task force. The southernmost opportunity parcel, First and William, is still contaminated and is capped with the existing parking lot. Designs for this site would not allow percolation of collected water through the soil as this could transfer contaminates to the groundwater, so any rainwater treatment would have to involve remediation of the site first. However, areas of phytoremediation were proposed which would alleviate some of these contaminates on-site. Portions of the next site, 415 W. Washington, remain impacted by the ongoing flux of contaminated ground water and requires periodic pumping treatment to meet acceptable limits. The northernmost site, 721 N. Main, is believed to be remediated to residential use levels. The remediation of this site allowed for designs with much larger bioswales and natural area plantings than the other two sites.

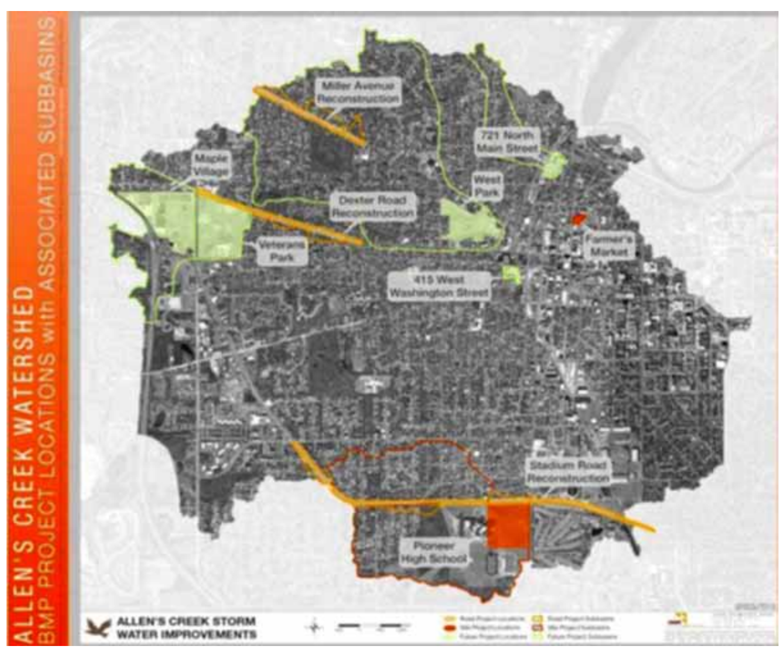


Figure 30: (enlarged in Appendix VI) Map of low impact development (LID) stormwater management projects within the Allen Creek Watershed (Sheehan, H, et al. 2008, p4)

Stormwater Analyses

The City of Ann Arbor and Washtenaw County Water Resources Office are working to decrease the strain on the existing Allen Creek Drain (the buried pipe) by employing a LID (Low Impact Development) distributed system of stormwater strategies (Fig. 30) (Sheehan, H., et al., 2008, p.4, 30).

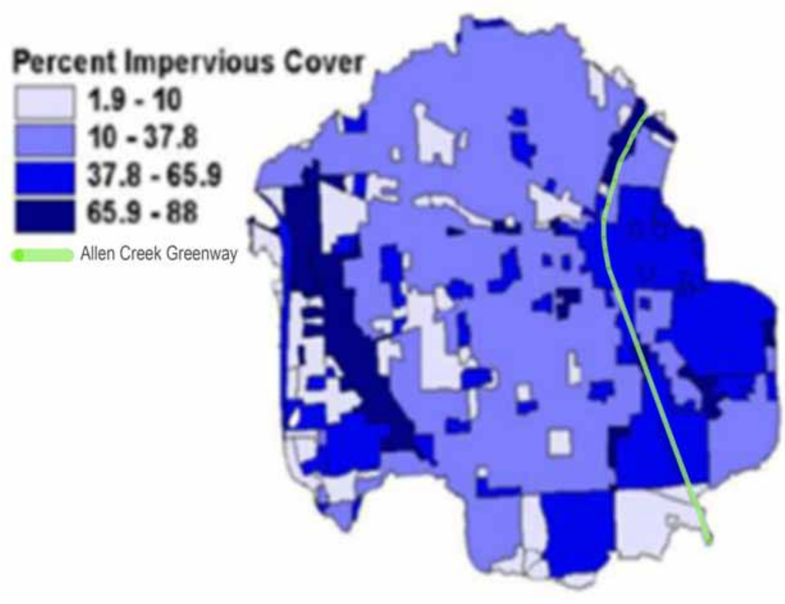


Figure 31: Impervious cover within the Allen Creek watershed (Sheehan, H, et al. 2008, p32)

