Leveraging Infrastructure: Sustainable Bus Rapid Transit Route Planning in Beirut, Lebanon

by

Jumana M. Nabti

B.S. Social Sciences
California Polytechnic State University, San Luis Obispo, 2000

SUBMITTED TO THE DEPARTMENT OF URBAN STUDIES AND PLANNING AND THE DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREES OF

MASTER IN CITY PLANNING
and
MASTER OF SCIENCE IN TRANSPORTATION
at the
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JUNE 2004

Signature of Author: .....
Department of Urban Studies and Planning
Department of Civil and Environmental Engineering
May 20, 2004

Certified by .....
Ralph A. Gakenheimer
Professor of Urban Planning, Emeritus
Thesis Supervisor

Accepted by.....
Frederick P. Salvucci
Senior Lecturer of Civil and Environmental Engineering
Thesis Reader

Accepted by.....
Heidi Nepf
Associate Professor of Civil and Environmental Engineering
Chairman, CEE Committee for Graduate Students

Accepted by.....
Dennis M. Frenchman
Professor of the Practice of Urban Design
Chairman, MCP Committee

Leveraging Infrastructure:

Sustainable Bus Rapid Transit Route Planning in Beirut, Lebanon

by

Jumana M. Nabti

Submitted to the Department of Urban Studies and Planning and the Department of Civil and Environmental Engineering on May 20, 2004 in Partial Fulfillment of the Requirements for the Degrees of Master in City Planning and Master of Science in Transportation

ABSTRACT:

This thesis applies the concepts of urban design, public transportation planning, economic development, and sustainability, to the routing and site plan of a two-kilometer bus rapid transit (BRT) line segment into downtown Beirut, Lebanon; linking a 20-kilometer BRT corridor to the region's core. Previous routing of the segment, which used typical transportation engineering processes produced routes that would degrade the line's quality of service and/or the adjacent land uses. While one route was preferred, none were compelling enough to be advanced to the next planning stage.

This thesis explores the possibility that, by expanding the criteria, the route selection and design process can be used to determine an alignment that not only supports high quality transit service, but leverages the capital investment in public transportation to improve environmental quality, economic development, community livability, and transit network connectivity in the areas it serves. In turn, the inclusion of these factors should aid in successful BRT implementation by broadening the base of supporters, and by acknowledging and catering to the physical, social, and political complexity of the project and the project area, substantially increasing project benefits.

The project identified a broad range of routes, and the primary institutions and constituencies affected in order to develop an alignment and site programming method to optimize support. Using public transportation infrastructure improvements as a catalyst and a mechanism by which to improve other aspects of the urban system, if successful, should not only improve the implementation likelihood, but also create greater incentives to continually expand the transit system.

Thesis Supervisor: Ralph Gakenheimer
Title: Professor of Urban Planning, Emeritus

Leveraging Infrastructure

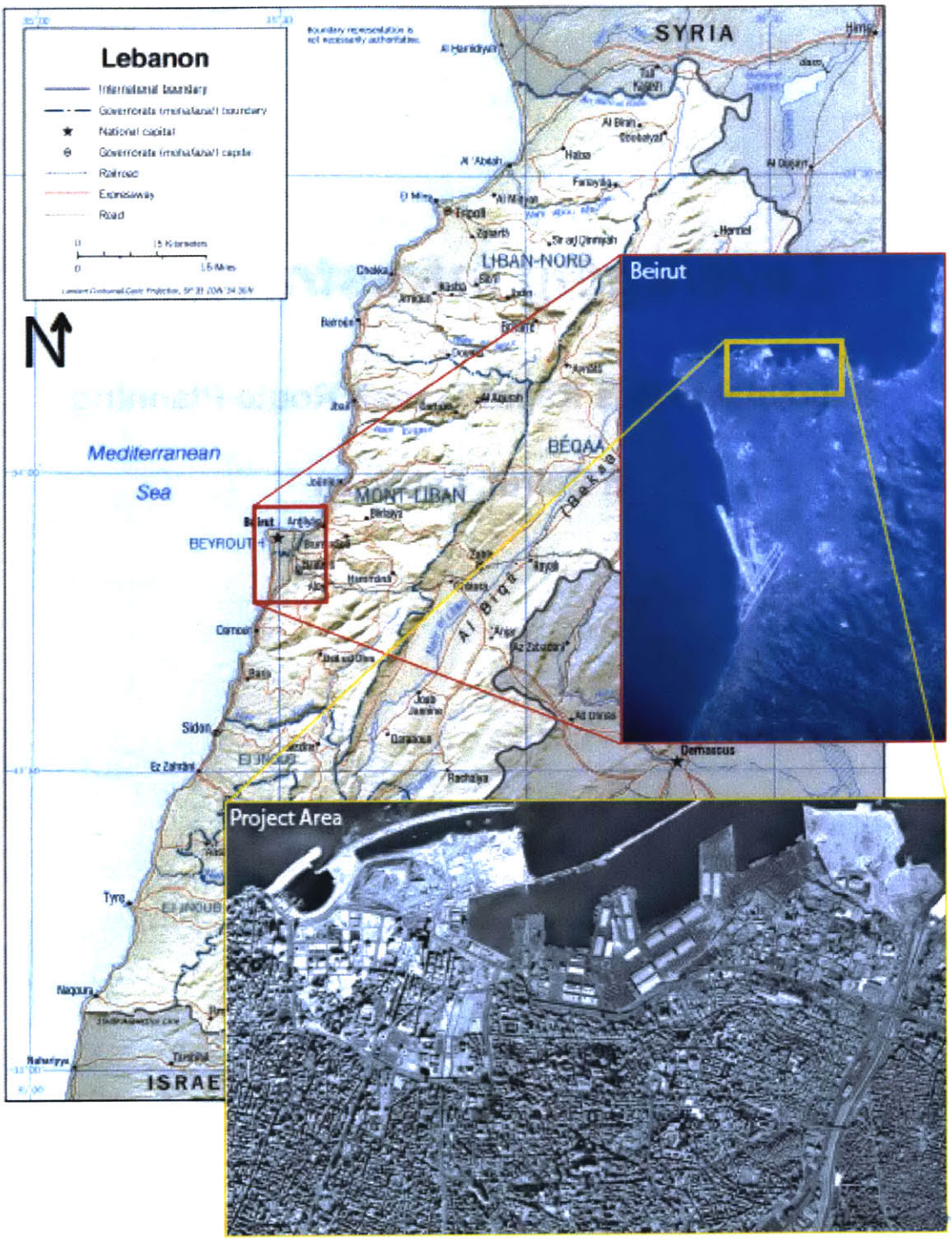
Sustainable Bus Rapid Transit Route Planning

in Beirut, Lebanon

by

Jumana Nabti

Figure 1-1. Project context map, showing Lebanon, Beirut, and the project area



This page intentionally left blank

Acknowledgements

This is the place where I get to thank everyone who helped me through the grueling process of graduate school and thesis writing. The list is long and distinguished; and unfortunately I'll have to abbreviate it, as it could be a thesis in itself.

So, I'd like to thank...

My *awesome* family for dealing with me and supporting me: Mom, Dad, Riyad and Dave.

My inspiring, warm, dedicated, and just plain fabulous DUSP and CTL classmates. Yay!

My professors, especially Fred Salvucci, Joe Coughlin, and Eran Ben-Joseph; and my advisor Ralph Gakenheimer.

Everyone in Lebanon that talked to me about this project and provided me with valuable insight, materials, and other information. Particularly Ammar Kanaan.

Also,

Julie Kirschbaum, Laurie Pessah, Alice Twohig, Lyssia Lamb-Macdonald, Sara Goplin, Vivian Shao, Alan Donovan, and Natalie Musick.

There are of course many more that deserve individual recognition but hey, I've only had four hours of sleep in the last 48 hours. Give me a break!

Table of Contents

Table of Figures

List of Acronyms and Definitions

BCD: Beirut Central District
BMR: Beirut Metropolitan Region
BRT: Bus Rapid Transit
BUTP: Beirut Urban Transport Project
CDR: Council for Development and Reconstruction
CEGP: Executive Council of Major Projects (Conseil Executif des Grands Projets) – Housed within the MOPW
CEGVB: Executive Council of Major Projects for the City of Beirut (Conseil Executif des Grands Projets de la Ville de Beyrouth) -- Housed within the MOPW
GBATP: Greater Beirut Area Transportation Plan
GDU: Directorate General of Urbanism
HOT: High Occupancy Toll
HOV: High Occupancy Vehicle
LL: Lebanese Pound or Lira (Currently the Lebanese Pound is stable at about 1500LL/USD)
LRT: Light Rail Transit
MOE: Ministry of Environment
MOF: Ministry of Finance
MOI: Ministry of Interior
MOMRA: Ministry of Municipal and Rural Affairs
MOPW: Ministry of Public Works
MOT: Ministry of Transport
MUNI: Municipalities
OCFTC: Railways and Public Transportation Authority (Office de Chemins de Fer et Transport en Commun)
RFP: Request for Proposals
RPTA: see OCFTC
SOLIDERE: Société Libanais pour le Développement et la Reconstruction du Centre-Ville de Beyrouth
Servíce: shared taxi or jitney
TDM: Transportation Demand Management
USTDA: United States Trade and Development Agency

This page intentionally left blank

1. INTRODUCTION

Let's start with conventional wisdom: developing countries have a big problem with money. In fact, they have too many problems and not enough money. Often, governmental institutional structures distribute these problems amongst their agencies, which are charged with regulating and ameliorating conditions within their specific sector. This hierarchical division of responsibilities appears to be a relatively efficient organizational structure, however its effectiveness is often lacking. Problems rarely fit well within a single sector, and because of this, the solutions are often deficient. Moreover, problems are usually connected to each other such that a specific solution may either solve several problems at once, usually at somewhat higher costs, or may cause other problems. An expansion of problems could lead to opposition, political gridlock, or construction of projects which either don't work or reduce government credibility because of severe *external* impacts. Is there a way to determine solutions that will solve multiple problems at once? Multi-problem solutions can be both more cost efficient, when viewed from a larger scale, and more effective. And developing countries have too many problems and not enough money.

Can a broader multi-problem solution achieve adequate political support to be implemented? And at the same time, can it be more efficient, even if more expensive, because it solves more problems?

Transportation is a prime example of a problem that spans several sectors. It impacts and in turn is impacted by various social, economic, and environmental issues. In order to rationalize these issues, specific functions and regulations are divided up according to their impact. In Lebanon, transportation is regulated and organized by at least five

ministries, and three other non-ministerial entities not including the Parliament, the President, or individual municipalities. Where agencies do not communicate there is not only little opportunity for the development of a single comprehensive regulatory and planning structure for solving transportation problems, but solutions that extend beyond transportation may never be identified and evaluated.

Transportation requires a massive and visible infrastructure system. In Lebanon, where little modal choice exists, no one questions reliance on a road-based system or its expansion. However, a transportation system built on the automobile is expensive and inefficient. In terms of capacity per lane, single passenger vehicles have the lowest efficiency of all modes. Public transportation is a great way to improve transportation efficiency, as it can carry considerably greater capacity per lane than automobiles. Furthermore, if managed well, it can cover its operating costs. In most developing countries, including Lebanon, public transportation, is a private business venture. This is particularly true with buses, which use the existing road infrastructure; however models using other modes and more exclusive rights of way have successfully covered operating costs, such as the subway system in Santiago, Chile.

One major problem with buses is that they are slow. They offer users no travel time benefit because they use the same facilities as automobiles, while at the same time stopping for passengers. In Lebanon, because there are no formal bus stops, they stop wherever there are potential passengers, further reducing travel time benefits. These systems capture few, if any choice riders.

Public transit systems that operate on exclusive rights of way provide considerably improved service. Other provisions that improve travel time include stop spacing, grade separation, station platforms for level boarding, and fare prepayment prior to boarding

the bus. Considering these operating characteristics when determining the route alignment is essential, in addition to passenger origins and destinations, and demand. However, developing this infrastructure is expensive, especially where right of way creation is necessary.

