Phase II Technical Studies—
Construction Phasing

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The **vision42** proposal is a citizens' initiative sponsored by the Institute for Rational Urban Mobility, Inc. (IRUM), a New York City-based not-for-profit corporation concerned with advancing cost-effective transport investments that improve the livability of dense urban places.

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vision42 CONSTRUCTION PHASING

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1. Executive Summary

The Construction Phasing scope of the vision42 project includes development of a conceptual construction staging plan for reintroducing approximately 2.5 miles of light rail system on 42nd Street river to river in Manhattan. The following assumptions were made when designing the Construction Phasing Plan, as directed by vision42 and the consultant team:

- The street would become auto-free at outset of construction.
- Delivery methods for hand carting from avenues are in place as per traffic study.
- An emergency/transit lane will be maintained until rail service begins.
- Temporary amenities for pedestrians will be provided during construction.
- Transparent construction fencing, seating, exhibit and plantings will be used to engage public's interest during all phases of construction and operations.

Two options were considered:

Option A: with minimum utility replacement
Option B: with full utility replacement

The overall construction methods and timing are broken into 3 segments and 5 stages within a typical segment. The corridor-wide strategy provides an overview scheme, with more detailed staging diagramed at the block-level. The schematics include phasing of components: utility relocation, street-work, landscaping, transit stops, trackwork, parking for construction vehicles and deliveries to retail, and pedestrian crossing points.

Finally, our scope and conceptual phasing strategy considered techniques to speed up the construction process given the highly sensitive nature of the project and location. As part of the scope, other light rail projects recently introduced and developed in other parts of the country and world were considered in order to identify methods used for other efficiently-constructed projects, where these were relevant to Manhattan.

Key findings from the Construction Phasing study included:

- To facilitate access to the stores, sidewalks will remain untouched throughout construction.
- Construction on each block segment can be accomplished in six months by using an innovative utility relocation plan and by carefully staging the work on a block-by-block basis for the two-year construction period.
- Self-propelled light rail vehicles, using fuel cell or other technology, are recommended, to expedite construction, provide a cleaner power source, and avoid overhead wires.

2. Historic and Modern Precedents

2.1 42nd Street New York City 100 Years Ago
Recent Light Rail Projects in U.S. and Global Cities

Until 1946, trolley cars provided the primary means of transportation along 42nd Street. vision42 seeks to modernize New York City's surface transit, reintroducing light rail vehicles to the former 42nd Street trolley route. Echoing the past, the proposed rail alignment runs down the center of the street. However, unlike in the past where vehicles, trolleys, horses and pedestrians battled congestion, vision42 seeks to reclaim the street for pedestrians and non-motorized vehicles; improving quality of life, the retail and entertainment experience and public open space along one of Midtown's most famous streets. The proposed construction approach echoes historic roots (routes) of New York and given future expansions of the UN, Times Square and the Jacob Javits Convention Center, points to a comprehensive approach to anticipated growth of pedestrian demands across midtown. The project maintains, protects and increases sidewalk space as well as the transit right-of-way throughout construction from ground breaking through completion, becoming an asset to the community even before construction reaches their blocks.

1946 – Last day of 42nd Street Trolley Service

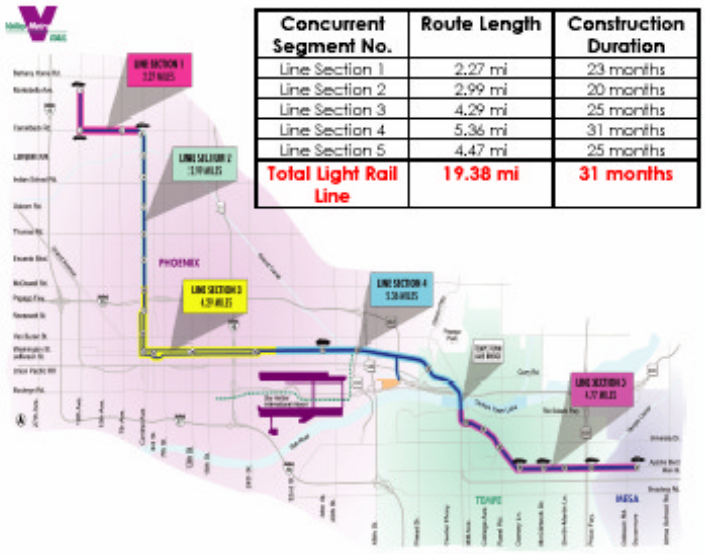
1903 – Subway Construction

1940 – 42nd Street/5th Avenue intersection (Knudtsen, Robert A.)

Light rail systems have been the subject of renewed interest across the United States in recent years as cities across the country have introduced various systems, from larger inter-urban connectors to more localized streetcar systems. Systems include San Diego (1981), Buffalo (1985), Portland (interurban-type LRT, 1986), Sacramento (1987), San Jose (1987), Los Angeles (1990), Baltimore (1992), St. Louis (1993), Memphis (streetcar, 1993), Denver (1994), Dallas (1996), Salt Lake City (1999), Kenosha (Wisconsin, 2000), Hudson-Bergen (New Jersey, 2000), Portland (streetcar, 2001), Tampa (streetcar, 2002), Tacoma (streetcar, 2003), Houston (2004), Little Rock (streetcar, 2004), and Minneapolis (2004). Streetcar systems are also in construction in Birmingham, Miami, Bayonne, Seattle, Atlanta, and San Diego and are under consideration for Los Angeles and its Glendale suburb, Tucson, Salt Lake City, Omaha, Cincinnati, Toledo, Huntington (WV), Richmond, Montgomery (Al), and Charlottesville (Va), Charlotte (NC), among others.

Concurrent Segment Construction for Expedience in Phoenix

Concurrent Segment No.	Route Length	Construction Duration
Line Section 1	2.27 mi	23 months
Line Section 2	2.99 mi	20 months
Line Section 3	4.29 mi	25 months
Line Section 4	5.36 mi	31 months
Line Section 5	4.47 mi	25 months
Total Light Rail Line	**19.38 mi**	**31 months**



2.2 Concurrent Segment Construction

The most relevant precedent information came from looking at the Valley Metro light rail project, which connects the cities of Phoenix, Mesa and Tempe, Arizona. Downtown Phoenix is semi-urban with a relatively complex underground utilities network. While the technologies employed are traditional, the concurrent segment construction approach would serve vision42 well.

Unlike other projects currently being constructed in the U.S., the Valley Metro light rail is being concurrently constructed in five segments. In most of the other cases studied, construction has proceeded in one direction moving from point of origin to point of termination. Working concurrently reduces overall construction time.

3. Choice of Technologies

In comparison to 42nd Street Manhattan, the majority of projects currently under development are considerably less urban in nature, providing vastly less complex underground conditions that would impact utility relocation and allow for more maneuvering room for construction of LRT rights-of-way parallel to city-streets. From discussions with representatives involved with a number of projects, including those in Portland, San Diego, Houston, Ottawa, Canada, Charlotte, and Phoenix, it was apparent that the vision42 project, as proposed, would be far more innovative, in using beam-strips and in all likelihood, self-propelled vehicles, as opposed to more traditional concrete slabs and overhead catenary wires. Technological advances in these innovative areas have made them more reliable. The higher cost of fuel cell technology remains a factor. However, it is anticipated that by the time vision42 is complete, given recent successes with testing, production of fuel cell propulsion systems will increase in popularity and production costs will come in line accordingly.

As described in the 2005 *vision42: an auto-free light rail boulevard for Manhattan's 42nd Street* technical report, beam-strip track and fuel cells were recommended for the vision42 project to expedite construction, to provide a cleaner power source and to avoid overhead power lines, which are not in use within New York City.

3.1 Support of Rails

3.1.1 Beam Strip Track

Confidence grows as research progresses on the technical soundness of providing strip foundations with intermittent tie bars on straight track, although concrete slabs would still be employed at turns for reinforced strength. This is the recommended approach for vision42, and is assumed in the Minimum and Maximum utility relocation schemes. As with most NYC transportation projects, there are admittedly no directly comparable completed project precedents.

In Edinburgh, as Chief Rail Designers, Halcrow is considering a variety of pre-casting beam strip options based on European practice to speed up construction. Standard, well-tried tram rails will be incorporated as opposed to some of the shallower, newer designs.

3.2 Self-Propelled Vehicle Technologies

3.2.1 Bordeaux Surface Conductor

According to the most recent reports, the Bordeaux Surface Conductor, in which current is activated directly below the light rail vehicles only when they are passing above, providing for safe pedestrian crossing, is working more reliably than when initially installed in December 2003. However, even at its current 99% reliability, it still falls short of the standard required for vision42. The system is currently not being implemented elsewhere. Additionally, for the 42nd Street location in particular, the DC current would cause stray current problems, resulting in the corrosion of metal utilities, especially steel pipes and conduits and the Subway shuttle roof.

3.2.2 Fuel Cells

Fuel cell technology is the most promising new technology fit for this purpose in our view. As recently reported at the Clean Urban Transport for Europe (CUTE) Conference in May 2006, the fuel cell bus trials in London and 9 other European cities completed a year's service and were highly successful. These were so reliable that London has extended its fuel cell routes. Both bus operators and passengers reported satisfaction with the buses, and no critical failures in 3000 hours of operation occurred. Quoting from Conference proceedings it was found that "[d]uring its 54 month lifetime CUTE demonstrated that hydrogen and fuel cell technology really is a viable option for public transport systems. Public acceptance of the fuel cell buses and the program itself was exceptionally encouraging and has helped to raise awareness and acceptance of hydrogen and fuel cells. Furthermore, both the hydrogen and fuel cells demonstrated a high degree of reliability and the operation of the buses proved to be very successful."

This European bus program is the most extensive transport application of fuel cells and is important for all modes of urban public transport. There is now absolutely no doubt about the feasibility of a fuel cell tram and it is now more a matter of details such as fuel methods and equipment location on the vehicles. Costs are continuing to come down and the environmental benefits are carrying more weight. While we have never undertaken a comprehensive appraisal of battery versus fuel cells, the fuel cell applications and developments make this the option more and more suited to vision 42.

Progress is being made with fuel cell rail applications in specific as well. The East Japan Railway Company has developed a diesel hybrid system which began testing in July 2006 for safety and performance, with running tests on a service line planned for April 2007.