The estimated volume of water flowing through the Allen Creek Drain, a 7'x 9' box culvert (Fig. 32) during the 100-year rain event is approximately 2,100cfs (cubic feet per second), translating to 15,709 gallons per second (Allen Creek Greenway Task Force, 2007,p.41) (Sheehan, H., et al., 2008, p.38). This large volume of water traveling through the culvert suggests that the best strategy for reducing flood risks is to prevent the water from entering into the pipe in the first place. According to Sheehan et al., a general rule for achieving "significant flood reduction requires storage that is 5%-10% the size of the total contributing area" (2008, p.38). The Allen Creek Watershed is approximately 3,150 acres which includes 44% impervious surfaces (Fig. 31)(Sheehan, H., et al., 2008, p.38). This means that between 157.5 and 315 acres of land throughout the Allen Creek watershed need to be dedicated to flood reduction and water quality control; the best way to find that amount of space in such a developed area is to use a series of distributed, strategically located structures, a strategy employed by LID.

Figure 32: Example of a box culvert

Using LID techniques, the practicum team made each of the three city-owned parcels runoff neutral by capturing and filtering, at minimum, the bankfull storm event for on-site runoff. The bankfull event was chosen because the three city-owned parcels receive direct runoff received from adjacent parcels (ALlen Creek Greenway Task Force 2007, Appendix p.1). According to the Allen Creek Greenway Task Force, the bankfull event is the 1.5 year storm event, or 2.3 inches of rain in a 24 hour period (2007, Appendix p.1). The Task Force also indicates that flooding begins in Allen Creek with the bankfull event and that attempts at storing significant volumes flowing through the creek could have adverse effects on overall flooding patterns (2007, Appendix p.1). Another reason to focus on the distributed treatment strategy is to serve as a catalyst and precedent for Ann Arbor to illustrate how effective LID can be in controlling runoff volume and improving water quality. The remaining drainage areas should be retrofitted with additional LID structures that complement each other and provide volume reduction and additional filtration beyond what the three sites can provide.

First Street and William Street is the smallest of the sites, with a surface area of 1 acre. However, because of its position in its landscape, it receives runoff from a total of 2.4 acres. However, because the site is contaminated with water-soluble arsenic and benzene, allowing stormwater to infiltrate through the soils could be detrimental to the larger groundwater table. The practicum team concurs with the phased approach to remediating this site presented by the Task Force; however, stormwater can still be collected by using impervious surfaces to direct water into an underground storage system to allow for full capture of the bankfull event. Using underground storage also maximizes the potential space for conversion to an urban garden plaza on such a small site while maintaining separation between the runoff and contaminated soils.

415 W. Washington has a total site area of 2.5 acres and a drainage area of 5.5 acres; this means that in order to achieve significant flood reduction storage, between 0.275 and 0.55 acres of the site need to be devoted to stormwater (Washtenaw County, 2007, p.1). The practicum team was easily able to achieve two times bankfull storage on 415 W. Washington through a vegetated swale system for on-site runoff that also provides contaminant filtration.

721 N. Main is larger than 415 W. Washington (5.1 acres) but has a much larger drainage area of 70 acres (Washtenaw County, 2007, p. 1). To have significant flood storage on 721 N. Main it would require between 3.5 and 7 acres of land area. The practicum team took this information, in combination with discussions with the City of Ann Arbor's water resource planners, and chose to directly capture the bankfull event through the swale and rain garden system. The remaining drainage area should be accommodated through use of LID techniques upstream. The practicum team's analysis and conclusions are supported by those of Washtenaw County (2007, p.1).