How can the costs of providing high quality public transit facilities be reduced to make it more feasible for developing countries? Once the larger-scale origin-destination demands are determined, how can transit alignment decisions be made at the neighborhood scale that best benefit the neighborhoods they pass through, improve the viability of the transit line itself, and the transportation network as a whole? Finally, how can the capital investment input for transit facilities provide synergistic solutions to improve the local and regional urban system?

This thesis seeks to combine the concepts of public transportation planning and engineering, urban design, land use and economic development, and sustainability planning, and apply them to the routing and design of a bus rapid transit (BRT) system in Beirut, Lebanon that is currently in the planning stages. The premise is that not only will this aid in successful BRT implementation, but that such transportation infrastructure improvements can serve as a catalyst and a mechanism by which to improve environmental quality, economic development, community livability, and transit network connectivity in the areas it serves. By including these goals in the initial routing and design process, it may broaden the base of stakeholders and supporters. The hope is that this in turn will strengthen the push for implementation of the project. A two-kilometer segment of the planned Beirut Suburban Mass Transit Line will be used as the basis of this report.

The implementation of BRT in developing countries is not new. However, those cities that have implemented BRT have generally done so as median lanes on large boulevards and highways. This is physically and politically impossible in Lebanon, where these facilities do not exist, or are already above capacity. In these cases we must look at the specific context of the city, its assets and liabilities, and the operating characteristics of the mode to determine what options are available.

Furthermore, while Curitiba and Bogotá are frequently cited as leaders for their implementation of innovative and highly successful transit systems, the unusual political conditions under which they were initially developed are not easily generalizable. Curitiba's system, which began under a dictatorship, became successful enough by the end of the regime that large constituencies supported its expansion. In Bogotá, a highly charismatic leader was able to mobilize lower income groups to support his policy of prioritizing non-auto modes. Even so, he was almost impeached before the positive impacts of the policy became apparent. The rapid implementation process was essential to his political survival, and that of the policies he was promoting. In both these cases the initial implementation period was crucial to the long-term success and expansion of the transit systems. While neither of these methods is applicable to the case of Lebanon, developing a strategy for achieving initial success in Beirut may provide the necessary momentum for longer term support and expansion of the transit system.

Bus rapid transit is unique in that it combines the operating, vehicle, and right-of-way characteristics of both bus transit and rail rapid transit systems. As a relatively new mode, BRT provides developing countries with more flexible and less costly options for providing high quality rapid transit at a fraction of the cost of typical rail systems, thereby extending service more broadly. While BRT is a unique routing challenge, its flexibility

allows the form of potential links to be more varied than with other modes; on non-exclusive roadways with various treatments that facilitate the movement of transit vehicles, on restricted lanes such as HOV or HOT lanes, or on fully restricted lanes, roadways, or rights of way. Nodes can range from standard bus stops to full-fledged stations. But in its pure form, on an exclusive right of way, it requires the political strength and stability to prioritize the use of road space for public transportation rather than the auto. In this sense, the politics are opposite those of grade-separated rail, which auto users support, since it removes surface buses and other vehicles from the roadway. Once the BRT mode is decided, the variety of options can serve to deteriorate the quality of facilities when better options are not immediately apparent or are politically more difficult to implement. This is particularly true when cost/benefit ratios are similar but effectiveness differs widely. Compromises to avoid cost or controversy can be so severe as to undercut the overall effectiveness and credibility.

The case of developing countries requires the acknowledgement that work is being performed in an environment of often inadequate information, poor institutional capacity, and greater uncertainty. Furthermore, ideals of development often follow models provided by already developed countries and international development institutions such as the World Bank. These ideals are backed by tempting funding opportunities with many strings attached. Short run political constituencies of engineering companies, contractors, and public works agencies have used this funding to get expensive projects built notwithstanding low economic activity. For example, Lebanon has embarked on an ambitious campaign of road expansion, which has contributed to its ranking in the top

twenty per capita debtor countries in the world[1]. At the same time, maintaining standard of living for a large portion of the population depends on overseas remittances rather than internal economic growth. Can multi-problem solutions help to develop this political will to move, in the longer range, in a more sustainable direction? Attempts to generalize these factors to achieve a singular model, applicable worldwide in a variety of political contexts, oversimplifies the problems. By addressing the concerns and issues of developing countries, and even more specifically of a single region, country, or metropolitan area, it should be possible to provide a high quality, comprehensive tool, ensuring that the best long-run transportation decisions are made.

[1] Association of Banks in Lebanon, "Economic Letter" March 2004. CIA World Factbook.

2. TRANSPORTATION IN LEBANON

This chapter provides an overview of the history of public transportation in Lebanon, the current modal mix and institutional structure of the transportation. It is intended to provide a view of the extent of the transportation problems that exist, the origins of the infrastructure, and the likely reaction of residents to the creation of a formal and effective public transit system.

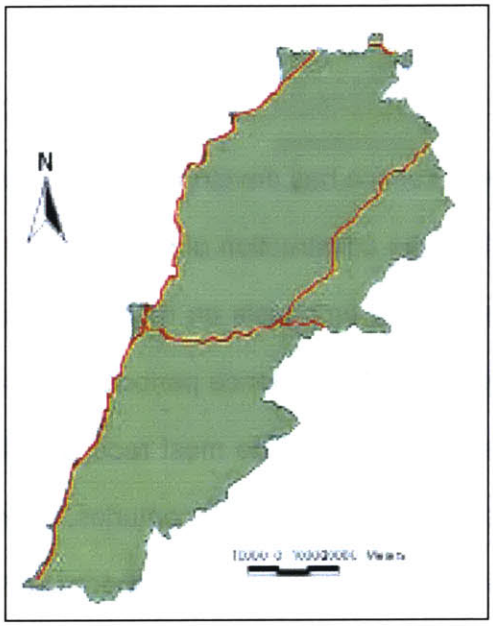
2.1 HISTORICAL CONTRIBUTIONS TO TRANSPORTATION AND PLANNING IN LEBANON

The backdrop of public transportation infrastructure and service has developed over more than a hundred years in Lebanon. This carries us from the construction of railroads and the electric tramway during the Late Ottoman period, to the emphasis on master plans and automobile circulation during the French Mandate and Independence periods, and to the destruction of much of the infrastructure and institutions during the most recent Civil War. While these periods cover large portions of the late 19th and the 20th centuries, they marked very different chapters in the region's history both in terms of planning theory and in terms of constructed (or destructed) infrastructure. It is an important reminder that transportation impacts are greater than just mobility, and that its infrastructure and its impacts often last well beyond other components of the urban system, affecting future decisions that cannot always be anticipated.

The Late Ottoman Period

The late Ottoman period was extremely important for transportation in Lebanon. It was during this period that much of the transportation infrastructure was developed, including the Coastal and Beirut-Damascus railroads and the electric trolley system in Beirut. The Ottomans sought to bring the city closer to Istanbul and Damascus, connecting the inland provincial capital with the Port of Beirut. When Beirut itself became a provincial capital in 1888, this infrastructure helped it cement its role and influence in the region.

Figure 2-1. Railroads in Lebanon, showing the Coastal, Damascus, and Bekaa railroads

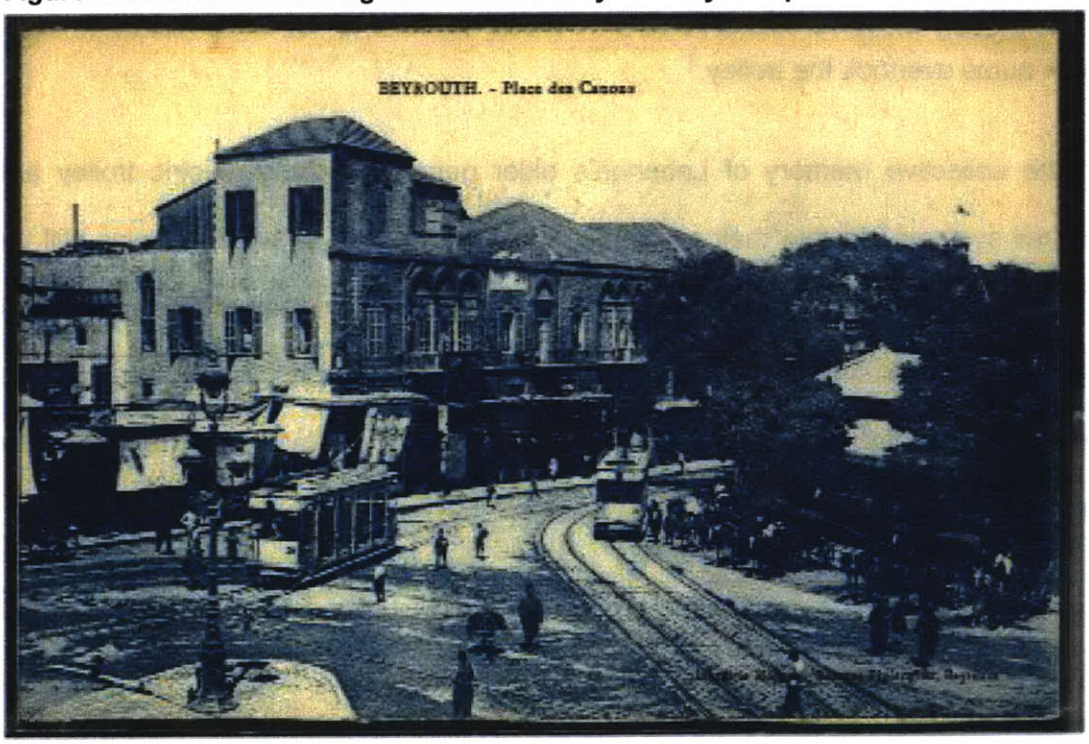


Source: Beirut Suburban Mass Transit Feasibility Study Final Report.

The connection of the railroads to the Beirut Port was a major boost to the port itself as well as for Damascus and the intermediate communities, which were previously cut off from the coast during the winter months. The railroad transported passengers between the major population centers, of Tripoli, Batroun, Byblos (Jbeil), Jounieh, Beirut, Damour, and Saida (Sidon) as well as Chtoura on the eastern foot of the Lebanon Mountains and Damascus. Dispersal of industry beyond the major cities became more viable. In Beirut,

the railroads were routed outside of the main population center and avoided the topographic barriers of the Achrafieh hill and Ras Beirut. A spur line accessed the Port area, running along the river to where it met with the main line at the NBT Station and Yards. The closest rail station to central Beirut was at St. Michel. Both the Beirut-Damascus Railroad and the Coastal "Tramway Libanais" were completed and began operations in the 1890s. When the electric trolley system was inaugurated in Beirut about fifteen years later, these facilities were finally connected directly to the heart of the downtown, attracting commerce to the city, and raising land values both in the more central districts and at the farthest extent of the lines.

Figure 2-2. Postcard showing the electric trolley in Martyr's Square



Source: unknown.

The electric trolley shaped transportation and the direction of development within Beirut and its closest suburbs early in the 20th century, prior to the advent of the automobile. The electric tramway was proposed and built by the same Belgian company that first provided the city with gas lighting on the streets in 1889. The trolley system opened for

service in 1909 after a construction process that required street widening and straightening. The four lines originated at Bourj Square[2] and extended out in four directions. They were garaged at the company's offices on Nahr St, which remains the Electricité du Liban headquarters to this day, and is within the study area for the BRT segment into Downtown.

The electric trolley not only had an impact on travel time and real-estate development, but also on labor and social attitudes. It was at the heart of labor protests by the trolleyc company employees to improve working conditions and pay; and was subject to a boycott when the company raised fares in its early years. The trolley system was dismantled in the early 1960s and its tracks paved over, like many systems around the world, as the desire for autos overtook the trolley.[3]

Still in the collective memory of Lebanon's older generations, the electric trolley and intercity rail systems, despite their problems, hearken to a time when Beirut was still the "Paris of the Middle East". Because of this, construction of a new centralized transit system may incur a similar reaction by the people of Beirut as a sign of progress, increased capacity of the government to solve the country's problems, and national pride. Lebanon is a small country, and this is a big thing.

---

[2] Bourj Square, named for the tower that once marked it, will be referred to by its more contemporary name, Martyr's Square through the rest of this report.