4. Construction Staging

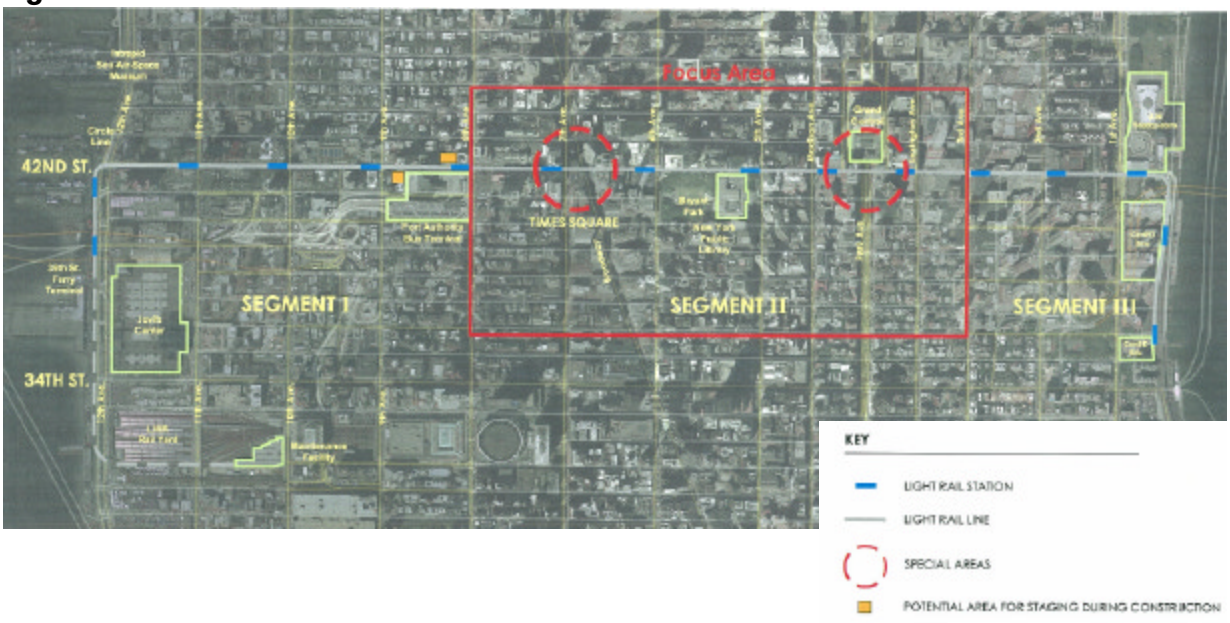
4.1 Conceptual Phasing Plan of vision42 by Concurrent Segments

The overall approach in conceptually diagramming the construction phasing plan for the 42nd Street light rail has been to minimize the negative impacts to pedestrians and retail operators while simultaneously identifying as efficient a strategy as possible. The main concept is to preserve the sidewalk zone throughout the construction process and to maintain continued bus service until the light rail system is operational, at which time the bus routes will be discontinued.

Similar to the strategy employed on the Phoenix Valley Metro light rail project, a concurrent approach is suggested for the 42nd light rail project. Figure 1 depicts the line divided into three segments, each concurrently under construction to expedite the project. Segment I runs from the west side rail yards at 31st Street up to 42nd Street and east to Eighth Avenue. Segment II spans 42nd Street between Eighth and Third Avenues. Segment III runs from Third Avenue to the East River and terminates at 35th Street. Where construction might be done in fewer segments, the duration of construction would lengthen. Additionally highlighted are potential staging areas, currently in use as parking lots, which might be looked at in the future as sites on which to store construction materials.

The detailed staging diagrams done for this study focused upon Segment II, which incorporates busy retail activity, Times Square, and Grand Central, all adding to current heavy congestion levels.

Figure 1



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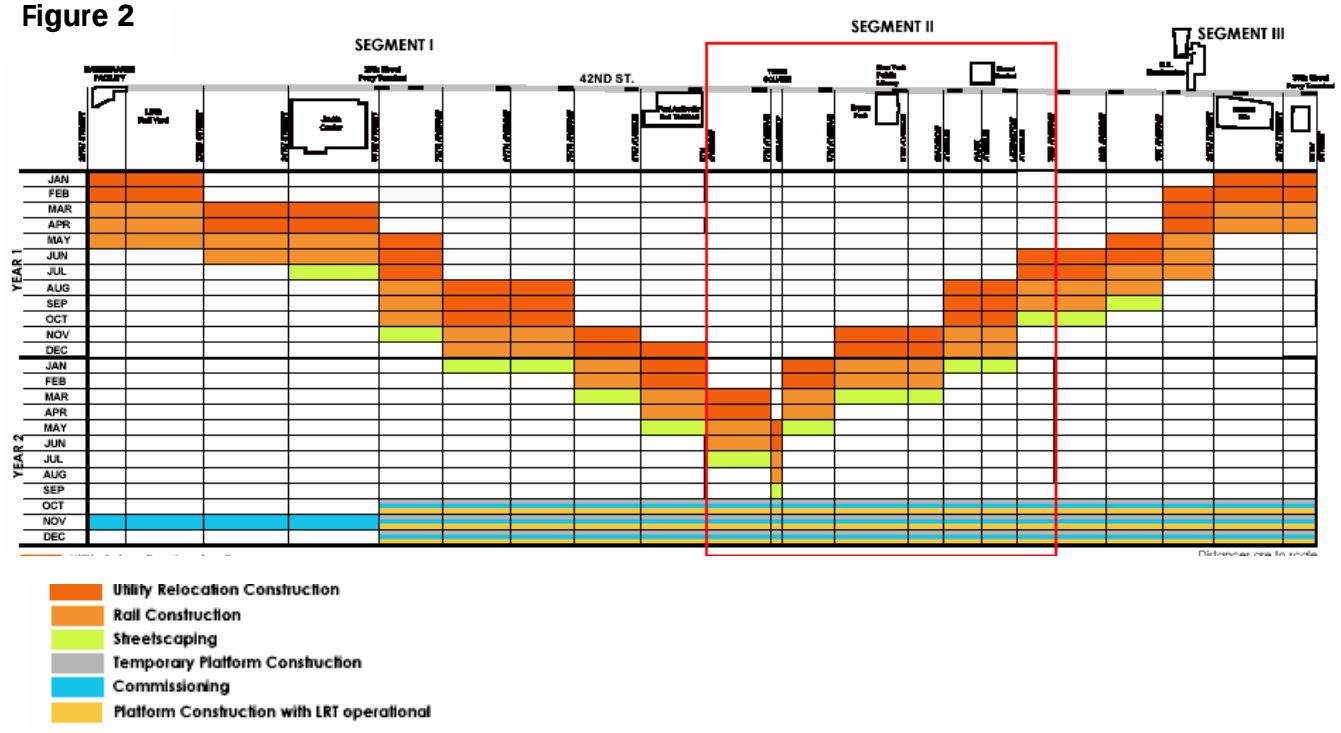
4.2 Option A ¾ Minimum Utility Relocation

The minimum utility relocation approach outlined in this study is the most sensible in terms of cost and time efficiency. In this scenario, construction is restricted to the central section of the street. Only the utilities interfering with the installation of the beam strips are relocated. Historically, utilities co-existed with the trolley rails, and for rare, occasional repairs to utilities deep underground, access would be possible through manholes located outside of the light rail platform area.

The minimum utility approach treats each block as one construction sub-segment. Utility relocation (with exceptions), rail construction and streetscape improvements would happen one after another, with one major construction phase of digging. This method ensures that the street is returned to pedestrians as efficiently as possible. As shown in Figure 2, the estimated duration for the Best Case Minimum utility relocation is approximated two years. Each block segment is under construction for approximately six months.

Construction progresses block by block, confined to the center of the street. New utilities are relocated to the area parallel to, but outside of, the rail and platform area, as space is available and put into service prior to removal of the old utility lines. Following three months of utility relocation and construction, each block segment would then undergo two months of rail construction and one of streetscaping. Once the rails have been set from terminus to terminus, the light rail platforms will be prefabricated. They will be installed once the train is operational, with commissioning taking place at night.

Figure 2



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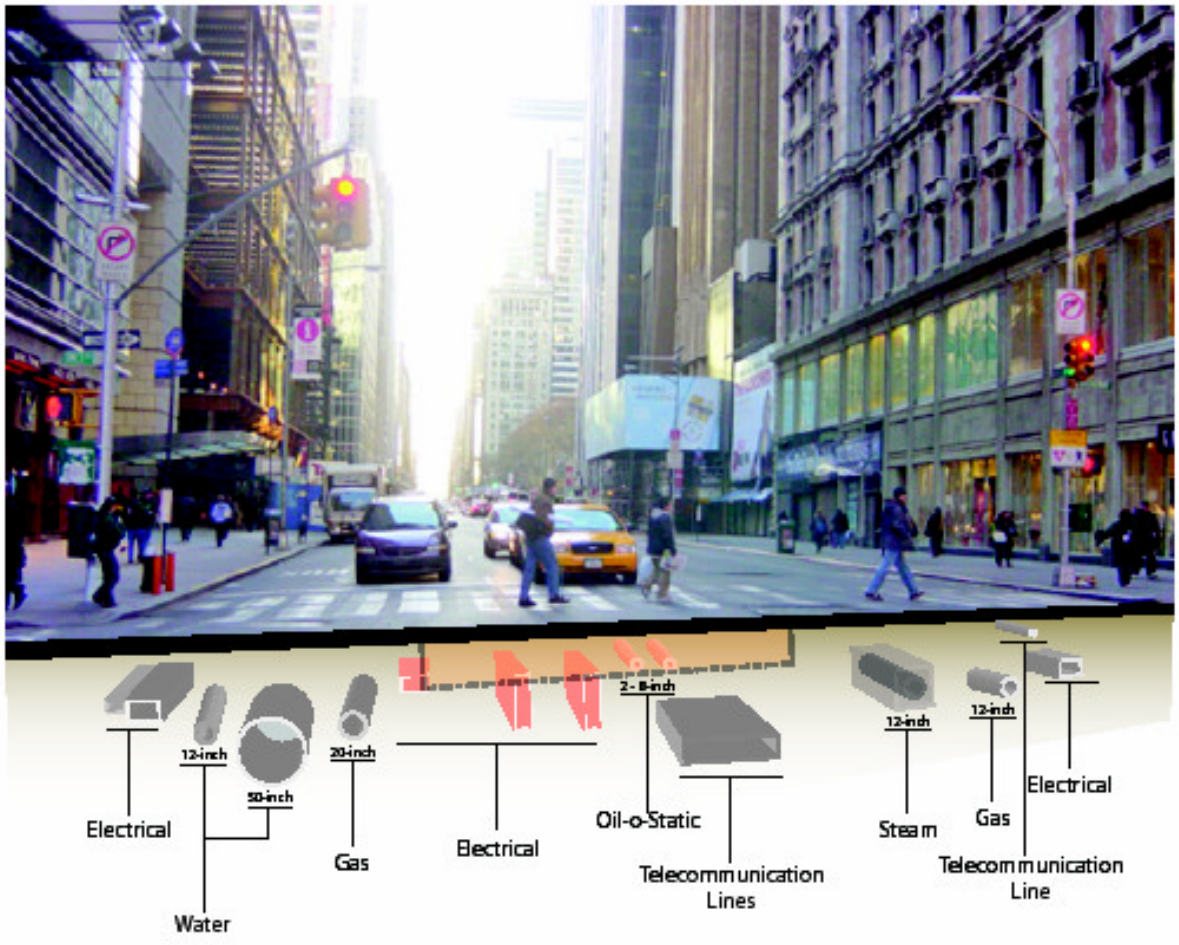
The utility cross-section, which outlines the anticipated construction zone in the center of the street, highlights the utilities that may need to be relocated when implementing the minimum utility relocation strategy in red. In this strategy, new utilities are installed at the outer edge of the construction zone, beyond the extent of the rails.

Due to the low probability of failure and limited need for access, it is believed that the oil-o-static lines may remain in place beneath the rail area. Proper care and protection along with the increased depth from the finished surface that resulted from the elimination of curbs will provide adequate cover to insulate the oil-o-static lines during the construction process. The inclusion of track crossovers, as indicated in the Phase I study, will allow sub-surface access to the oil-o-static lines in the rare event repairs are required, while still maintaining light rail service.

Implementation of the vision42 light rail project will require a detailed design study that should also include a risk analysis to determine the economic comparison of relocating all of the utilities below the track area versus selectively relocating only those utilities that require the greatest probability for access. While the exact positioning of the relocated utilities would need to be determined in a design study, should the decision be made to relocate the oil-o-static lines, or any other utility line in question, adequate space exists within the right-of-way of 42nd Street to relocate the identified utilities under the minimum utility relocation strategy.