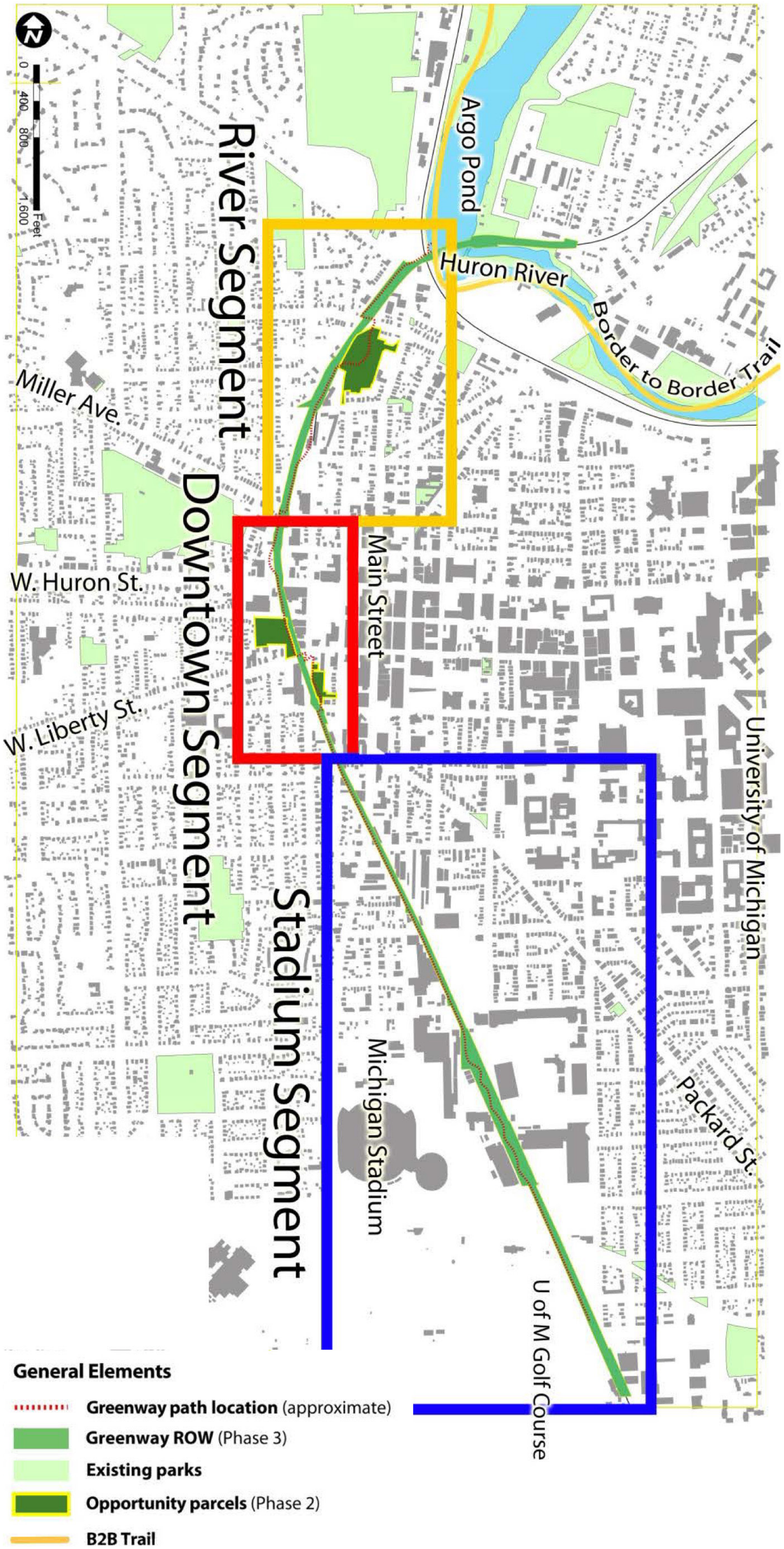


Figure 33: Segments of the Allen Creek Greenway