[3] Hanssen, J. (1998) "Your Beirut Is on My Desk:" Ottomanizing Beirut under Sultan Abdülhamid II (1876-1909). In Rowe, P. and Sarkis, H. (Eds.) *Projecting Beirut: Episodes in the Construction and Reconstruction of a Modern City*. pp. 50.

The French Mandate Period

The French Mandate period in Lebanon, between 1920 and 1943[4], was an important era of urban planning in the region. The French were determined to pull Lebanon out of the backwardness that the Ottomans had left it in. They attempted to apply European development concepts and ideals, through the implementation of grandiose yet mostly unattainable master plans. They succeeded more in reforming institutional structure, and the only portions of the plans built were Star Square, which required the destruction of a large portion of downtown Beirut, and the grand seaboard Avenue de Paris, or the "Corniche" as it is commonly called. What is significant about this period in terms of transportation is that it heralded and responded to the era of the automobile. The master plans included creating massive avenues for the ease of automobility. Much of the infrastructure of these plans maintained momentum into the current reconstruction process, such as completion of the ring road around Downtown. Public outcry led to more context-sensitive avenues Downtown, however other freeway projects within the Beirut Metropolitan Region (BMR) have been given new life in the Greater Beirut Transportation Plan (GBTP)[5] completed in 1995 and the Beirut Urban Transport Project (BUTP) plan of 2000, both for the Council for Development and Reconstruction.

As the post- World War II era saw a major increase in automobile traffic, the electric tramways began to be perceived as obstructions to traffic flow, at least by auto drivers, rather than the traffic itself. They were removed from service and the tracks paved over in

---

[4] In November 1943, Lebanon became the first country in the region to gain its independence from an occupying/mandate power. France remains one of Lebanon's closest allies.

[5] The GBTP is also referred to sometimes as the GBATP, the Greater Beirut Area Transportation Plan.

the early 1960s. The railroads lasted until the late 1960s with minimal service to heavy industry continuing to the mid-1970s. With the onslaught of fighting in 1975, this service discontinued as well.

The Civil War

The impact of the Civil War from 1975 to 1990 was not in the plans that were developed for Beirut during this time, though several were, but in the destruction that it caused. During those 15 years, conflict between politico-religious factions tore the country apart physically and socially; with the greatest impact in Downtown Beirut and along the Damascus Road (dubbed the Greenline). During the war, the government in Beirut basically disintegrated, and services halted or were completely unreliable. Businesses moved to the suburbs (creating a polycentric metropolis), moved out of the country, or closed operations altogether. While fighting took place over a fifteen-year period, it is also important to mention that there were cease-fire periods that lasted months at time, leading people to believe the war was over. It was during these times that initial reconstruction efforts began; they were halted in infancy with the resumption of conflict. The end of the Civil War heralded a new era of reconstruction. It also began a new drive for development, with reconstruction a means of attracting investment and catching up to not only pre-war conditions, but to the first world dreams of many returning Lebanese.

2.2 The Entities of Reconstruction

1990 began an intense period of reconstruction, which continues to this day. The government created two entities to manage the reconstruction effort, the Council for

Development and Reconstruction[6] (CDR) and the private real estate company, Société Libanais pour le Développement et la Reconstruction du Centre-Ville de Beyrouth, or Solidere[7]. The end of the war and the early reconstruction period offered the country a clean slate, and various master plans developed and evolved to fill it. While the concept and importance of quality public transportation did not escape planners, implementation has.

Council for Development and Reconstruction

In theory, CDR, which is directly under the Prime Minister manages all government projects that require foreign assistance, and works with the various ministries on implementation. Operation and maintenance of the facilities is then the sole responsibility of the ministries. However, in practice, the edges are fuzzy and the roles of the ministries sometimes overlap with that of CDR. For example, the Beirut Suburban Mass Transit project has been a sole effort of the Ministry of Public Works and Transport, with little to no CDR input despite support from the US Trade and Development Agency (USTDA).

---

[6] CDR was founded in 1977 during one of the first breaks in the war, to begin reconstruction unhindered by red tape. These efforts were cut short several times by a resumption of fighting.

[7] "Downtown Beirut", "Beirut Central District" or "BCD", and "Solidere" are often used interchangeably in the literature, as the area within which Solidere has jurisdiction. While terms such as Downtown Beirut existed prior to the company Solidere, its boundaries have become more strictly defined and formalized; they are now marked on most city maps. Note: BCD is often mistaken for the more general term "Central Business District" or "CBD", used in urban planning, design, and transportation literature; BCD refers to Beirut's CBD.

Until 2002, CDR had focused on basic infrastructure and service provision (water, sewage, solid waste, electricity, and phone service). In the post-war rush to catch up, several things happened:

- Over-construction of major roads
- Little consideration of the impacts of construction
- Little consideration of (less costly and less negatively impactful) alternatives
- Massive accumulation of foreign debt
- Little concern for social investment

While many roads in Beirut remain congested, expensive highway, viaduct, and tunnel bypass projects have been constructed in anticipation of higher traffic levels. Less costly congestion relief, such as promoting alternative transportation modes and transportation demand management (TDM) initiatives have not been seriously considered for either the short or long terms. The projects that have been built were not assessed for the negative impacts that both construction and the final product would have on the communities they served and passed through. Furthermore, these communities were not consulted or involved in the planning process at all, let alone adequately informed of the length or timing of construction. Major blows to confidence in government, these projects serve as ambassadors of government effectiveness and process[8]. They have also contributed to

[8] The case of a sewage improvement project on An-Nahr Street (in our project area) is just one of these examples, where business owners and residents did not know construction was to begin on their street, despite announcements on radio and in newspapers, and were unclear as to how long it would continue.

the country's soaring foreign debt. Currently at 18.5 Billion USD[9], Lebanon has among the highest per capita foreign debts in the world at almost $5,000[10].

Only in the last few years did CDR begin to recognize these impacts and has since begun to focus more on increasing social and community capacity, as well as assessing the social impacts of their infrastructure projects. It is telling that social investments such as community and economic development support and poverty alleviation programs were only initiated in 2002[11], with the launching of the Economic and Social Development Fund and the Community Development Program at CDR. Prior to this, their social programs generally included school and health center construction, but not the programming within them. The recent inclusion of this program within CDR provides an excellent opportunity for a project that improves infrastructure and transportation systems as well as social, economic, and environmental enhancements.

In 1995, CDR completed a transportation plan for Lebanon which includes a major road development campaign, parking and signal plans, as well as the creation of a comprehensive subway system. In publications, and conversation with CDR officials, they are proud to claim that everything in the plan is currently in progress or has completed

---

There were also anecdotal accounts of loss of business by store owners as well as confusion about detour routes and traffic flow.

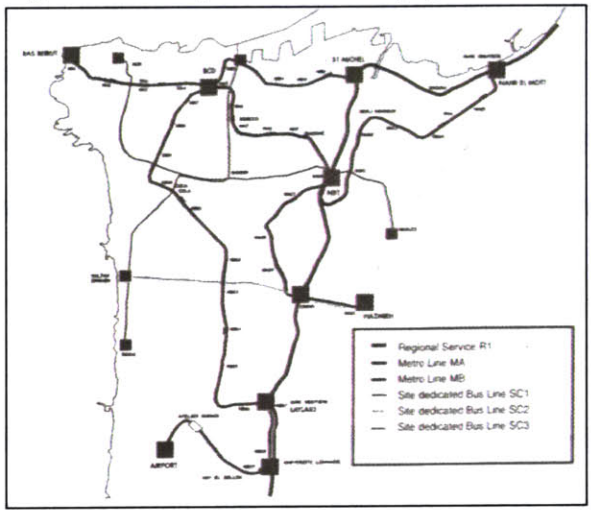
[9] Association of Banks in Lebanon (ABL) "Economic Letter", Issue No. 3. March 2004. p. 5.

[10] This figure was determined using Association of Banks in Lebanon debt statistics for Feb. 2004; and population (July 2003) and comparison statistics from the CIA World Factbook, December 2003. Comparisons presented on www.nationmaster.com.

[11] With the exception of infrastructure construction related to the social sector such as schools and health centers.

implementation. However, no element of the public transportation plan has been implemented and only very preliminary studies have been contracted or completed. According to many transportation professionals the subway was dead on arrival. There is now general consensus that it will never get built because it is inappropriate technology for a country that has a wealth of subterranean archeological resources, and a dearth of financial ones.

Figure 2-3. The planned subway system in the Greater Beirut Transportation Plan (1995)



Solidere

Because the destruction in Beirut's downtown was so intensive, the level of importance played by this area in the economy and identity of the country, the complex ownership issues, and high financial costs, the national government created Solidere, a real estate holding company to manage and implement the reconstruction effort of the BCD. Solidere maintains responsibility for the area bounded by the Fakhreddine Street on the west, Soleiman Frangie Avenue and General Fouad Chehab Avenue on the south, Georges Haddad Street on the east, and the Mediterranean Sea to the north. It is required to undertake all construction that takes place within its boundaries. Solidere is a corporation

that is regulated by the national government, and owned by shareholders, many of whom previously owned property in the downtown area[12]. See

[12] For a more in-depth review of issues surrounding the ownership of Solidere, see Tamam Mango's MIT Master's Thesis. (2004) *Solidere: The Battle for Beirut's Central District.*

Figure 4-1 for the boundaries of Solidere's jurisdiction.

Currently, Solidere's transportation plan follows that of the CDR's Greater Beirut Area Transportation Plan of 1995, albeit with a few additions. A major theme in Solidere's plan has been mitigating the impact of motor vehicles. This has resulted in the development of underground tunnels to channel through traffic, pedestrian streets in major portions of downtown, and the use of traffic calming techniques. Earlier plans for the downtown area show major highways dividing the downtown from the rest of the city, as well as from the new waterfront. Due to public feedback[13], most of these segments have been reduced in scale and are now at grade.

Recognizing that the roads into the BCD have a finite capacity, and that increasing the vehicle capacity is undesirable for various reasons, public transportation was considered necessary for the continued growth of the BCD. The transportation plan for Solidere has included reserved bus lanes, alternative routes and stations for the planned subway (as discussed in the CDR's 1995 Transportation Plan), as well as shuttles within key downtown locations. Despite these public transit goals, there has been no movement toward them within Solidere or CDR; the agency has focused on private vehicles and *services* for travel to downtown, and pedestrians for travel within downtown.

In Downtown, congestion has already become a problem during peak hours. With only about 30% of the floor area so far developed, not all of which has been occupied, we can expect congestion to worsen:

---

[13] In interview, Gavin, A. stated that while there was no direct public input, there was considerable press generated on the plans, as well as discussions among professional planners and politicians; all of these sources were heeded in the revision of the Master Plan. Also discussed in Gavin, A. *Beirut Reborn.* pp. 53.

> *"The GBATP demonstrated that by the year 2010 the level of congestion of the street network will start reaching intolerable levels on certain corridors, in spite of all the committed additions to the road network. The trips generated by the forecasted level of development cannot possibly be served without a well-developed public transport system."*[14]

In Beirut, all roads lead to Martyr's Square. It was once the inter- and intra-city transportation hub of both downtown and the entire metropolitan region, with buses, taxis, *servíces*, and the electric trolley using it as their hub. As the gateway to the city from other towns and villages as well as from other parts of Beirut, it belonged to everyone, regardless of economic class, religion, or origin[15]. By avoiding "stronghold" status for any one group, it became the no mans land of the Civil War. While contributing greatly to the land uses and identity of the Square, Angus Gavin, head of urban planning for Solidere, has stated that these historical transportation uses are undesirable and "incompatible with the [the new vision of the] downtown" [16, 17].

---

[14] Council for Development and Reconstruction. *Beirut Urban Transport Project*: Preparatory Study, Executive Summary (2000). pp 17.

[15] This refers to village vs. city origin. Some, including Hashem Sarkis, in his course "Developing Worlds" at the Harvard Graduate School of Design, Fall 2003, contend that the 1975-1990 Civil War arose not only from sectarian tensions but from the unbalanced investment in rural communities as compared to urban ones.

[16] Interview with Gavin, A., Urban Development Division Manager, Solidere. July 2003.