Figure 3 – Utilities needing to be relocated out of the rail alignment construction area



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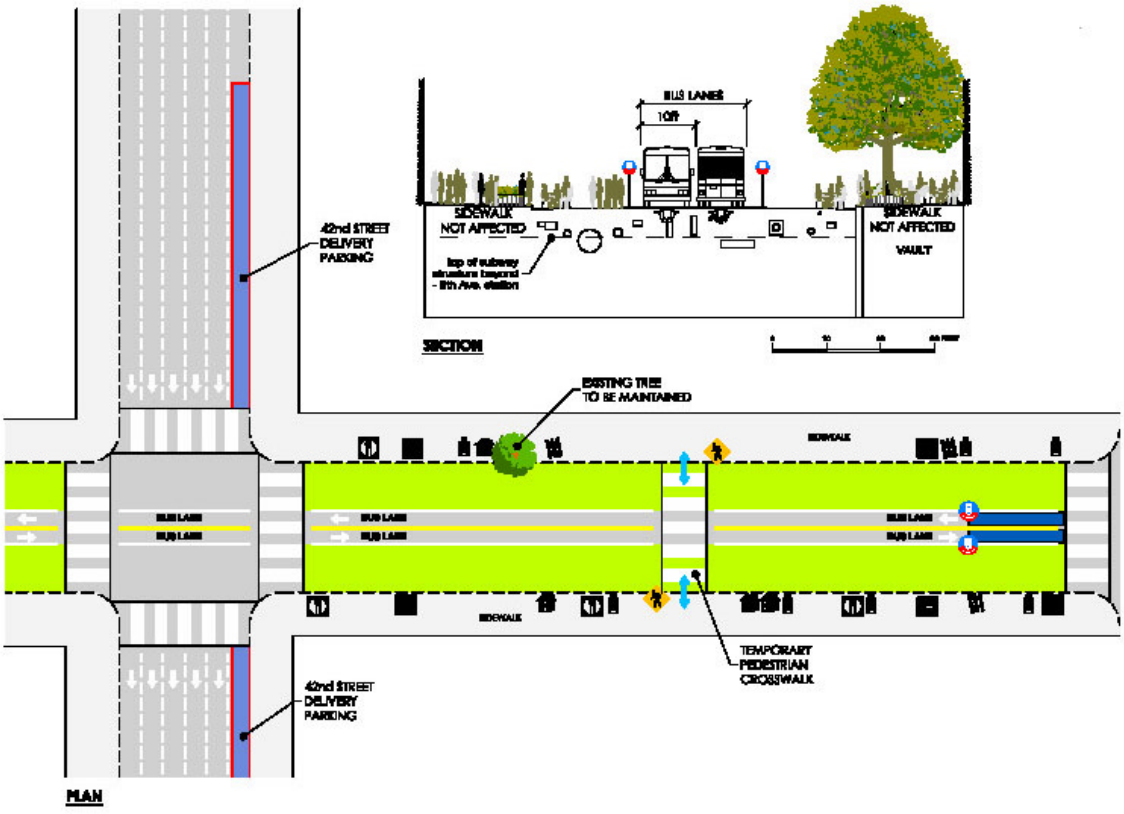
4.2.1 Stage 1: Pre-Excavation

For segments of the line not under construction on the first day of the vision42 light rail project, a Pre-Excavation Stage has been identified. The duration of this stage will vary by block, ranging up to a year for the last blocks to undergo construction. Under the assumption that as of day 1 of the project, 42nd Street becomes auto free, the street would be opened up to pedestrian use until construction begins. The placement of bus service in the center lanes to mirror the light rail alignment would connect transit and land use along 42nd Street to the Jacob Javits Convention Center and the United Nations Headquarters – River to River. Specially designated delivery parking zones would be introduced along the avenues to allow convenient access and replace delivery spaces lost along 42nd Street in the transition to being auto free.

Diagram 1 - Stage 1: Minimum Utility Replacement Pre-Excavation



4.2.2 Stage 2: Utility and Rail Construction

During Stage 2, the utilities are replaced and the rail beds constructed. As construction is limited to the center of the street, bus service will be temporarily moved to the outer lanes. Utilities are first relocated to the outside of the rail alignment and then the rails laid down the center.

Pedestrian circulation will be maintained with crossings preserved at intersections and one or more mid-block steel plate pedestrian crossings will be introduced. 42nd Street delivery parking along the avenues remains, we recommend that 1/3 of the zone designated as staging space

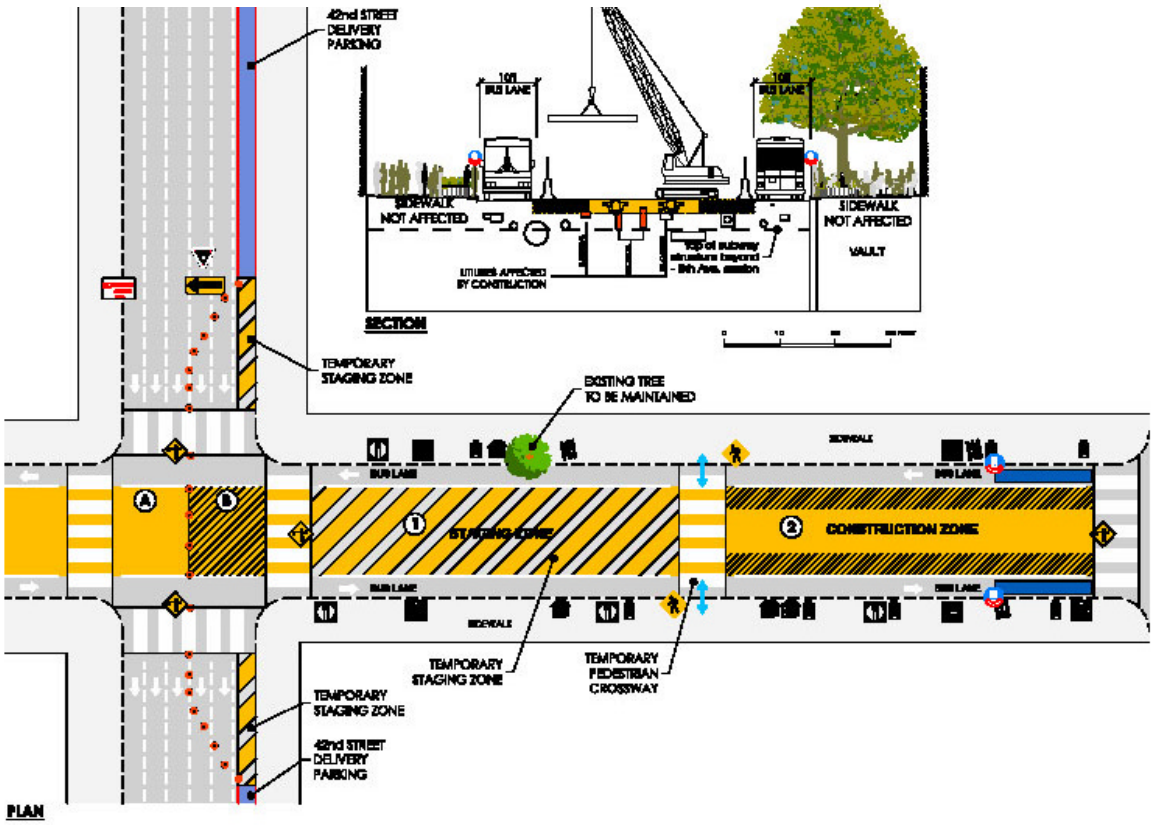
to serve the construction zones from the north and south. This will provide minimal temporary construction staging space for vehicles and materials.

In order to minimize the demand for construction staging space along the avenues or blocks, the utility and rail construction at each block sub-segment are divided into two zones – staging (1) and construction (2). Half of the block is under construction while the other half stages equipment, vehicles and materials. Upon completion of zone 1, construction moves to zone 2.

Similarly, intersection construction is divided into two zones, A and B, to maintain and protect traffic on the Avenues. It is our recommendation that this work be performed during off-peak nighttime hours. As one zone finishes, construction will move to the opposite zone. When setting the rails, the entire intersection may briefly need to be closed. Prefabricated materials should be used to expedite rail construction.

For each block sub-segment, the utility replacement and rail construction are estimated to last between two and three months, for a total construction duration ranging between 4 and 6 months.

Diagram 2 - Stage 2: Utility and Rail Construction

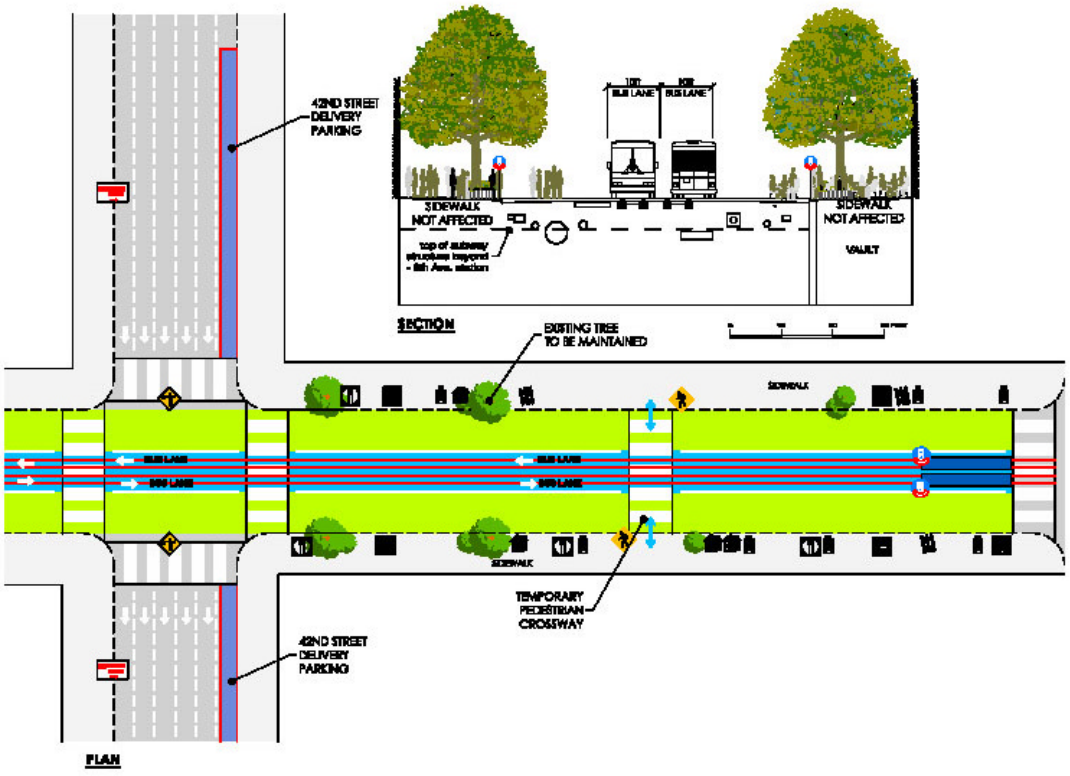


4.2.3 Stage 3: Streetscaping and Light Rail Commissioning

Upon completion of the rail alignment, the major construction in the block sub-segment is finished and the streetscaping is underway. Buses return to the center of the street, running over the rails – this will not harm them. The block sub-segment is landscaped, pavers are installed with the hardscape almost complete, and the street is reopened to pedestrian use. Additionally, the designated 42nd Street delivery parking along the avenues is returned in full to that purpose.

Once the rails have been laid from river to river, the system is commissioned through nighttime testing in order to eliminate interference with daytime and peak hour bus movements.

Diagram 3 - Stage 3: Streetscaping and Commissioning

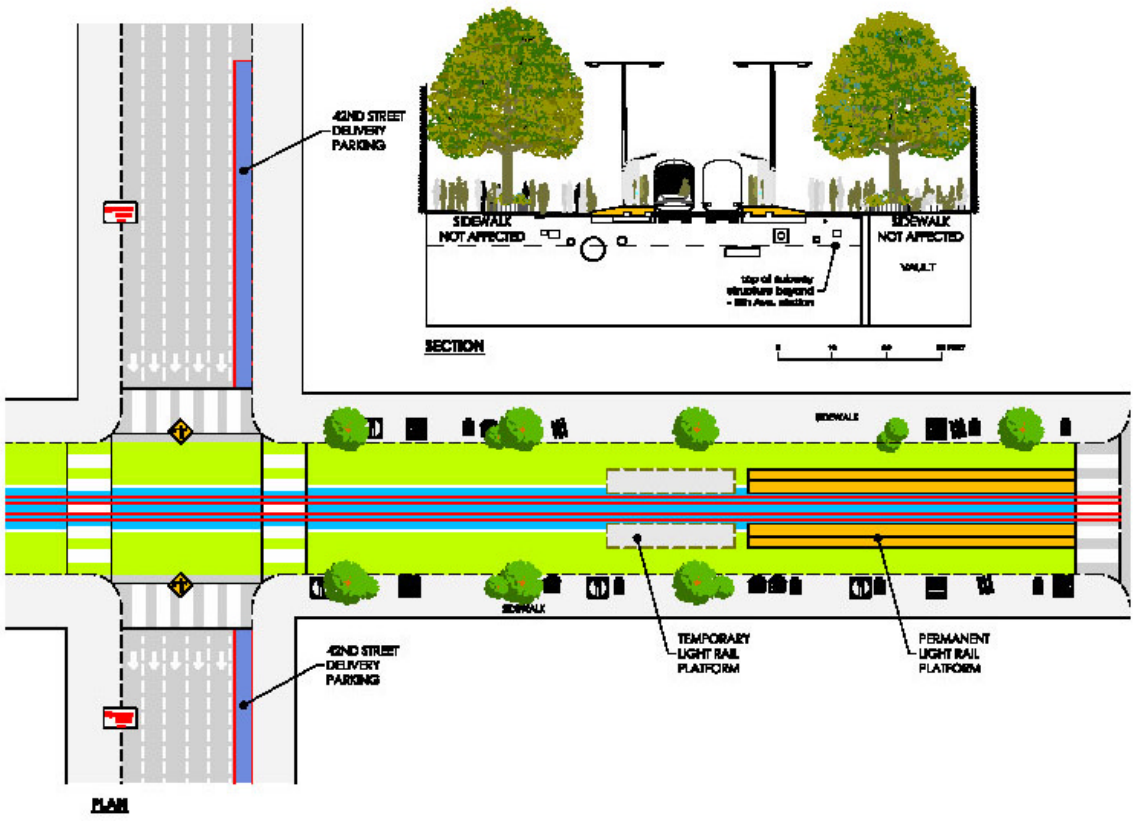


4.2.4 Stage 4: Platform Construction

Following the commissioning, the light rail vehicles will be operational and most of the streetscaping will have been completed. The Project now enters Stage 4: Platform Construction. Passengers will initially board the light rail vehicles at a temporary stop outside the platform construction zone while the actual light rail platforms are constructed. The platforms themselves will be prefabricated and brought to grade with the street, once installed. It is expected that this stage will last approximately one month.

This approach, although apparently adding time to the project, was conceived in order to address the size differences between the light rail vehicles and public buses and ensure continuous east-west transportation provisions while maximizing designated pedestrian street space. The buses are wider than the light vehicles and would require a width greater than the distance between the opposite loading platforms to operate in two directions. Were the platforms to have been constructed during the utility and rail phase, the buses would have had to have operated in the outer lanes, thereby impacting the landscaping work, pedestrian usage of the street and length of construction.

Diagram 4 - Stage 4: Platform construction



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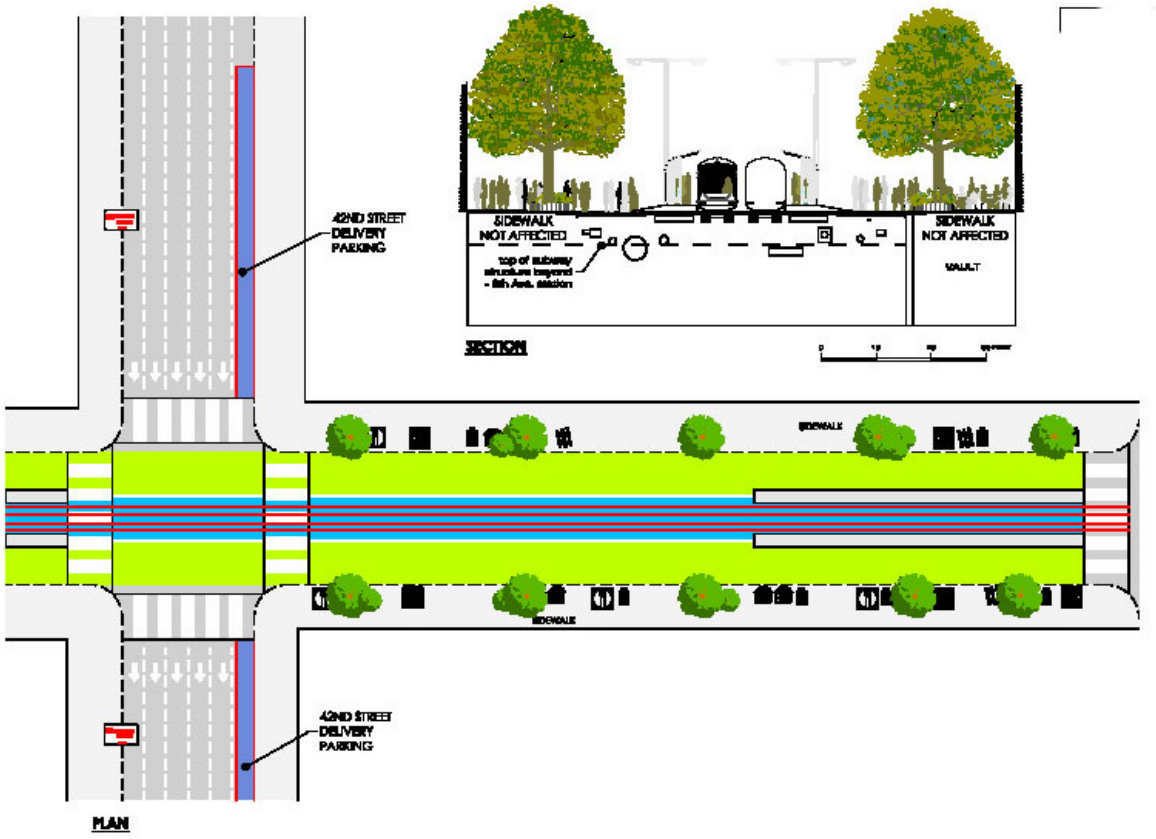
4.2.5 Stage 5: Completion

The last stage is completion. The 42nd Street light rail system is fully operational, picking up passengers at the platform. The landscaping is completed, the street fully opened to pedestrian use, and all temporary construction staging areas along the avenues are returned to short-term delivery parking. If permitting allows for it, 42nd Street retail and restaurant operators may extend activities onto the street with outdoor cafes and other events at this time.

Diagram 5 - Stage 5: Completion



4.3 Option B ¾ Maximum Utility Relocation

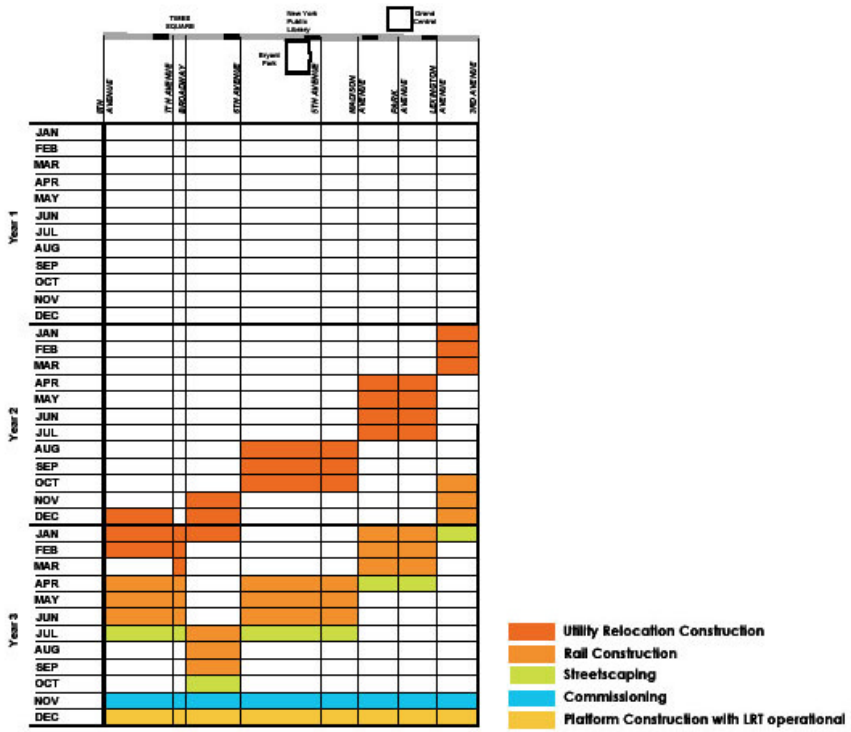
The alternative to the minimum utility relocation is the maximum utility relocation approach, replacing all utilities lying below the rail alignment. Within the focus area of this study – between 3rd and 8th avenues, this would also include telecommunications lines, but beyond the focus area, would include sewer lines and major utilities.

The construction staging for the Maximum Utility relocation follows the same overall approach as the Minimum scenario with concurrent construction taking place in multiple segments. But, in the Maximum relocation scenario, construction is divided into two stages: Utility Relocation Construction followed by Rail Construction. The overall construction duration from river to river extends from two years to three and the number of stages increases from five to six, including the pre-excavation phase.

The segment between Third and Eighth Avenues is installed last. As a result, during the first year of the project, this section is in the pre-construction stage (Figure 4). Construction of each block segment is approximately seven months, divided into two main 3 month stages, with a five to six month pause between them.

The rail construction in the center of the street does not proceed until all of the new utilities in the outer lanes are in place and in service. At that point, the construction zone moves to the center lanes and resumes as in the minimum utility relocation approach. Work would again proceed block by block, and is the same as the Construction progresses, block by block, with two major construction phases per block segment.

Figure 4 – Construction Schedule for Focus Area (Third Avenue to Eighth Avenue)



*During year 1, the Focus Area shown above is in the Pre-Excavation stage. It is the last segment to be constructed from River-to-River, and construction will be carried out on blocks to the east and west.

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In Stage 2, utilities are relocated to the outside of the street, beyond the rail and platform area. The construction zone is in the outer lanes, with buses operating in the center, and steel plated pedestrian crossings being maintained. In Stage 3, construction moves to the center zone and bus service moves to the outer lanes.