[17] Gavin, A. *Beirut Reborn.* (1996)

Figure 2-4. Pre-war Martyr's Square was the center of the region's transportation system

Source: Postcard, Telco-Sport, Beirut

The problem with this position is that the Beirut's roads and Martyr's Square have evolved concurrently, over hundreds of years. The ease of access it provides to and from all areas of the city makes it an ideal candidate for regaining its role as the central transportation node. Regardless of where this node is located in the downtown, a major investment in public transportation is essential. For people to work, shop, live, and recreate in the Downtown, they must be able to get there. Attempting to separate transportation functions by relocating them to the inaccessible and structurally severe Charles Helou Station stigmatizes transit and is essentially self-destructive for Solidere, particularly since the road network, at least with the current mix of vehicles, will not support full Downtown development. Forcing those who are unable to afford a vehicle physically and figuratively to the margins, further advances the process of socially and economically stratifying access to the Downtown.

2.3 Public Transit in Lebanon

Several public transportation modes currently operate in Lebanon, including bus, mini bus, taxi, and servíce taxi. There are currently no systems with exclusive alignments. The

following section includes a brief review of the existing modes, and institutional structure in Lebanon.

Modal Descriptions

Table 2-1. 1998 Demand Distribution by Vehicle Classification for Greater Beirut

Mode	# Trips	% of Total	% of Non-Private Car Trips
Private Cars	1,190,000	68%	--
Service & Taxi	262,500	15%	47%
Private Sector Buses	245,000	14%	44%
OCFTC Buses	52,500	3%	9%
Total Bus Trips	297,500	17%	53%
Total Daily Motorized Trips	1,750,000	100%	32%

This table shows the mode split for Greater Beirut, an area with a population of approximately 1.3 million people; and for Tripoli, an area with a total population of approximately 400,000.

Bus

The bus mode can be divided into three separate groups of operators: the OCFTC, private bus companies, and private owner operators.

The OCFTC provides bus service in the Greater Beirut Area (24 routes) and the Bekaa Valley (15 routes); there are also plans to begin service in Tripoli, the second largest city in Lebanon (12 routes). In 1999 it had a bus fleet of 302, up from only 44 buses in 1996.[18] This number has since decreased to just over 100 operating buses. Unable to cover maintenance expenses, the OCFTC has cannibalized many of its vehicles for parts.[19]

---

[18] Mourtada, A. (1999) Rehabilitation of Public Transport. In Baaj, H. (Ed.) *The Workshop on Land Transport Policy for Lebanon.* Ministry of Transport. pp. 41.

[19] Interview with 'Awad, S., Property Manager of OCFTC, July 2003.

Figure 2-5. Cannibalized buses at St. Michel Station.

As can be seen from Table 2-1, above, the mode split of the OCFTC is relatively low, as compared to other public transit, while at the same time requiring a substantive subsidy. The operating deficit of the OCFTC, at 49%[20] of the operating costs, is in line with those of publicly operating transit agencies in developed countries. However in most developing countries, including the private bus operators in Lebanon, public transit is rarely provided with any subsidy; and if so, they are usually minor. This subsidy reached 9 million USD in 1999, while the amount requested rose to 13.3 million USD in 2000.[21]

The largest private bus company in Lebanon, comparative to the size of the OCFTC, is the Lebanese Commuting Company (LCC). Table 2-2 compares operating characteristics of the two agencies. The stark difference between the two, in spite of similar fleet sizes,

---

[20] Mourtada, A. (1999) Rehabilitation of Public Transport. In Baaj, H. (Ed.) *The Workshop on Land Transport Policy for Lebanon.* Ministry of Transport. pp. 46.

[21] Baaj, H. (2000) The Public Land Transport Sector in Lebanon. *Journal of Public Transportation.* 3(3). pp. 94.

highlights the inefficiencies of the public agency. This provides an interesting opportunity to compare the operations of the two agencies.

Table 2-2. Brief comparison of OCFTC and LCC (1998)[22]

Characteristic	OCFTC*	LCC
Fleet size in operation (# buses)	164 Beirut 20 Bekaa	185 Beirut
Routes in operation	24 Beirut 15 Bekaa	12 Beirut
No. of Passengers Annually (million)	14	18
Annual travel distance (million bus-km)	10.5	12.8
Annual Revenue** (million USD)	4.7	6
Annual Cost (million USD)	11.7	7.7
Cost/Bus-km (USD)	1.33	0.61
Annual Deficit (million USD)	9	1.7
Ratio of Employees to Operational Fleet Size	3.8	2.4

*Figures for OCFTC include operations in both the Beirut and Bekaa Areas
**Excludes non-ridership revenues such as advertising

The rest of the approximately 2000 red commercial plates issued to buses belong to small private companies and owner/operators. Beyond the fleet size, I have not found any information on these operators, as they are almost totally unregulated. In 1994, the Parliamentary decree that increased the total number of red plates also developed a new designation, the mini-bus, or microbus. These vehicles, similar to minivans in the U.S., are essentially large services, or shared taxis that usually travel intercity routes. As with most intercity transportation, operators pick up passengers by congregating at a customary location for their specific destination (such as a square or intersection) and wait until their vehicle is full before initiating the trip. There have been complaints that the minibus designation is unlawful for public transportation, since it does not adhere to

[22] Baaj, H. (2000) The Public Land Transport Sector in Lebanon. *Journal of Public Transportation.* 3(3). pp. 95.

Lebanese public city bus standards; and the vehicle is not designed to efficiently function as a public transport vehicle.

Table 2-3. 1994 Parliamentary increase in the number of red commercial license plates

	Pre 1994	Post 1994	% Increase
Taxi & *service*	10,650	33,000	310%
Bus	618	2,236	362%
Microbus	0	4,000	n/a

Taxi and 'service'

Services can be defined as shared taxis; they generally operate by roaming the streets in search of passengers. When they find one, they continue to pick up passengers en route that are going the same general direction. Due to these operation characteristics, the service has a higher level of service than buses, but are also less efficient in terms of passengers per kilometer. Fares reflect the level of service provided, with a standard service fare of 1000 LL (about $0.66), bus fares of 250 to 500 LL, and taxi fares generally in the 5000 LL range. Table 2-3 above, shows the number of red plates assigned to taxi and service vehicles as compared to other transit modes. Only 1,300 red plates are licensed to taxi operators, while the other 32,000 are service vehicles. Most of these service vehicles, probably around 20 to 25,000 operate in the Greater Beirut Area, while only about 4000 operate in Tripoli.[23] This has created problems with an over supply in the central areas of Beirut and lack of providers in the inner suburbs. The barriers to using the bus transportation system are high, with no public information on routes or fares. Services fill the gap in the public transit system by providing a travel option that is flexible and easy to use. However, a lack of regulation and the increase in commercial licenses

[23] Baaj, H. (2000) The Public Land Transport Sector in Lebanon. *Journal of Public Transportation.* 3(3). pp. 89.

within the sector has created an environment of inefficiency, on-street competition, and low wages for operators. While they play a vital role as an alternative to the private vehicle, their operating practices currently serve to increase congestion rather than decrease it.

Institutional Responsibilities

There are several agencies that affect the operations of public transportation in Lebanon. The following descriptions and tables define these responsibilities.

Ministry of Transport [24] (MOT). Defines policies, and develops and enforces standards and regulations for all transportation modes. The OCFTC is housed in this ministry. While the greatest power in the transport sector, it has as yet been unable to exercise it to its fullest potential for political reasons. Coordination with other ministries is likewise poor. A Transportation Regulatory Unit (TRU) has recently been developed within the MOT; however there is little information on this office. It was developed in accordance with World Bank requirements.

Ministry of Public Works (MPW). Rehabilitates and maintains the road network for major expressways and roadways outside of urban areas. It is currently implementing the World Bank financed National Road Project as well as the Transport Plan for Greater Beirut, which concentrates on parking policy, intersection upgrades and traffic control.

---

[24] Prior to 1993, the Ministry of Transport was a Directorate within the Ministry of Public Works. It was promoted to a full ministry, but in 2000 they were recombined into the Ministry of Public Works and Transport. Their functional responsibilities remain relatively independent, so they will be referred to separately in this document.

Ministry of Interior (MOI). Operates the vehicle registration program, including distribution of red plates for commercial vehicles, vehicle inspections, driver testing and licensing, traffic enforcement, and security at transport terminals. While the MOI distributes the red plate, Parliament determines the total number issued, by vehicle type, with the MOI recommendation. In 1994, Parliament more than tripled the number of red plates, to provide more jobs in a floundering economy. This decision flooded the market supply, increasing on-street competition. This served to worsen working conditions and income for commercial drivers.

Ministry of Environment (MOE). Sets emissions standards to curb environmental damage; in the transportation sector, this focuses on air pollution. Standards are enforced for all vehicles. In the summer of 2002, the MOE implemented further regulation on taxi and service vehicles forbidding the use of diesel engines and limiting the age of purchased vehicles.

Ministry of Finance (MOF). Develops and implements all taxation regulations, including fuel and value-added taxes. The direct impact on transportation is apparent in the cost of fuel, and vehicle and parts imports. The MOF also provides the funding for infrastructure projects.

Municipalities and the Ministry of Municipal and Rural Affairs (MOMRA). Municipalities are responsible for the roads within the municipal borders. The MOMRA supervises the elected municipal councils. Councils are elected by citizens registered in the municipality; their family's town of origin not necessarily their primary residence. However, the Municipality of Beirut the Municipal Council has no implementation or enforcement powers; it makes recommendations to the Governor of Beirut, who is

appointed by the Minister of Interior. The Greater Beirut Metropolitan Area consists of 53 Municipalities located within the Governorates of Beirut and Mount Lebanon.

Ministry of Industry and Petroleum (MIP). Controls the quantity of petroleum imports into the country, including the proportions of fuel types, import and distribution licenses, and fuel prices. This directly affects the costs of public transportation provision.

Council for Development and Reconstruction (CDR). Performs central planning and coordination of reconstruction efforts, including preparation, financing, and implementation. It is housed within the office of the Prime Minister.

Table 2-4. Existing institutional responsibilities in transportation [25]

Process Responsibility / Modes and Functional Issues:	Urban Transportation Coordination	Road Construction/ Maintenance	TSM and Control	Parking Policy and Control	Road Safety	Vehicle Licensing and Control/Traffic Enforcement	Public Transport	Paratransit
Policy and Research		MOPW					MOT	MOT
Standards and Regulations	MOT	MOPW		MOPW, GDU	MOT	MOI, MOE	MOT	MOT
Strategic and Tactical Planning	MOT	MOPW, CDR					OCFTC	
Financing		MOF, CDR			MOF, CDR	MOI	OCFTC, MOF	
Project Preparation and Implementation		MOPW, CDR, MUNI, MOMRA	MUNI, CDR	MOMRA, MUNI	MOPW, CDR, MUNI	MOI	OCFTC, MUNI	
Operations Management		MUNI		MOI, MUNI		MOI	OCFTC, MOMRA	
Maintenance Management		MOPW, MUNI					OCFTC	
User Information and Awareness						MOI	OCFTC	

All responsibilities of the OCFTC apply solely to the public operating agency, not to private transit operators. List of Acronyms is located at the beginning of the document.

[25] Salam, Y. (1999) Institutional Set-up of the Transport Sector. In, Baaj, H. (Ed.) *The Workshop on Land Transport Policy for Lebanon*. Ministry of Transport. p. 106.

3. THE BEIRUT SUBURBAN MASS TRANSIT PROJECT

In 1999 an effort began, through the Ministry of Transport, to reinstate the coastal railroad as a commuter/rapid/freight rail line between Damour, to the south of Beirut, to Jounieh approximately 20 km to the north, with plans to eventually continue north to Tripoli. With a USTDA grant, a joint venture between the IBI Group and DMJM Harris consulting offices in Boston, MA, was chosen to complete a feasibility study for this project.