Figure 5 – Stage 2 Construction Zone: The stage 2 construction zone is highlighted in red. Utilities from the center of the street are relocated to the outside of the street with existing utilities moved as needed to make space.

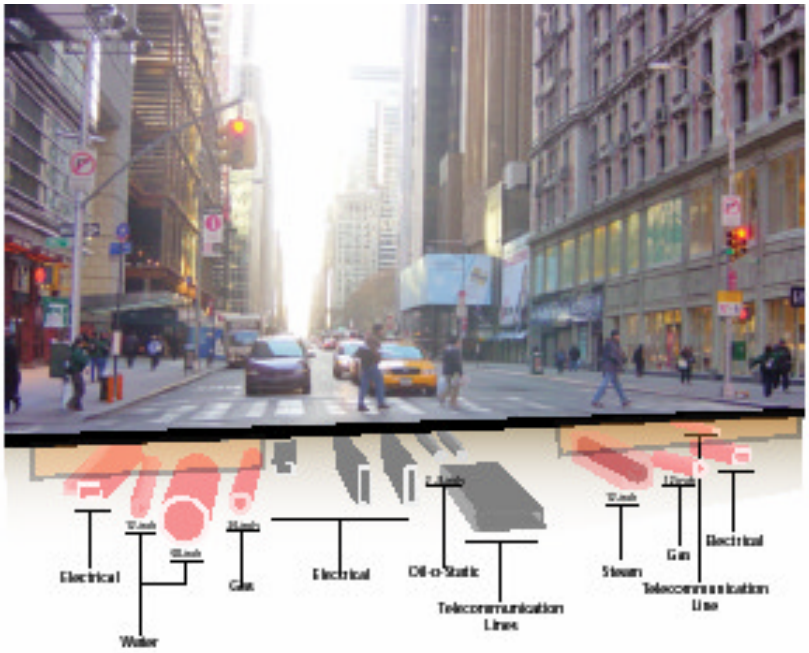
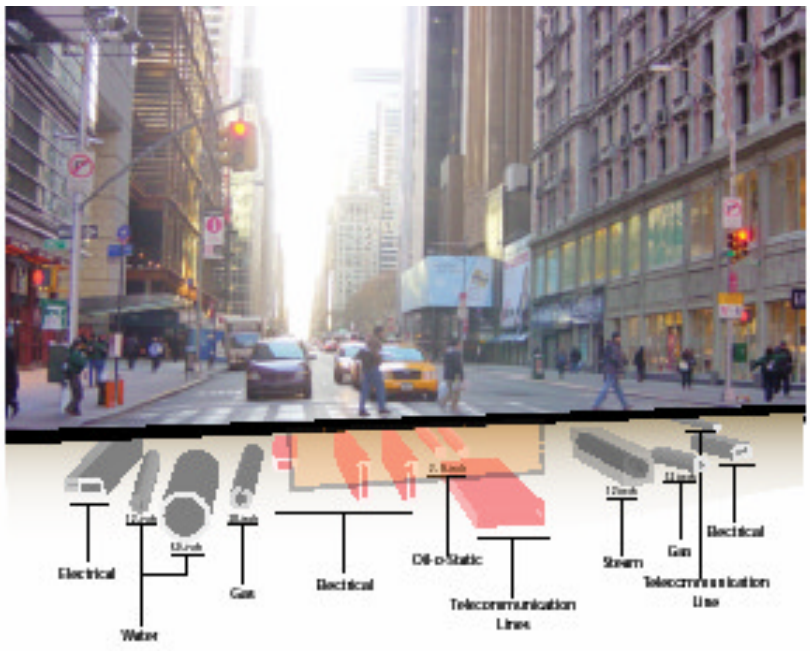


Figure 6 – Stage 3 Construction Zone: The stage 3 construction zone is highlighted in red. Utilities in the center of the street are removed to prevent interference with rail placement.



5. Facilitating Construction

5.1 Transparent Construction, Night Work, Clear Signage and Street Furniture

A variety of techniques may be employed during construction staging to expedite the process as well as promote public awareness and understanding of the causes for inconvenience. Transparent barriers, prefabricated materials, night work, and clear signage are examples that are frequently used. Street construction in Lower Manhattan has begun to set a local precedent for clean, open and accessible construction zones. These practices and temporary closings of lanes and pedestrian detours are commonplace now in NYC and throughout the world.

Figure 7 - New York: Transparent Construction Fencing Protecting Continuous Pedestrian Right-of-Way

Figure 8 - Helsinki: Transparent Pedestrian Barricade

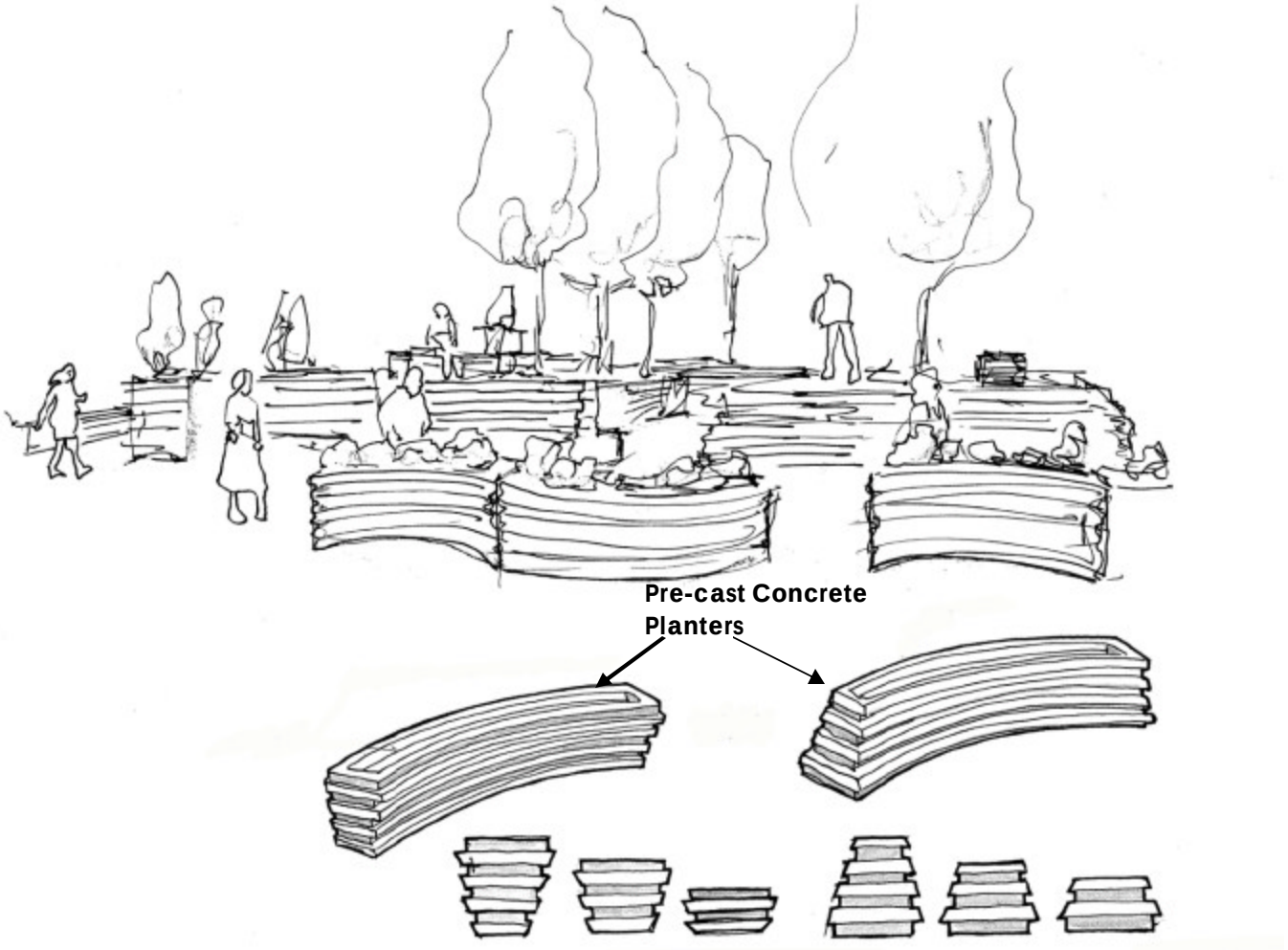
Figure 9 - New York: Aerial Profile of Construction Staging Adjacent to the World Trade Center Site

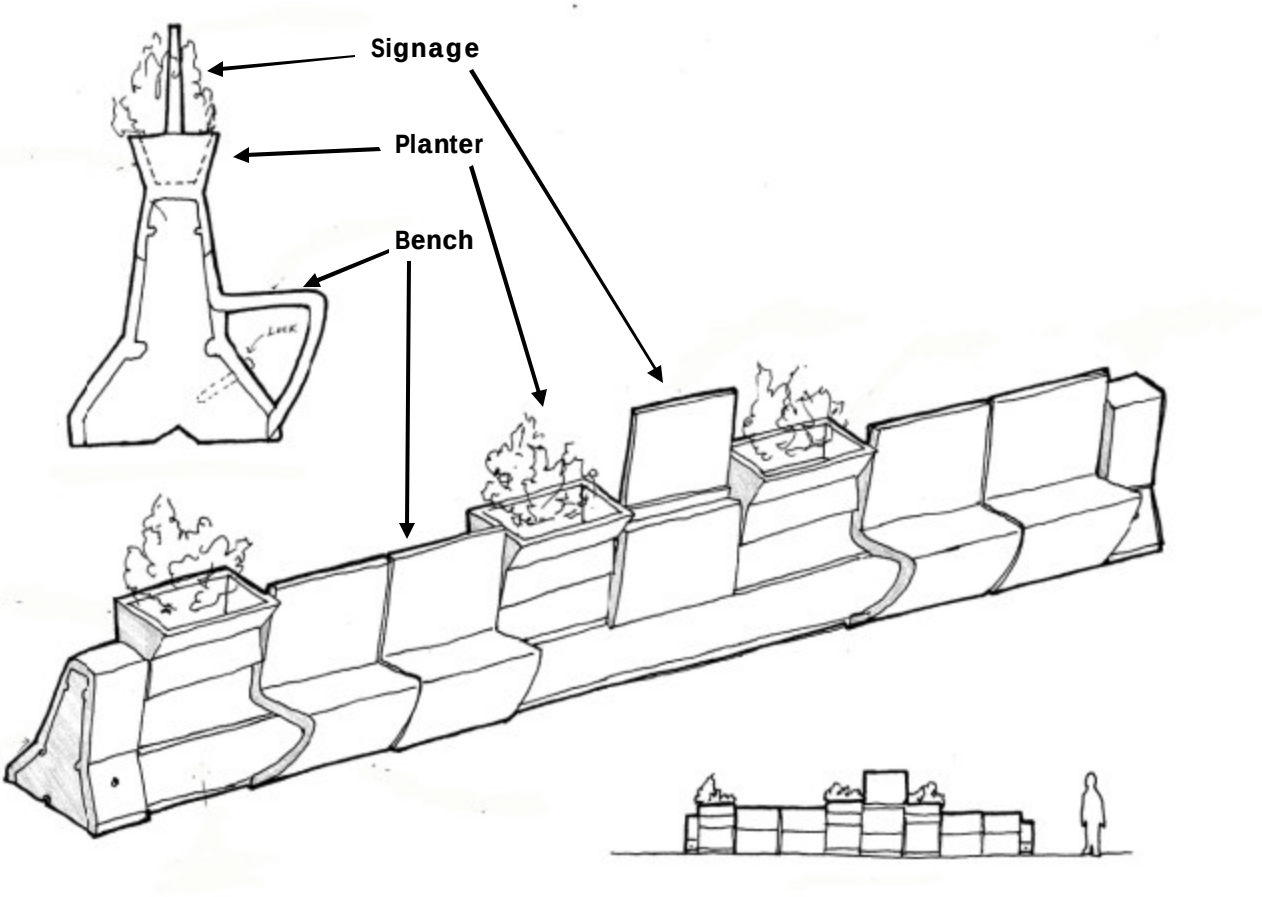
Pre-Fabricated Barriers and Street Furniture

One potential opportunity for improving the pedestrian experience and streetscape aesthetic during construction is to incorporate pre-fabricated barriers that are currently in conceptual design, but which would double as street furniture, providing planters or benches. Alternatively, transparent screens mounted atop the concrete base offer added safety. The units are easily movable within the construction site.