3.1 PHASE I

The original scope of work, beginning in May 2000, contained the following components:

- **Task 1.** Meet with Project Sponsors
- **Task 2.** Review Past Studies, Assess Travel Demand and Pricing Elasticities
- **Task 3.** Mode Choice and Development of an Operating Plan
- **Task 4.** Freight Demand and Modal Choice
- **Task 5.** Preferred Alignment, Land Acquisition and Cost Analysis
- **Task 6.** Develop Creative Public-Private Financing Options
- **Task 7.** Beirut Mission
- **Task 8.** Interim Report
- **Task 9.** Conceptual Engineering
- **Task 10.** Environmental Review

- **Task 11.** Performance Specification and Design Criteria
- **Task 12.** Bid Package
- **Task 13.** Draft Final Report
- **Task 14.** Final Report

Partially through the completion of the initial scope of work, it was determined that further information was needed in order to determine the most appropriate transit mode and technology. Three additional reports were added to the scope prior to the presentation of the Interim Report. They discussed the viability of private commercial development along the transit line and in cooperation with the project, the impact on various macro economic indicators, and the most appropriate technology for the transit system. This final report, entitled the "Alternatives Analysis and Preferred Alternative Report" showed the right of way needs of each technology and what this means in terms of routing, grade elevation, and cost in the Beirut context was necessary to discuss the true cost of the technology. As such, this is the first report to outline the specific routing and right of way alternatives into Downtown Beirut for the Northern Corridor. It compared three LRT route alternatives and three BRT route alternatives, which were locationally almost identical beyond grade elevation factors. These alternatives were first compared internally, within each mode, and the best modal alternatives were then compared. Further discussion of these alternatives and the selection factors can be found in Section 3.3, Phase I Routing Alternatives, below.

The Interim Report provided the following conclusions[26]:

---

[26] *Beirut Suburban Mass Transit Corridor Feasibility Study, Final Report Phase I:* Overview and Timeline. pp. 3.

- Demand exists for a transit corridor in the Beirut Metropolitan Region, particularly to the north of Beirut, which is more heavily populated.

- The demand exists both along the old railroad right of way as well as in a wider area, primarily to the east, as development has densified in the foothills and mountains. Meeting this demand would require a feeder and distributor network.

- The railroad right of way is in significant disrepair along its entire length; and some portions have been encroached upon by development. In order to claim the entire right of way for public transportation or freight usage, immediate action would need to be taken to prevent further degradation.

- The southern portion of the right of way is directly adjacent to the coastline, which may serve to hinder potential tourism development.

- Much of the demand is reliant on a connection into central Beirut, however the right of way bypasses the core of the city, including the central business district

- Completion of a full rail system not only requires additional signaling and power systems, but also the construction of the entire right of way. This is financially infeasible for the Lebanese Government to undertake at this point.

The Interim Report also determined that the lower demand on the southern portion could be served by buses using the new highway for at least the near term and that the northern corridor presented a larger demand, and greater congestion, despite the better right of way position. This set the tone for the remaining portion of the study. The scope was revised to focus on the northern corridor and particularly on a wider set of locational, modal, and operational alternatives, as well as a collection and distribution system. Finally, an implementation plan was

developed and preliminary engineering completed for the northern corridor. The revised scope of work was the following:

Revised scope, June 2002

- **Task A.** Development and Analysis of Transit Options for Beirut Northern Entrance
  - A.1 Elaboration of Policy framework
  - A.2 Development of Transit Options
  - A.3/A.4 Network Analysis for Northern Entrance Corridor and Connectivity and Transfer Among Travel Modes
- **Task B.** Evaluation of Options
  - B.1 Cost Estimation
  - B.2 Development of Evaluation Criteria
  - B.3 Selection of Preferred Alternative
- **Task C.** Development of Mass Transit Plan for Northern Corridor
- **Task D.** Role of RPTA vs. Private Sector
- **Task E.** Brief Environmental Review
- **Task F.** Conceptual Engineering Considerations
- **Task G.** System Procurement
- **Task H.** Setup and Training for Multimodal Planning Model at Ministry of Transportation
  - H.1 Model Setup
  - H.2 Training
- **Task I.** Final Report

When modal options were compared, it was found that the Bus Tollway option on the rail right of way was the most feasible in the short run, within the first five to ten years. This is mostly due to its speed of implementation. It is important to quickly reclaim the right of way for transit use before it deteriorates further, and benefits of improved bus operations can be greater if accrued for a longer period. The long-term benefits of the bus tollway option are reduced considerably as demand increases and the need for a higher capacity line become imminent. At this point the benefits of the bus rapid transit mode kick in. By implementing the system in two phases, bus tollway initially and bus rapid transit later, the system can take advantage of the time-limited benefits of each. The following table shows the BRT and Bus Tollway Cost estimates for the portion of the line between Jounieh and St. Michel (approx. 17.6km), as well as the average cost per kilometer of the BRT option. These costs are in line with BRT cost ranges in the United States, between 10 to 20 million USD per mile (or 6 to 12 million USD per kilometer).

Table 3-1. Capital cost summary of the BRT line from the feasibility study

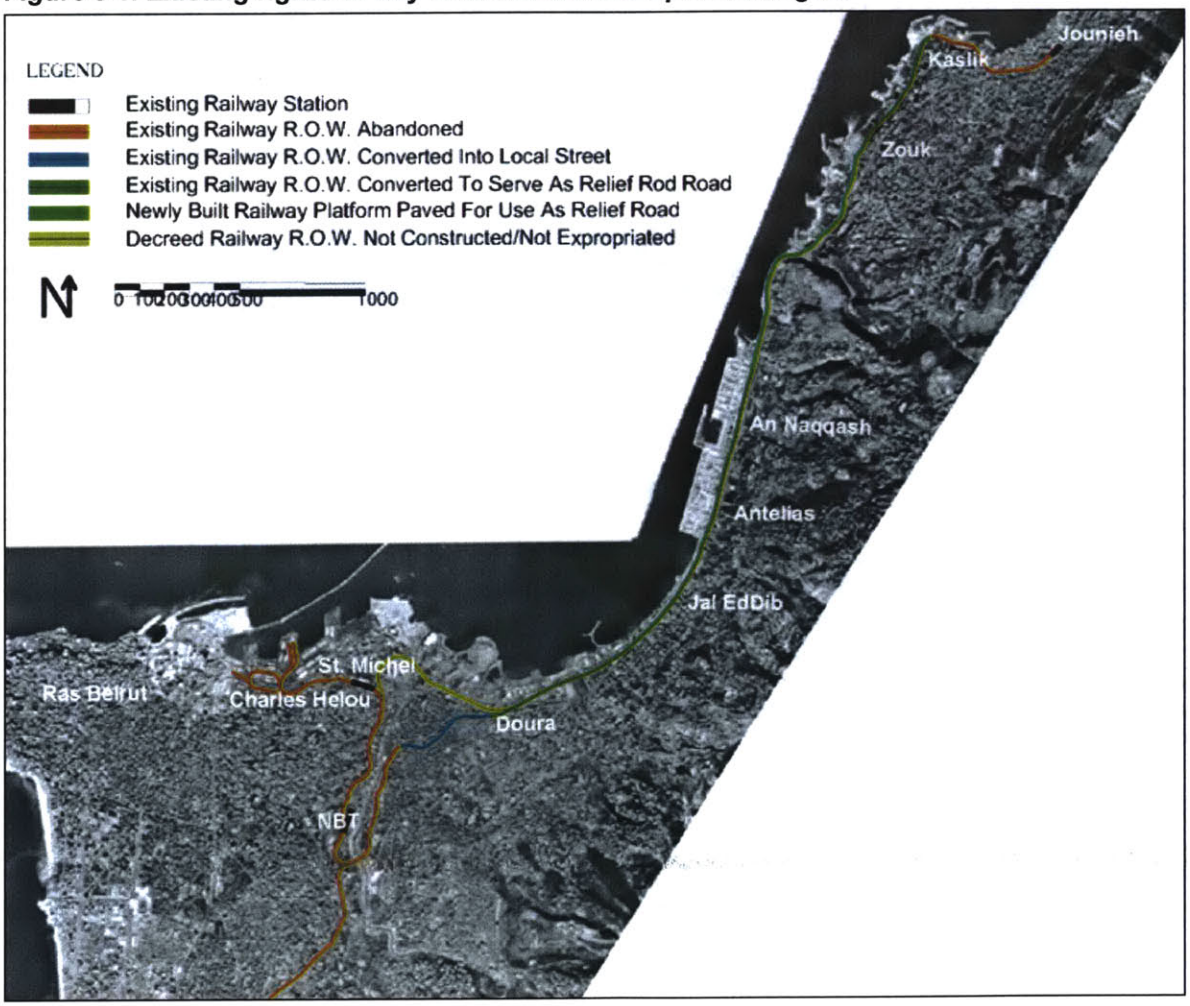
Cost Category	BRT[2]	Bus Tollway - BRT	BRT Average Cost per km
Rolling Stock[3]	$22,000,000	$22,000,000	$1,250,000
Stations & Facilities[4]	$25,000,000	$25,000,000	$1,420,455
Systems	$4,000,000	$6,000,000	$227,273
ROW Improvements[5, 6]	$60,000,000	$60,000,000	$3,409,091
Yards & Shops	$10,000,000	$10,000,000	$568,182
Subtotal	**$121,000,000**	**$123,000,000**	**$6,875,000**
Project Management, Design, Supervision	$12,100,000	$15,200,000	$687,500
Subtotal	**$133,100,000**	**$138,200,000**	**$7,562,500**
Contingency	$19,965,000	$20,730,000	$1,134,375
Total	**$153,065,000**	**$158,930,000**	**$8,696,875**

Source: Beirut Suburban Mass Transit Corridor Feasibility Study, July 2003
Capital costs are calculated for the entire Northern Corridor between Jounieh and St. Michel. This table has been altered from that in the study by only including BRT and Bus Tollway – BRT modal alternatives.
1 Cost in year 2002 – ($) US dollars.
2 Includes the cost of the feeder distributor system.
3 Rolling stock for Bus Tollway will vary from 0-15M depending on the desired service level.
4 No special facilities for maintenance/storage and no suburban stations.
5 ROW assumes existing rail ROW from Jounieh to St. Michel with required land expropriations.
6 Bus Tollway system does not require access into St. Michel but rather connection to local roadway system.

Routing decisions in the study

Despite findings in Phase I that much of the transit line's demand relied on a connection into the core of Beirut, additional study on the route alternatives between the BCD and St. Michel Station were neither discussed nor refined. It is unclear whether this portion was left out of the later analyses and reports because it would use existing roads - as per the Phase I recommendation, it would not exist at all, or the problem was too complicated to focus on at that point.

Figure 3-1. Existing rights of way in the Beirut Metropolitan Region



Since existing right of way was available for most of the line, as shown in Figure 3-1, routing was not a major discussion topic. In Phase II of the study, additional options were introduced beyond the right of way. These focused on a few operational models using the main highway, including HOV/HOT lanes and an exclusive bus lane. While bus and bus rapid transit operations are more flexible in terms of routing than rail modes, the length of the line (approximately twenty kilometers), and the topography in the area, have limited the number of options between Jounieh and Beirut. The discreet options of the main highway and the right of way were available. Other major and minor roads to the east of the highway are also available, however these were not considered at all. The idea of closing lanes of major avenues, or the entirety of a smaller road for the benefit of transit, has never been attempted in Lebanon. Yet it remains an interesting and potentially successful alternative, particularly if the main goal, as is stated for this project, is to maximize mode shift from private automobiles. Because the portion of the main right of way within Beirut skirts the Downtown and central areas, any route extension into the downtown from St. Michel, would either have to create a right of way, which is typically expensive and politically difficult, or it would have to operate on existing roadways in traffic or on exclusive or semi-exclusive lanes. The routes that were proposed in Phase I do exactly this. A spur rail right of way and tunnel accessing the Port of Beirut via Charles Helou Station seems to have been unknown or glossed over during this process despite its appearance in entirety on a few maps, and partial appearance or suggestion of existence on most maps and images.

3.2 THE PROBLEM

It could be argued that there is little need for the transit line to enter the downtown area, particularly because the BCD has not been the main commerce center for Beirut since the

beginning of the Civil War. However, just looking at the following simple evidence suggests it should be a major consideration:

- The downtown is approximately 30% developed. It is poised to be the business, retail, entertainment, and government center of the country. And with the development over the old Normandy landfill, which will become the financial district, considerable land area has been added to the downtown.

- Congestion already grips parts of the downtown area most of the day.

- Millions of dollars have been invested in the planning and implementation of the Downtown redevelopment. The return on this investment will be significantly reduced if people cannot physically access the downtown. In fact, estimates that up to one third of the projected Downtown development cannot be supported by the current transportation system.

- While most businesses and residences relocated to the outer edges of Beirut and nearby suburbs during the war, the road system is oriented toward the downtown. Access to many parts of the city is easiest from the downtown. As the spine of a potentially extensive public transit system, connection to the downtown and development of the downtown as a future transportation hub is highly strategic.

While most of the transit line is appropriately routed on the old Coastal Rail right of way, this is not an option for the segment that serves the BCD. The St. Michel Station is the closest point between the Coastal Rail right of way and the downtown area. It is also the terminal for the line as it currently stands, upon completion of the feasibility study and preliminary engineering tasks. Bereft of a metro line, as outlined in the 1995 Greater Beirut Area Transportation Plan, Solidere's transportation plan proposes shuttle buses between a transit station (either St. Michel

or Charles Helou) and the downtown[27]. However, since the downtown is not only a major trip origin and destination, but also the most visible and an excellent connection to other parts of the city, it is unwise to depend on shuttles to transport passengers from a remote transit station. It should be linked directly. To say the least, this will not encourage the maximum mode shift, which is the Ministry's stated project goal.

Three route alternatives were proposed in Phase I for bus rapid transit to extend into downtown. The first alternative uses the right of way and existing roads to enter downtown from the east. The two other routes depart from the Coastal Rail right of way north of Beirut in Antelias, and use a combination of reserve lanes and aerial structures to enter downtown from the south. They each identified Martyr's Square as the downtown terminal. The first alternative was determined to be the most feasible, but it did not seem to provide the needed solution, as subsequent reports did not include it. The Phase 1 routing alternatives will be discussed in more detail below.

3.3 Phase I Routing Alternatives

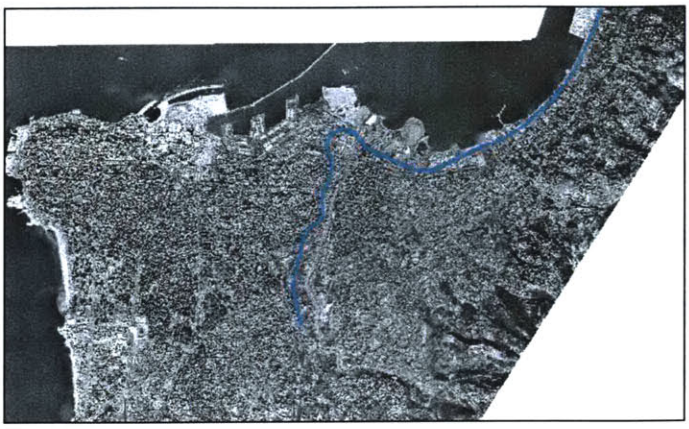
Six route alternatives were proposed for the Northern Corridor in the Phase I "Alternatives Analysis and Preferred Alternative Report". These were divided into three rail and three BRT routes that corresponded almost exactly in terms of alignment, but differed by grade separation. The alternatives were evaluated within their mode, and the best options from each mode were compared. The following information has been taken from the Beirut Suburban Mass Transit Corridor Feasibility Study, "Alternatives Analysis and Preferred Alternative Report."

---

[27] Gavin, A. *Beirut Reborn*, pp. 123

Phase 1, Alternative A

Figure 3-2. Phase 1, Alternative A alignment



This alternative runs along the existing and decreed railroad right of way between Jounieh and St. Michel. It then uses Charles Helou Avenue to enter Downtown. It is unclear how it would access Charles Helou Avenue from the St. Michel Station and whether this segment would be exclusive or not. However since the percent of semi-exclusive right of way is considerably higher for this Alternative, it can be assumed that much of this is between St. Michel and Downtown. The terminal location was not included for this alternative; however it is probably at Martyr's Square, as this has always been the transportation hub of the city. We can also assume that most, if not all of the 17% of the semi-exclusive and non-exclusive ROW is between St. Michel and the final stop downtown.

Table 3-2. Phase 1, Alternative A right of way breakdown

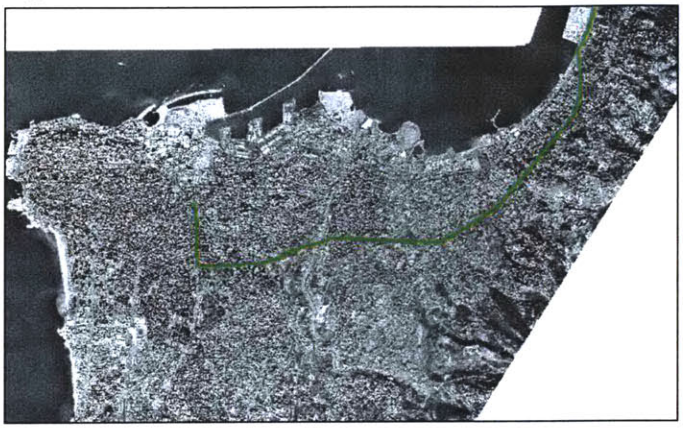
Type of ROW	% of total route
Exclusive grade-separated	41%
Exclusive with grade crossings	43%
Semi-exclusive (existing roads)	11%
Non-exclusive (shared with traffic)	6%

The total length of this option is 19.8 kilometers, and the cost of this alternative is the lowest of the three, due to the length and since the segment between St. Michel and the BCD is entirely on existing roads. The main cost arises from the Beirut River crossing and expropriation

between the river and the St. Michel Station, and is estimated at US $27.5 million, or almost $1.4 million per kilometer.

Phase 1, Alternative B

Figure 3-3. Phase 1, Alternative B alignment



Starting in Jounieh, the second alternative deviates from the railroad right of way in Antelias; from there it uses the planned Peripherique and Penetrator PN2 expressway reserve lanes to the NBT. It continues on an elevated platform above the median of the existing Becharra El-Khoury Street to Martyr's Square, entering it from the south. The total length of Alternative B is 21.1 kilometers.

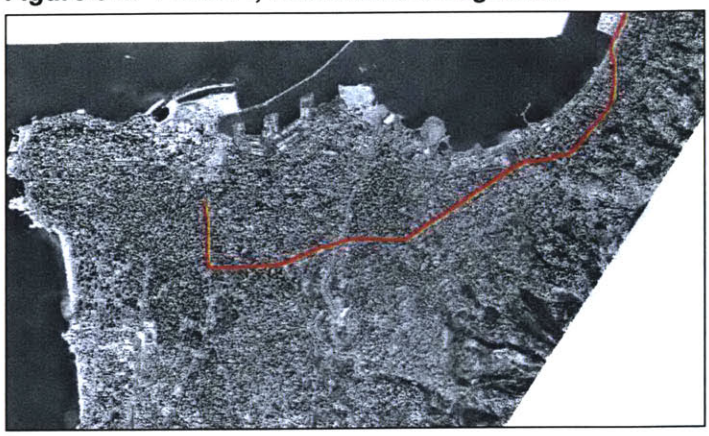
Table 3-3. Phase 1, Alternative B right of way breakdown

Type of ROW	% of total route
Exclusive grade-separated	78%
Exclusive with grade crossings	14%
Semi-exclusive (existing roads)	3%
Non-exclusive (shared with traffic)	5%

The cost of this option is considerably higher due to expropriation along the Peripherique and Penetrator PN2, as well as the elevated platform portions, estimated at approximately US $137.9 million, or approximately $6.5 million per kilometer.

Phase 1, Alternative C

Figure 3-4. Phase 1, Alternative C alignment



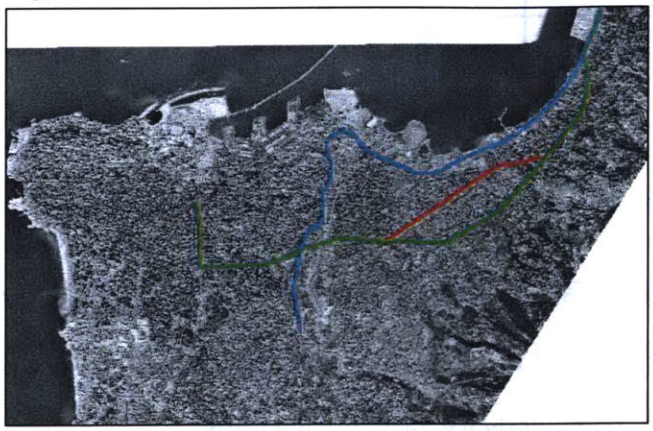
Alternative 3 is similar to the second one; it deviates from the right of way in Antelias. However, it continues on a raised platform along the Sinn El-Fil Boulevard, instead of using the Peripherique. It then uses the Penetrator PN2 reserve lanes to reach the NBT. From here it meets back with Alternative B alignment, using an elevated platform on Becharra El-Khoury Street to Martyr's Square. The total length of Alternative C is 21.9 km, and the cost was calculated to be US $123.8 million, or approximately $5.6 million per kilometer.

Table 3-4. Phase 1, Alternative C right of way breakdown

Type of ROW	% of total route
Exclusive grade-separated	77%
Exclusive with grade crossings	15%
Semi-exclusive (existing roads)	3%
Non-exclusive (shared with traffic)	5%

Phase 1 Route Evaluation and Comparison

Figure 3-5. Comparison of Phase 1 route alignments



Evaluation of the routes considered the following criteria, on the basis of cross-comparison, i.e. best alternative, worst alternative, and average or similar:

- Cost
- Ridership
- Implementation schedule
- Risk management (government- i.e. if the system fails)
- Feasibility of conversion to a heavy/freight rail system
- Private sector involvement
- Environmental impact

Table 3-5. Comparison of Phase 1 route alignments

North	1A	1B	1C
Ridership (Peak Hour)	●	●	●
Cost	●	○	○
Environmental Impact	●	○	○
Schedule	●	○	○
Conversion	◆	◆	◆

Legend: ● = Best
○ = Worst
◆ = Average or Similar

Source: Beirut Suburban Mass Transit Corridor Feasibility Study, Alternative Analysis and Preferred Alternative Report, p. 22. December 2003.

The cross-comparison completed in the report offers a visual way of quickly comparing the provided alternatives; it does not provide any element of scale, and was not used solely as a summary. This is important in decision making, particularly for large investments.

This evaluation left out several important criteria and considerations, including construction and operational impacts on the neighborhoods and businesses, impacts of the right of way on transit service quality, specific lane configurations and the feasibility of lane conversion or expansion, and the level and type of support needed to implement such a project. Another important omission was discussion with Solidere on the most appropriate location for exclusive or non-exclusive right of way, stations and the route terminus. Solidere must approve and construct the segment within their jurisdiction. While their transportation plan identified locations for a metro station in their master plan, the operational characteristics of BRT are different enough to warrant further review and discussion. These are issues that will be further discussed below and addressed in the plan proposed in this report.

Critique of the Phase 1 Route Alignments

The three alternatives presented in Phase 1 of the feasibility study attempted to maximize ridership demand. They also attempted to minimize expropriation costs by locating along existing or planned roads; the cost of long segments of land purchase would be prohibitive for

this project. While cost was a factor in determining route alignments to the point of minimizing expropriation costs, it wasn't considered in terms of how or where exactly the buses would operate on the alignments. This was manifest in one of two ways: either significant portions were located on aerial platforms, as in Alternatives B and C, resulting in high construction costs; or, as in Alternative A, little thought was given to lane configurations on existing roads, particularly Charles Helou Avenue The fact that bus bays exist on the Charles Helou Avenue viaduct above the Station make it a tempting choice for inclusion in a bus route, however when the potential lane configurations are examined closer, exclusive or semi-exclusive operations are problematic due access to intersecting roads and ramps.

While it is important to design new road infrastructure to accommodate bus lanes from the beginning, it is dangerous, in terms of implementability, to route an exclusive transit line like this on a road that has not yet been constructed, particularly since it is possible the road will never get built. Such is the case with Alternatives B and C, which use the Peripherique and PN2 Penetrator roads. It is ironic that public transit improvements, which could provide the additional capacity that these roads justify, would be routed on them.