Figures 10 and 11 - Concrete Barriers with built-in benches and planters

Illustrations: Matt Maleska, 2002





Elevation

Concrete base with transparent mounted screen barrier

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5.2 Community Involvement — An Example: Valley Metro Project, Phoenix

The Valley Metro project, due for completion in December 2008, has worked to engage the public from early stages of the design process, appreciating that strong public resistance that can arise in reaction to light rail construction's inconveniences. Efforts focused especially on local retailers and their fears of negative impacts on business. Each construction segment has a community outreach coordinator, and the project's leaders have worked with the community to ensure extra signage is displayed for businesses otherwise affected by restricted visibility. Additionally the outreach campaign has published information aimed at connecting local businesses adversely impacted by the construction to loan opportunities, such as through the U.S. Small Business Association. Other innovative outreach has included the collaboration with Arizona State University's School of Business Honors Consulting student organization, in which business students assist businesses along the light rail route with planning and organizational management, marketing and customer service, financial management, inventory management, maintenance and safety.

Central Phoenix Construction, Metro Valley Rail 2005

The Valley Metro project also collaborated with the community in designing streetscape guidelines. Examples of the design standards cover a range of topics including accessibility for those with disabilities, shade elements, lighting and safety, surface pavers, and seating and recreation facilities. The public's involvement in directing what the ultimate end-result would look like helped keep communication lines open and increase support for the project.

Valley Metro Rail Urban Design Taskforce Community Placemaking Meeting, November 2000

7. Appendix – Construction Phasing Diagrams

Stage 1 - Minimum Utility Relocation : Pre-Excavation

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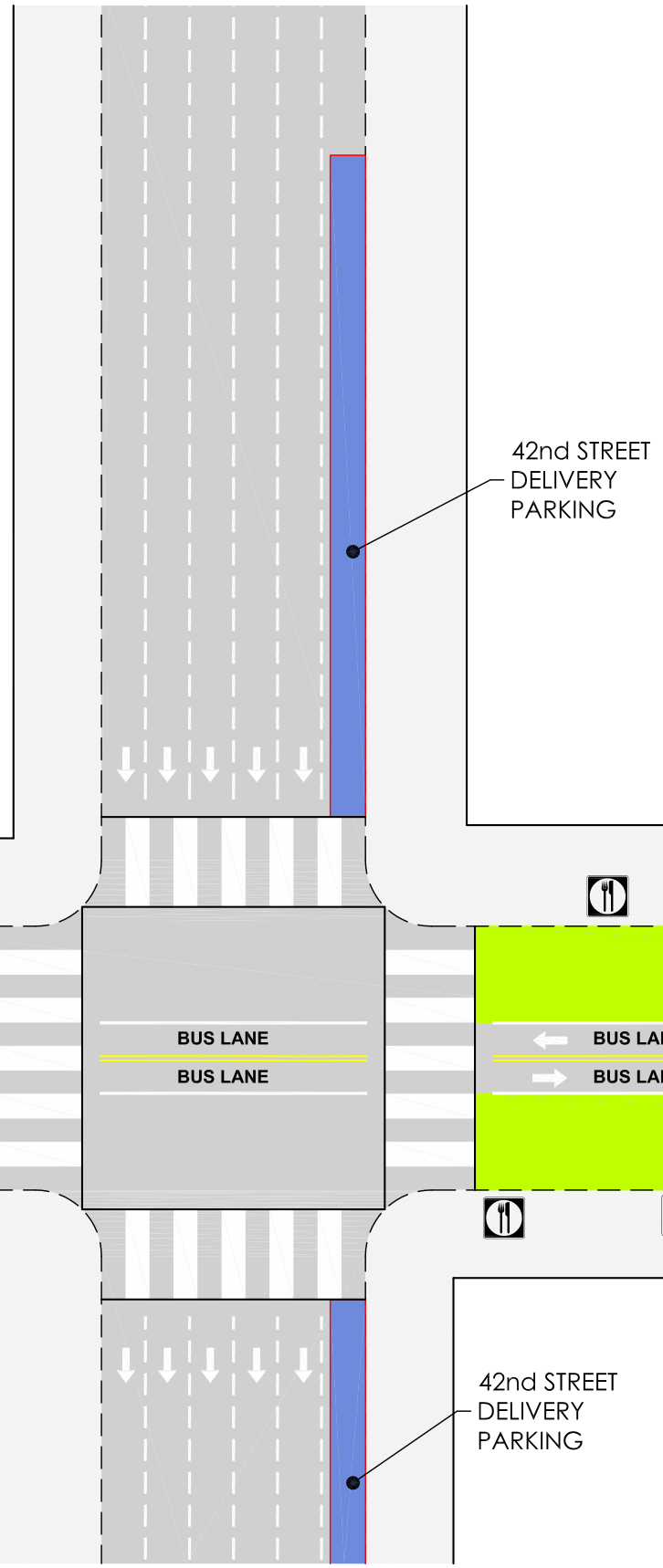
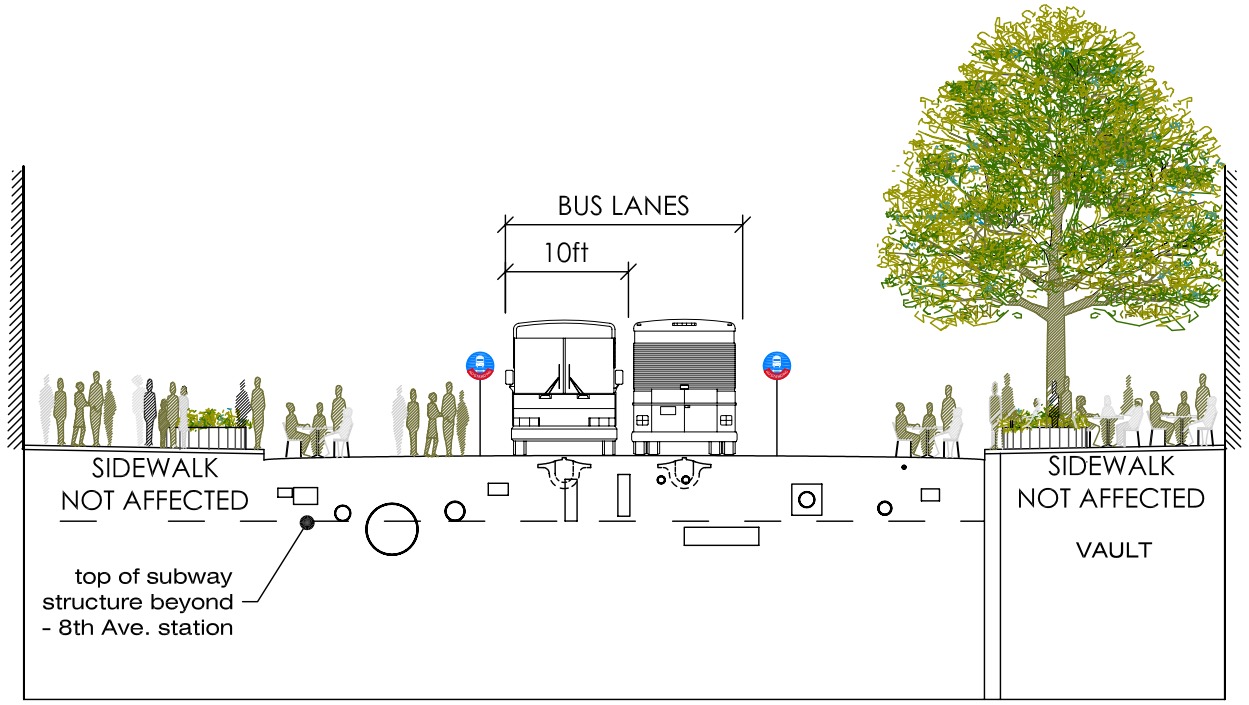
TYPICAL BLOCK





SECTION

0 10 20 30 FEET

PLAN

- On Day 1 of the project, 42nd Street becomes auto free;
- Bus service is moved to the center lanes;
- The outer lanes, auto free, are available for pedestrian use until construction is underway.

		Pre-Excavation	Utility Relocation Construction	Rail Construction	Streetscaping	Commissioning	Platform Construction with LRT operational
Year 1	JAN						
	FEB						
	MAR						
	APR						
	MAY						
	JUN						
	JUL						
	AUG						
	SEP						
	OCT						
	NOV						
	DEC						
Year 2	JAN						
	FEB						
	MAR						
	APR						
	MAY						
	JUN						
	JUL						
	AUG						
	SEP						
	OCT						
	NOV						
	DEC						