One final critique, which is a central theme in this thesis, is that the routes presented here provide little added value to the neighborhoods, city, region, or wider transportation system beyond their intended purpose of maximizing mode shift (and its directly related benefits). In fact, as has been discovered throughout the United States, the creation of new aerial structures, such as in Alternatives B and C, has the potential to degrade the quality of life in the city and particularly those areas directly adjacent to the structure.

The route development process failed to produce a single compelling alignment. The report found Alternative A, which runs along the existing Charles Helou Avenue between St. Michel Station and the BCD to be the most feasible option. In doing so, it took advantage (or fell

victim) to the flexibility of the bus mode to operate on semi-exclusive or non-exclusive rights of way, with 17% of the length on these right of way types; more than twice as much as the other two options. Despite its selection in Phase I of the study, it was not included in the subsequent initial engineering task. The route was considered to terminate at St. Michel Station, with the decreed right of way that crosses the Beirut River and enters St. Michel Station from the north, included in the initial engineering task. However the segment between St. Michel and the BCD was not mentioned at all.

More compelling results can be achieved by not only expanding the alignment options, but also including other goals and constraints, not typically associated with transportation projects. This inclusion in the routing process acknowledges that transportation exists within and for human settlements; and can be used as a catalyst to improve them. With this in mind as we look at new options for this final segment of the transit route, the next section covers the existing conditions between St. Michel and the Downtown Beirut.

4. EXISTING SITE CONDITIONS

In attempting to solve the problem of routing a transit route within a built up area, it is important to understand the physical attributes and dynamics of the area. This is particularly true if the goal is not only to provide quality transit service, but also to leverage the construction investment to improve other aspects in the area. Many of the strengths and weaknesses of the different route alternatives will involve the existing conditions of the alignments and their immediate surroundings.

While Lebanon is generally oriented on the north-south axis, the study area is located on the peninsula of Beirut, as shown in Figure 1-1, and is oriented on the east-west axis, with the sea to the north, and the neighborhood of Achrafieh, situated on a steep hill directly to the south.

This chapter will describe the potential transportation nodes and links as well as the character of the neighborhoods within the project area.

This page intentionally left blank

Figure 4-1. Map showing the neighborhoods within the project area

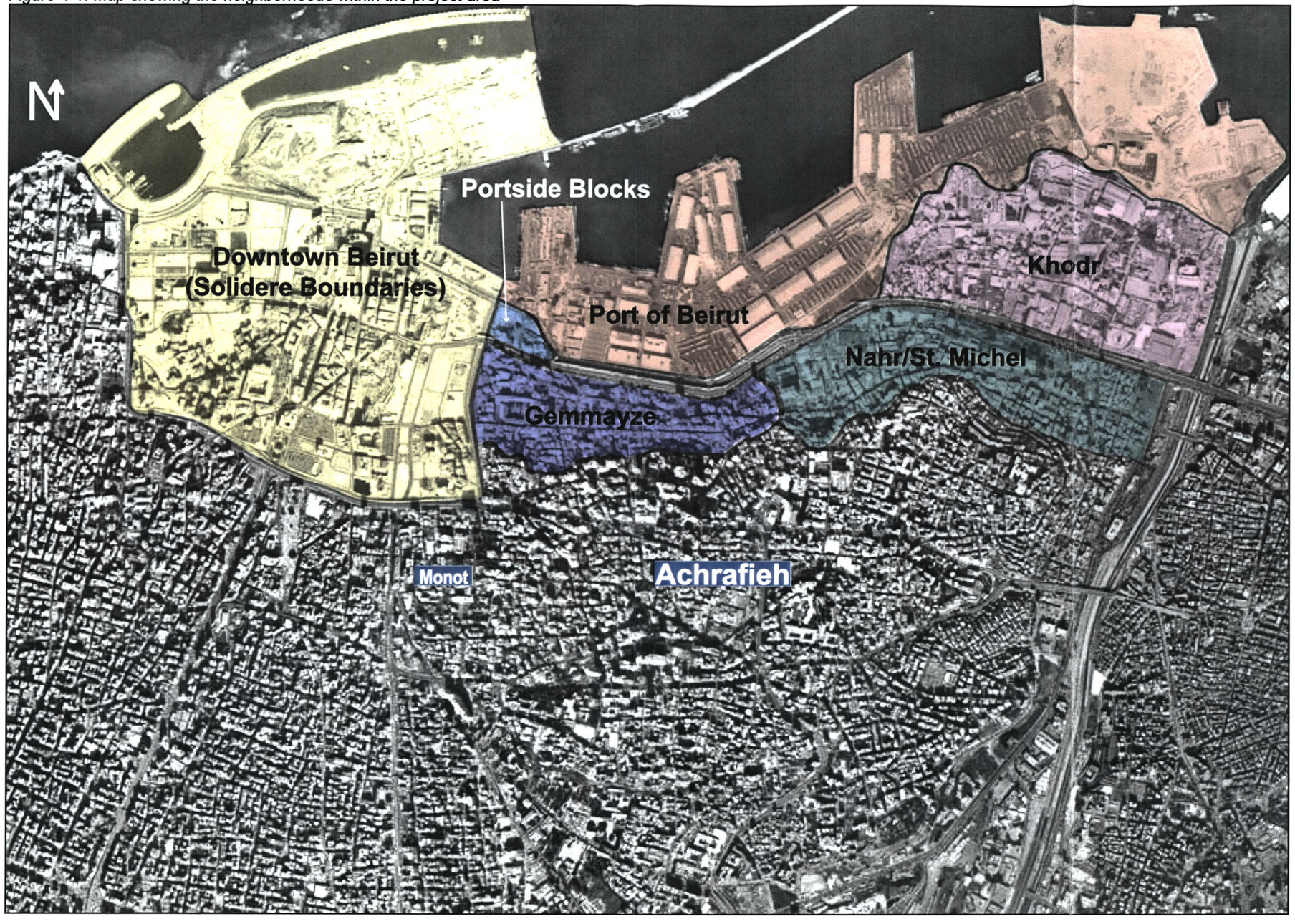
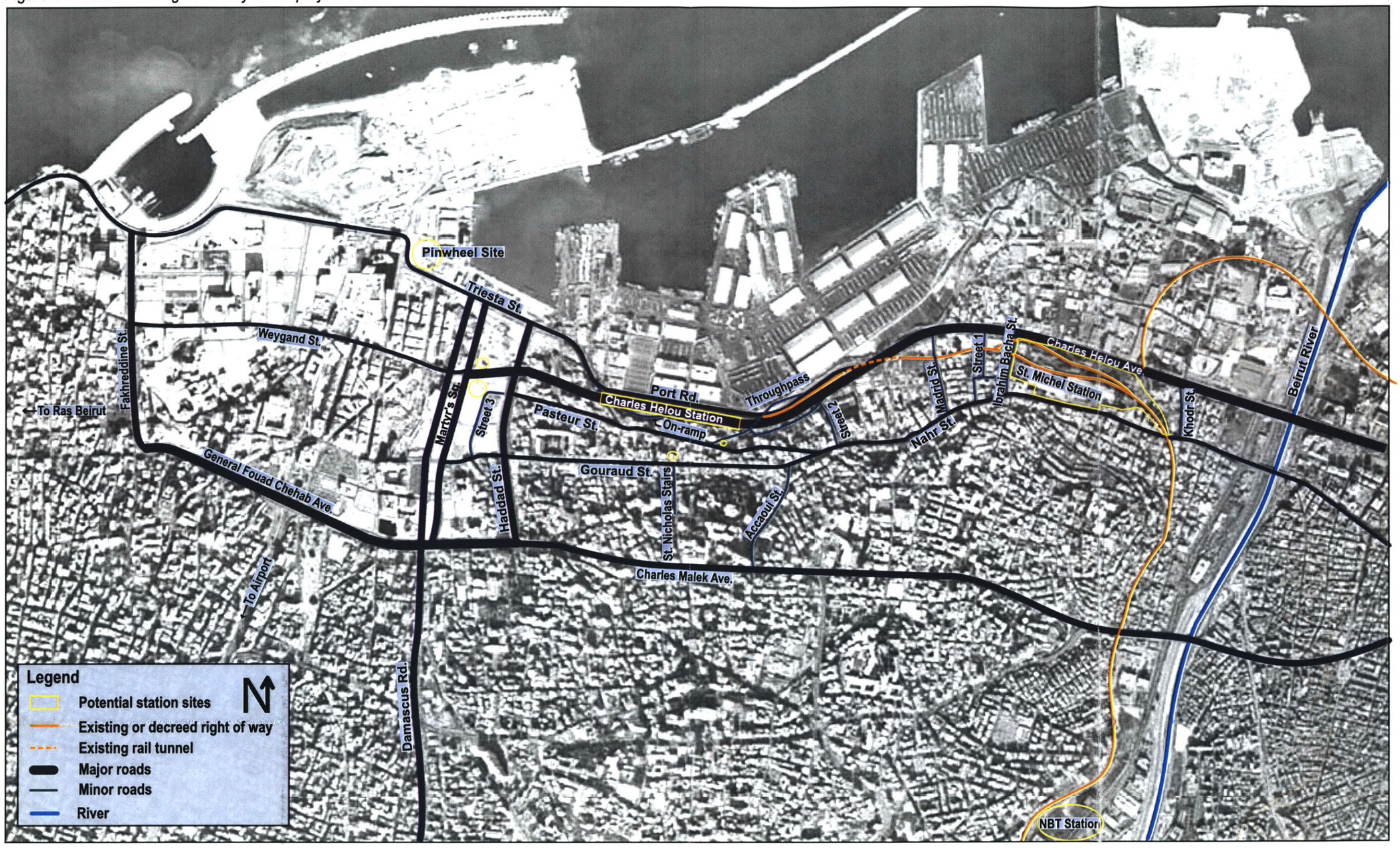


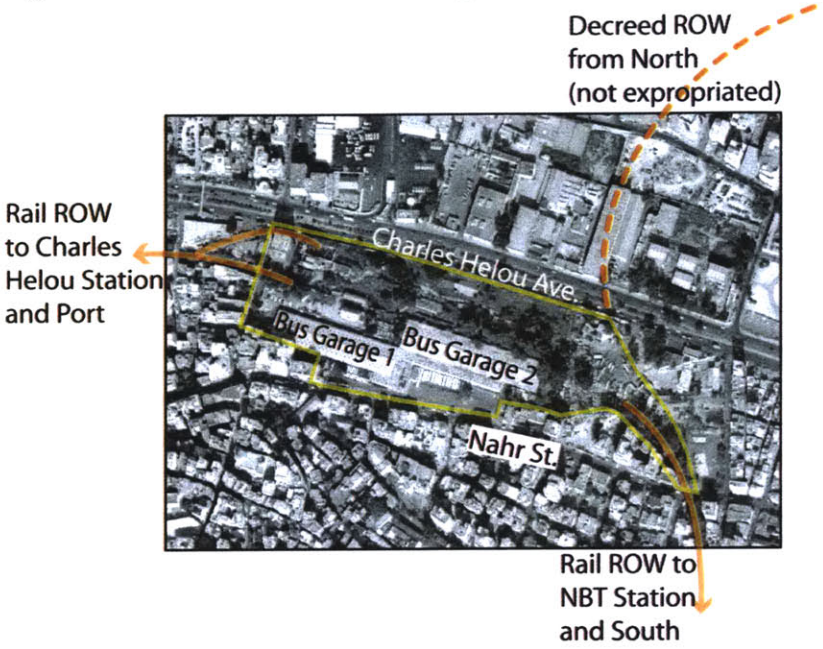
Figure 4-2. Roads and rights of way in the project area