TIMELINE

Stage 2 - Minimum Utility Relocation : Utility and Rail Construction

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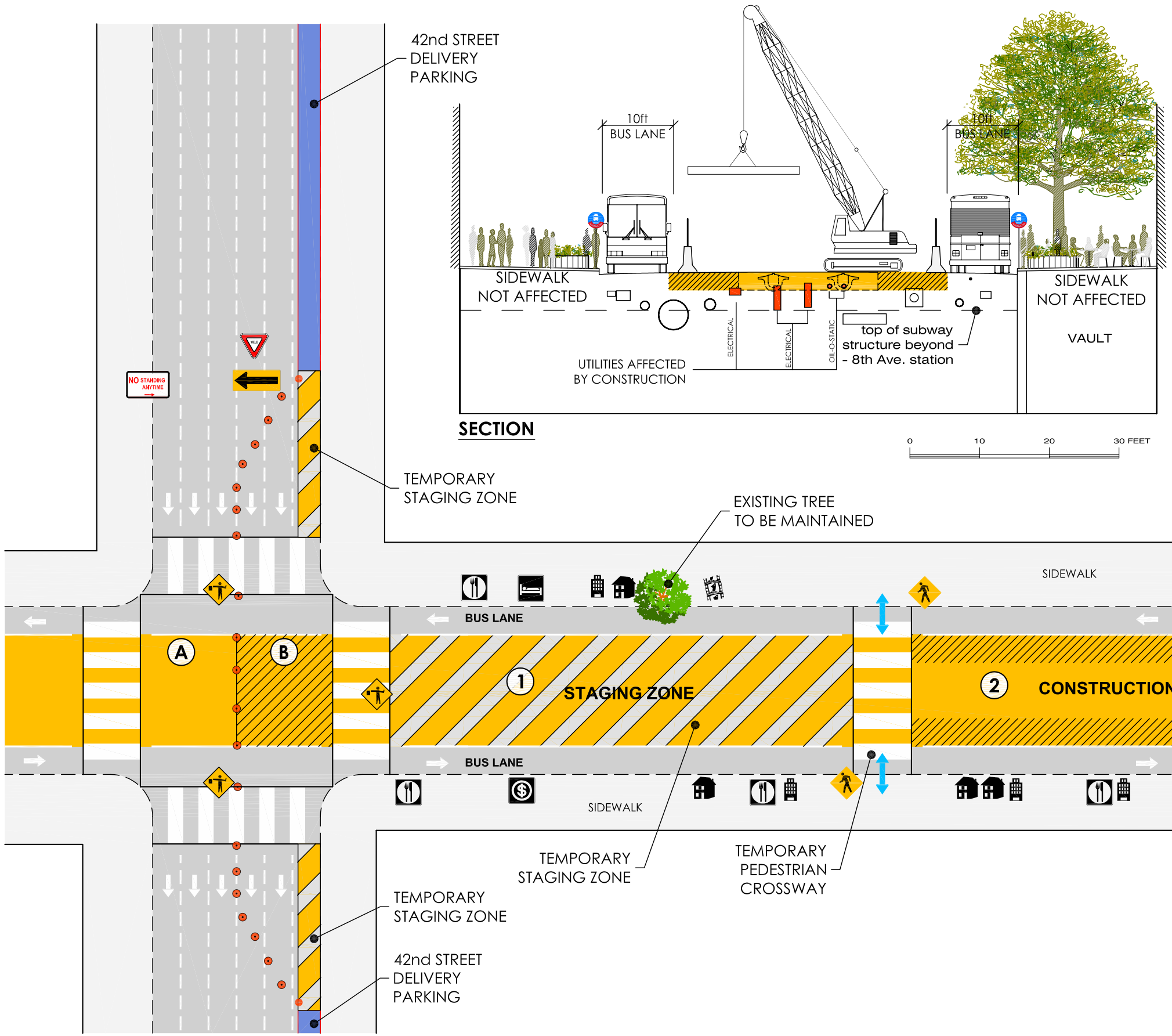
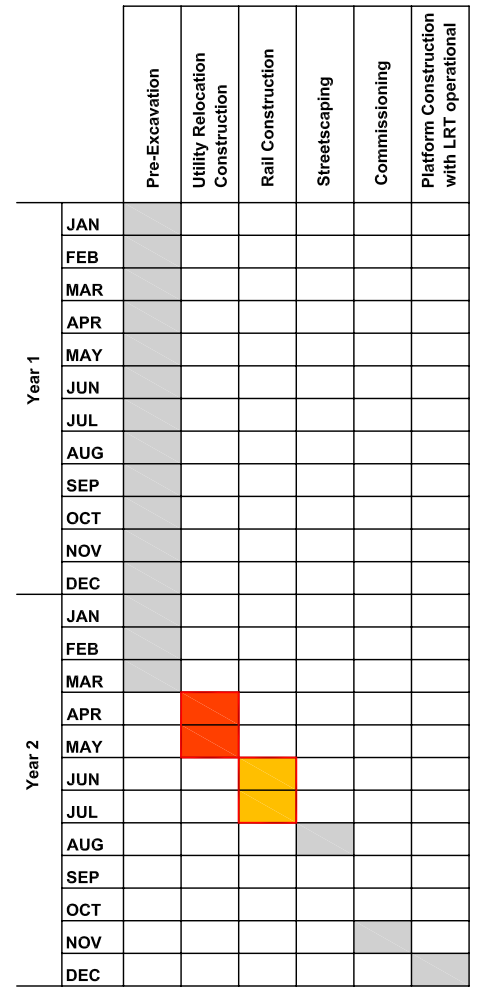
TYPICAL BLOCK



SECTION

PLAN

- Bus service is moved to the outer lanes;
- The construction zone is confined to the center of the street.
- Utilities are first relocated to the outside, and then rails laid down the center.
- All utility and rail construction is limited to the center of the street;
- Pedestrian crossings at intersections are preserved with steel plates;
- 42nd Street delivery parking along the avenue remains. 1/3 of the zone provided minimal temporary construction staging space for vehicles and materials.
- Construction along the block segment is divided into two zones [Zone 1 and Zone 2]. Half is under construction while the other half stages equipment, vehicles and materials. Upon completion of zone 1, construction moves to zone 2.
- Intersection construction is divided into two zones, A and B, which will be performed during off peak hours finishing one side before closing the other side. When setting the rails, the entire intersection may briefly be closed, prefabricated materials will be use to expedite rail construction.



TIMELINE

Stage 3 - Minimum Utility Relocation : Streetscaping and Light Rail Commissioning

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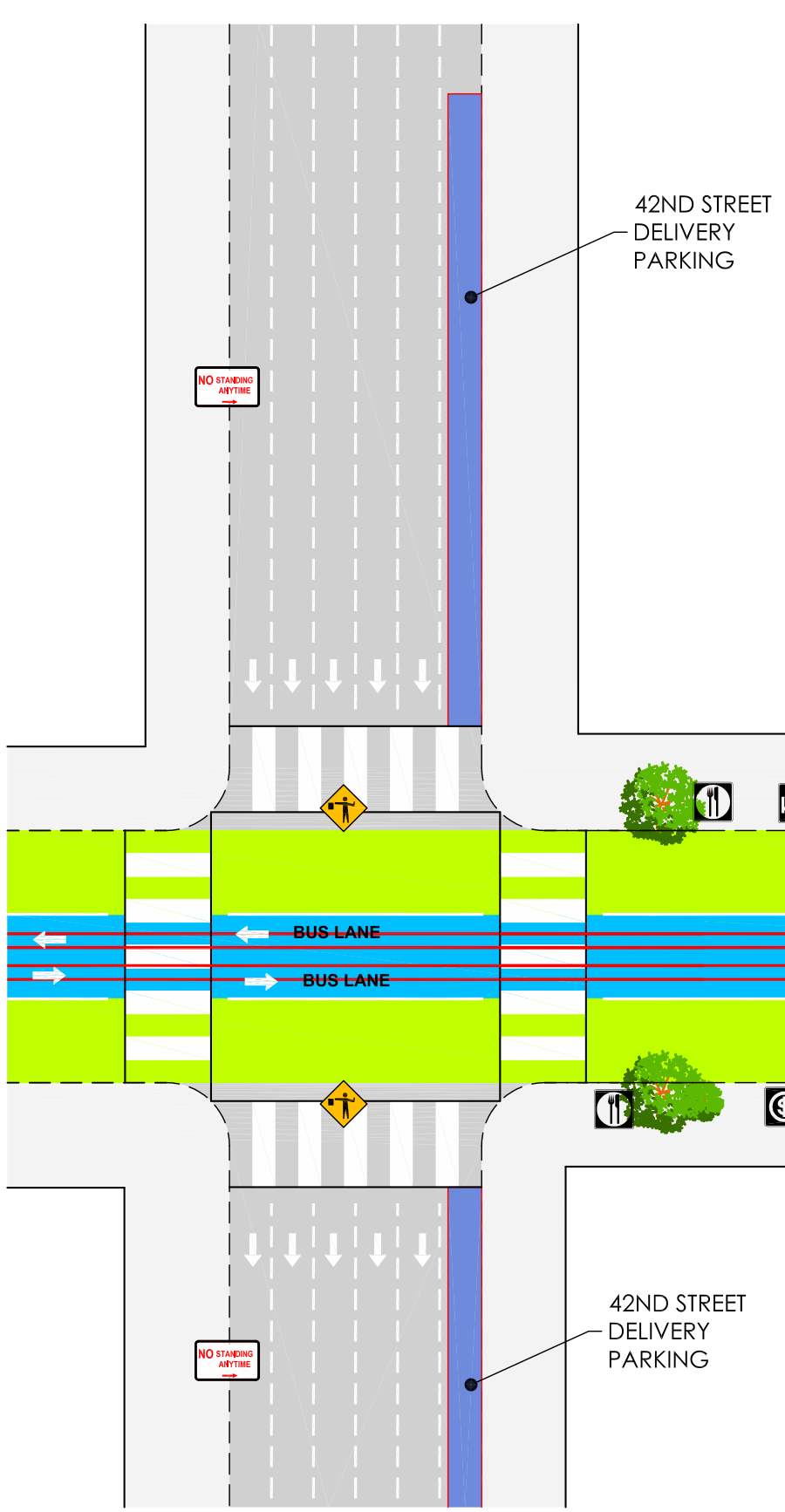
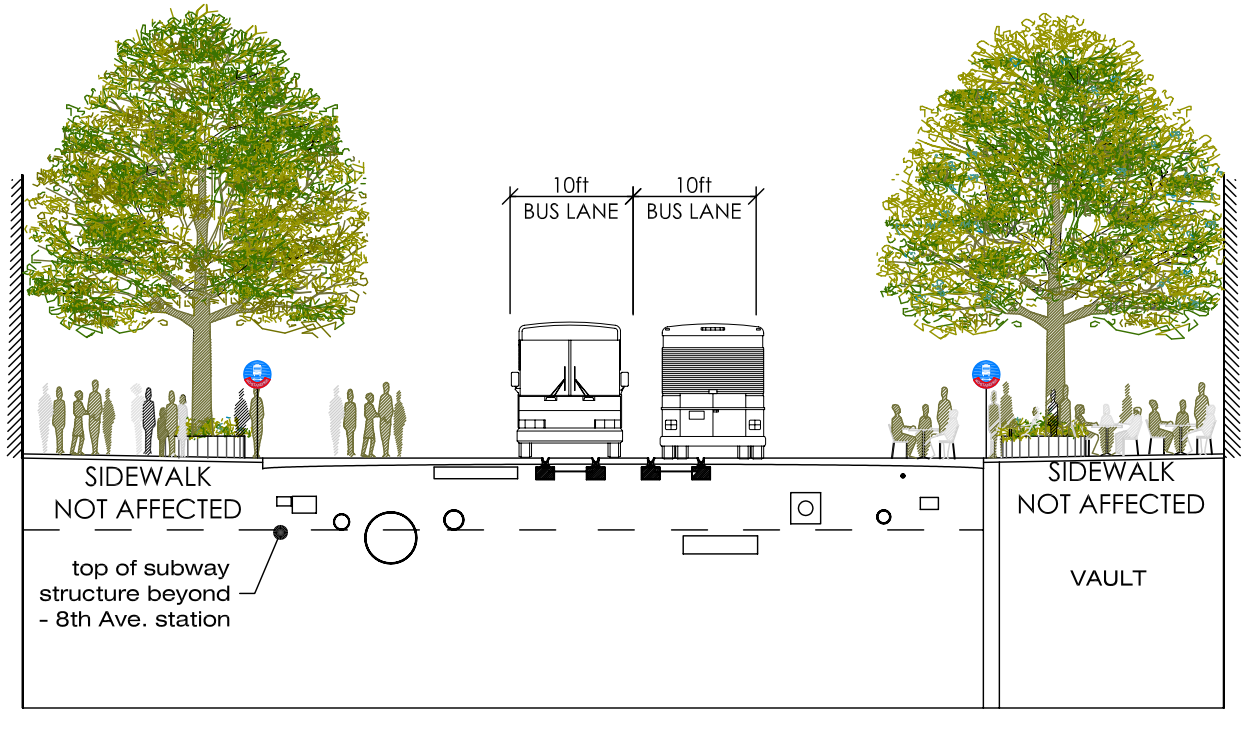
TYPICAL BLOCK



PLAN



SECTION

0 10 20 30 FEET

- Major construction within the avenue segment is complete;
- Buses return to the center of the street, running over the rails;
- Streets are landscaped, pavers installed, hard sacep and streets opened up for greater pedestrian use;
- Upon completion of the entire rail line, the system is commissioned with vehicles tested at night.

		Pre-Excavation	Utility Relocation Construction	Rail Construction	Streetscaping	Commissioning	Platform Construction with LRT operational
Year 1	JAN						
	FEB						
	MAR						
	APR						
	MAY						
	JUN						
	JUL						
	AUG						
	SEP						
	OCT						
	NOV						
	DEC						
Year 2	JAN						
	FEB						
	MAR						
	APR						
	MAY						
	JUN						
	JUL						
	AUG						
	SEP						
	OCT						
	NOV						
	DEC						

TIMELINE

Stage 4 - Minimum Utility Relocation : Platform Construction

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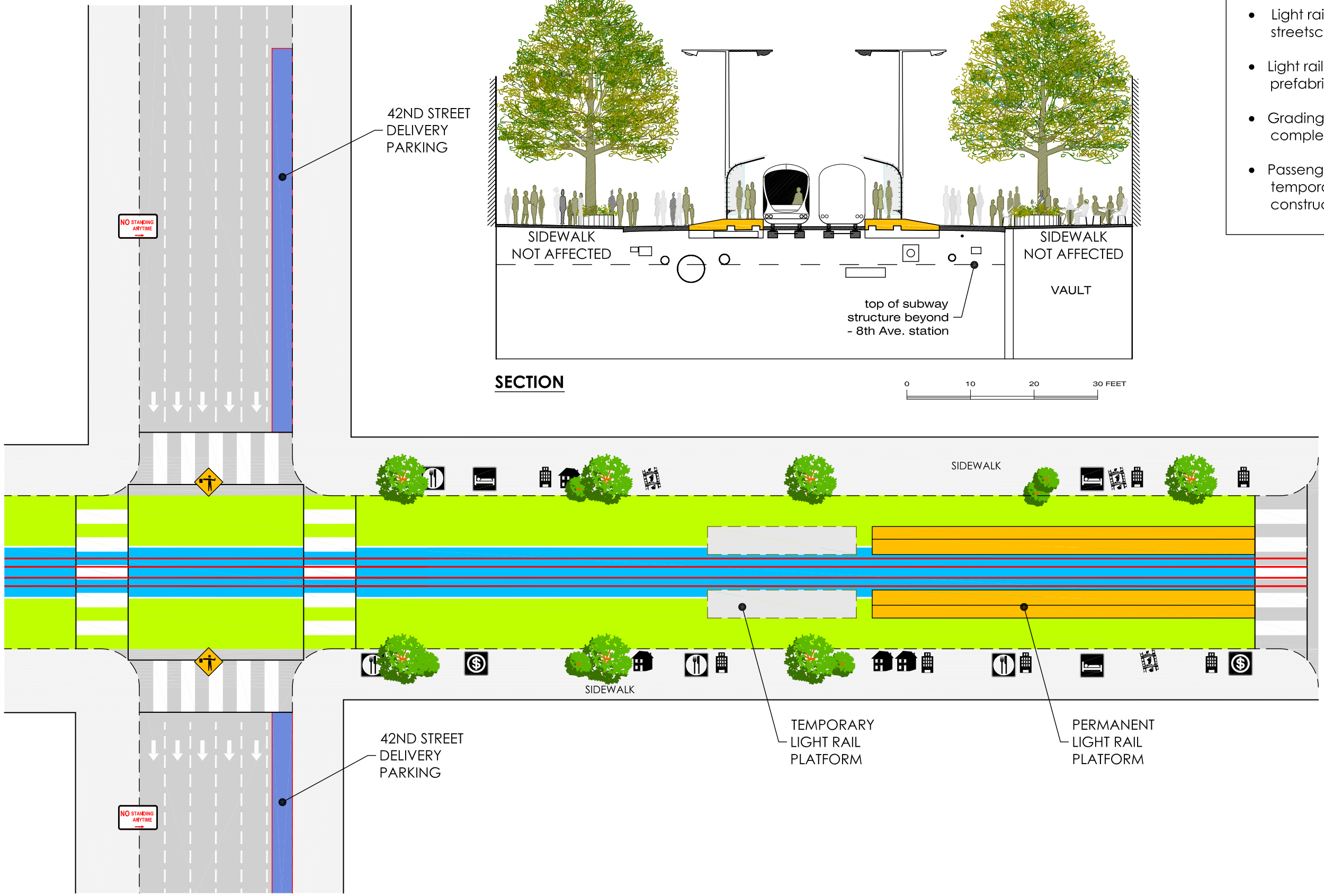
TYPICAL BLOCK



SECTION

PLAN

- Light rail vehicles are operational and most streetscaping has been finished;
- Light rail platforms are set in place from prefabricated material;
- Grading of platform with the street is completed;
- Passengers board light rail vehicles at a temporary stop outside the platform construction zone.

		Pre-Excavation	Utility Relocation Construction	Rail Construction	Streetscaping	Commissioning	Platform Construction with LRT operational
Year 1	JAN						
	FEB						
	MAR						
	APR						
	MAY						
	JUN						
	JUL						
	AUG						
	SEP						
	OCT						
	NOV						
	DEC						
Year 2	JAN						
	FEB						
	MAR						
	APR						
	MAY						
	JUN						
	JUL						
	AUG						
	SEP						
	OCT						
	NOV						
	DEC						

TIMELINE

Stage 5 - Minimum Utility Relocation : Completion

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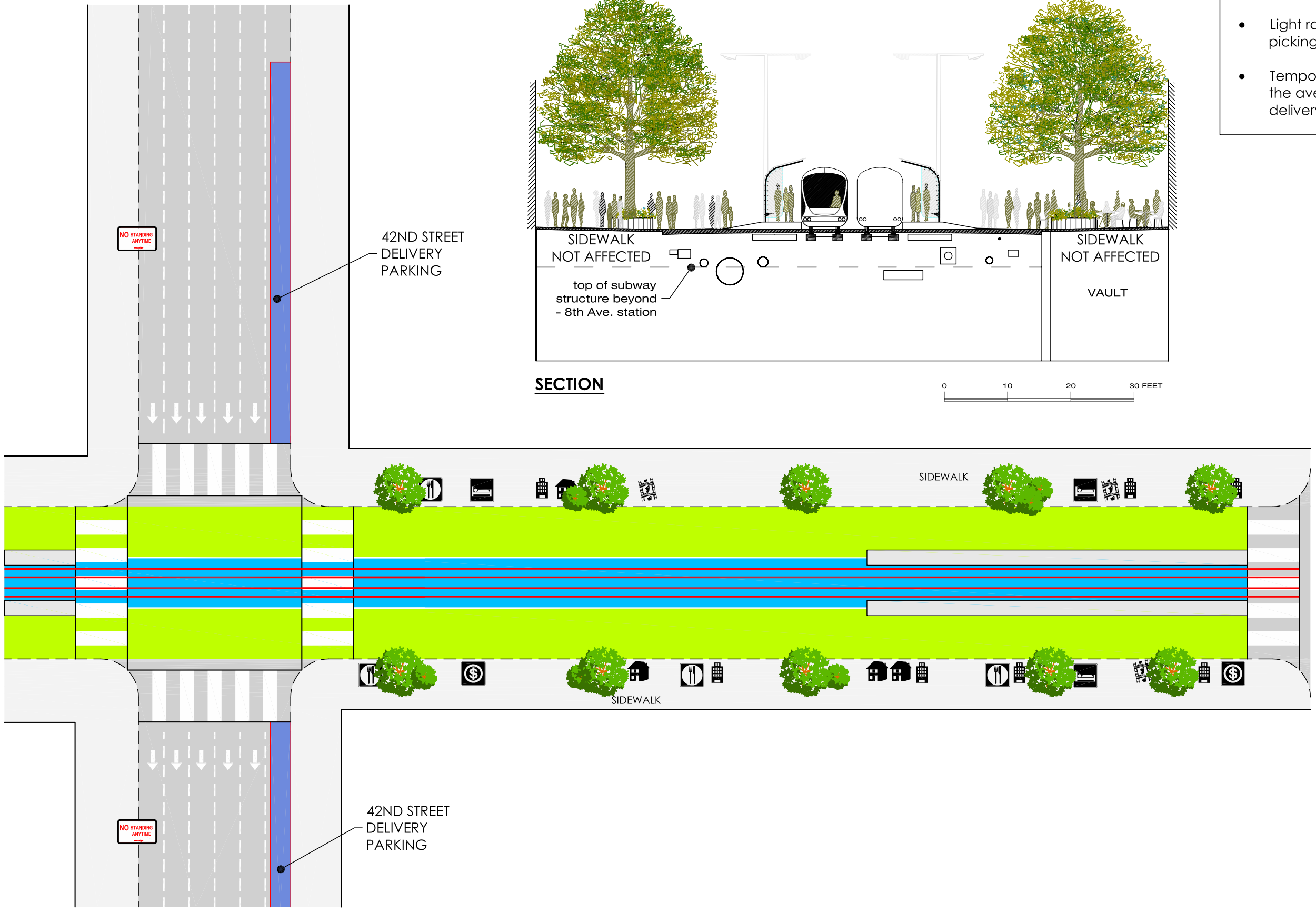
TYPICAL BLOCK



PLAN

SECTION

- Light rail vehicles are fully operational, picking up passengers at the platform;
- Temporary construction storage areas along the avenues are returned to short-term delivery parking areas.

8. Bibliography

Crawley, Gemma. CUTE Conference Report, Hamburg May 2006. *Fuel Cell Today (May 2006).* Online at http://www.fuelcelltoday.com/FuelCellToday/FCTFiles/FCTArticleFiles/Article_1097_CUTEwrapupconference.pdf

Dorn, M.L. and Bollier, John. "GMCM Contracting: The Formula for Success on the Portland Streetcar Project." *New Start Project Development – Overcoming Obstacles with Innovation. Track 4 – New Starts.*

East Japan Railway Company. Development of the World's First Fuel Cell Hybrid Railcar. (April 2006). Online at http://www.jreast.co.jp/e/press/20060401/index.html

Kramer, Frederick A. *Across New York by Trolley: The Third Avenue Railway System in Manhattan, The Bronx and Westchester*. (New York: Quadrant Press 1975).

Moll, Betsy, HDR/ S.R. Beard & Associates. *Placemaking, Partnerships and Light Rail Transit: The Phoenix METRO Urban Design Story (Phoenix, AZ: 2005.)*

Regional Public Transportation Authority/ Urban Design Task Force. *Urban Design Guidelines for the Central Phoenix/East Valley Light Rail Transit Project*. (Phoenix, AZ: Valley Metro Rail. 2001.) Available Online at http://www.metrovalley.org

Sound Transit. *Light Rail Link Fact Sheet*. (Seattle, WA: Sound Transit, 2006).

The Railway Forum. *Fuel Cells and the Railway of the Future*. Online at http://www.railwayforum.com/getfile.php?id=117

Valley Metro Rail. *Business Outreach Handbook*. (Phoenix, AZ: Valley Metro Rail. 2004.) Available Online at http://www.metrovalley.org

Valle Metro Rail. *Central Phoenix/East Valley LRT Project - Public Involvement Program for Final Design & Construction*. (Phoenix, AZ: Valley Metro Rail. 2003)

Valley Metro Rail. *Light Rail Progress Report: Central Phoenix/East Valley Light Rail Transit Projecy.* (Phoenix, AZ: Valley Metro Rail. December 2005.)

Valley Metro Rail. *Light Rail Construction Fact Sheet*. Available Online at http://www.metrovalley.org