This page intentionally left blank

4.1 St. Michel Station

Figure 4-3. St. Michel station existing conditions



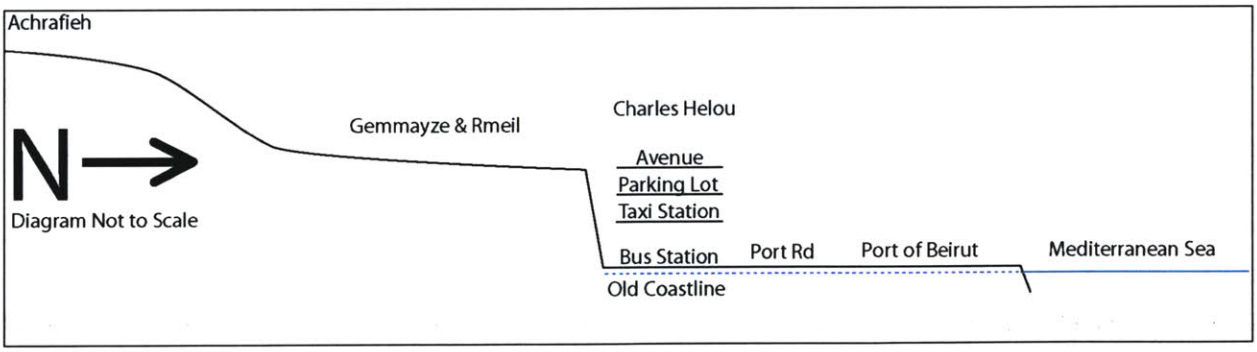
St. Michel Station is currently the terminal station on the planned transit line, with decreed right of way entering the site from the north. All potential route alignments will thus start from this station, and continue west to the BCD. The St. Michel Station itself was once the rail yard and station closest to both the Port of Beirut and the BCD. It is currently used as a bus maintenance garage and offices for the Office de Chemin de Fer et Transport en Commun, the government's public transit authority (OCFTC). The St. Michel property lies between Charles Helou Avenue, the main highway extension into Downtown to the north, and Nahr Street to the south. A large wall separates the station property from Charles Helou Avenue such that most people are not aware of its existence. On the Nahr Street side of the property, a poorly maintained sidewalk is lined with inoperable buses, now used for parts; these buses have been placed end to end such that they too form a wall. There is one entrance to the garage on this side and another entrance on the southern side toward the Port and BCD. Only a fraction of the 6.84 hectare property is being used, with much of it abandoned and overgrown.

Figure 4-4 (A and B). St. Michel Station is separated from Nahr Street by a wall of cannibalized buses; two large garages like this one on the right serve as maintenance and storage facilities

4.2 CHARLES HELOU STATION

Charles Helou Station, located between St. Michel Station and the BCD, was constructed in 1995 as Beirut's main bus and taxi terminal, underneath the Charles Helou Avenue viaduct. It replaced Martyr's Square as the pre-war transportation hub during Downtown's construction. Charles Helou is a four-level facility, which includes a bus and taxi station on the bottom and second levels; a parking lot on the third level; and Charles Helou Avenue, the main highway extension into the BCD on the top level.

Figure 4-5. Cross section of the project area at Gemmayze and St. Michel



Gicôme, the company that designed the station and re-designed the roadway had the foresight to rebuild the now six-lane Charles Helou Avenue viaduct with wide sidewalks, built-in bus bays,

and ramps and stairways into the parking lot below. The built-in bus facilities make it an easy route choice for the rapid transit line.

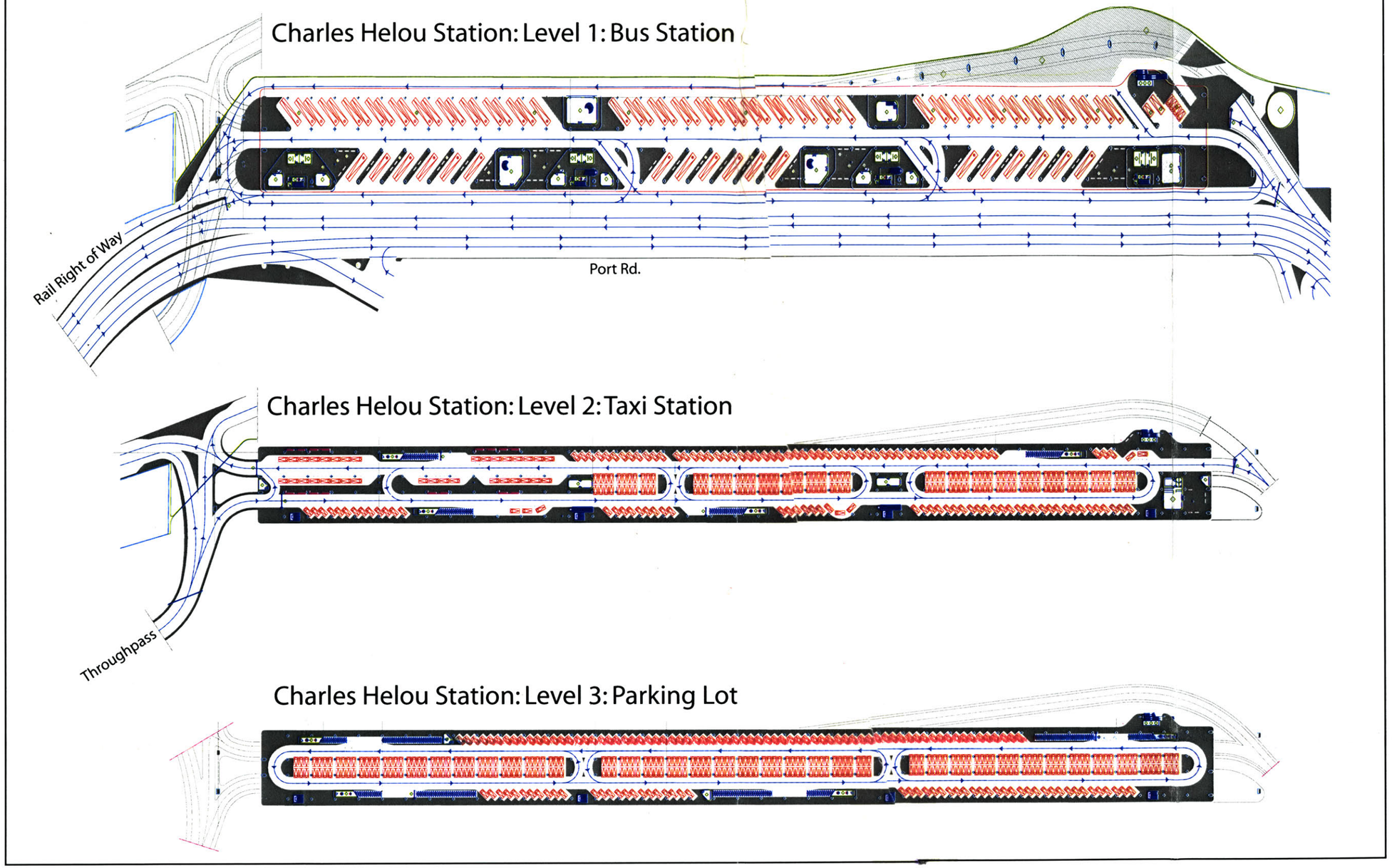
Figure 4-6. Charles Helou Avenue viaduct

The parking lot, which has a 400-car capacity, is only accessible from Charles Helou Avenue, however access to it has been blocked and it is currently not in use. The taxi depot is only used for those with international destinations and has a 300-car capacity. Intercity jitneys and informal owner-operated buses congregate in two major intersections to the north (Doura) and south (Cola) of Beirut proper rather than at the station. The size and capacity of these lots could provide a location for a park and ride lot for people leaving Beirut on the transit line and international buses, and also as a remote parking lot for those with destinations downtown.

The bus station serves formal intercity and international buses, as well as 6 of the 27 OCFTC bus routes[28]. While there is pedestrian and automobile access to the facility from Charles Helou

[28] Office de Chemin de Fer et Transport en Commun, Republic of Lebanon, Public Transportation Route Map.

Figure 4-7. Charles Helou Station Plans



Source: Gicôme – Antoine Salame and Associates S.A.R.L.

This page intentionally left blank

Avenue, these have been closed, such that currently, the only station access is via the Port Road. The station also contains spaces designed for offices and various amenities, but these are unused.

The Charles Helou Station also boasts a sizeable empty space between the station structure and the cliffs supporting Gemmayze. It is located under the high viaduct of the Charles Helou on-ramp. An old, poorly maintained stairway provides the only direct access to Pasteur Street and Gemmayze, and the remains of a traditional Lebanese house provides a quaint backdrop for a park area.

Figure 4-8. The south side of Charles Helou Station

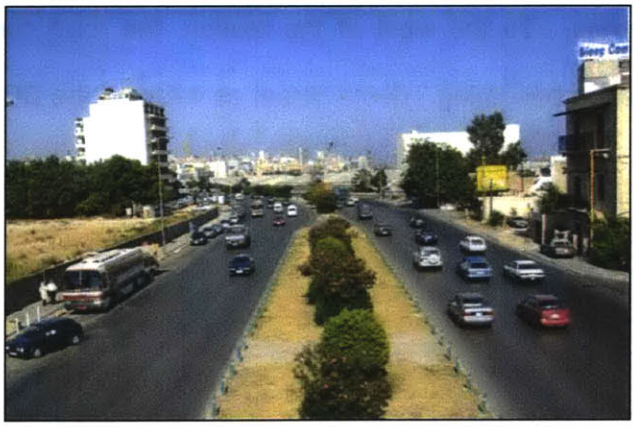
4.3 Charles Helou Avenue (the Main Highway)

Charles Helou Avenue is the extension of the main northern highway, into Downtown Beirut. It passes along the north side of St. Michel Station, directly above the Charles Helou Station, and ends in Martyr's Square, where it becomes Weygand Street. Charles Helou Avenue carries approximately 120,000 vehicles per day[29] and approximately 5,000 vehicles per hour during the

[29] This figure refers to Charles Helou Avenue, just east of the Beirut River. Traffic counts to the west of the River will be somewhat lower. Beirut Urban Transport Plan. Council for Development and Reconstruction, 2000.

peak hours[30]. It is designed as a major arterial, with approximately 3 traffic lanes in each direction, with sidewalks, a landscaped median, access to side streets, and industrial and commercial uses. Traffic is a major issue here and congestion occurs often during weekday commute times, as well as Saturday mornings and Sunday evenings. While traffic is almost always heavy, a single pedestrian bridge just west of the St. Michel Station is the only facility to aid people crossing. The Port Road splits from this just before the Charles Helou Station structure, and Charles Helou Avenue continues into downtown along the top level of the station. Between the river and the pedestrian bridge, the road is dominated on both sides by tall, blank walls, with St. Michel on the southern side, and Sukleen, the solid waste collection company, the Fire Station, and other industrial uses on the northern side. A few small businesses are located between the pedestrian bridge and the Port Road intersection as well as several empty or abandoned parcels and buildings.

Figure 4-9 (A and B). Charles Helou Avenue from the Pedestrian Bridge; looking east toward St. Michel Station – the parcel on the right with trees, and west toward Charles Helou Station, respectively



[30] Traffic Counts performed by author at the Charles Helou Avenue/Port Road intersection, August 2003.

4.4 THE PORT ROAD

The Port Road runs between Charles Helou Avenue and the BCD, between the Charles Helou Station and the Port of Beirut. It runs directly adjacent to the station, and then turns away from Charles Helou Avenue between the station and the BCD. It is the equivalent of about 3 lanes of traffic in each direction; it has a peak hour volume of approximately 1,400 through vehicles westbound and almost 350 vehicles eastbound[31]. Two ramps, one from each direction of the Port Road provide access to eastbound Charles Helou Avenue and the second level taxi terminal. The eastbound ramp, which will be referred to in this report as the Charles Helou On-ramp carries a high level of truck traffic from the Port of Beirut. The westbound ramp, referred to as the Charles Helou Throughpass, since it threads through the second level of the station, provides access to Pasteur Street and Nahr Street in the adjacent neighborhood, it carries a high level of bus traffic. Approximately 500 vehicles use the Charles Helou Throughpass during the peak hour. The Port Road is divided with what appear to be a permanent version of Jersey barriers. To the west of the station, the road curves to run a block north of Charles Helou Avenue becoming Triesta Street as it enters the BCD.

[31] Traffic counts performed by author, August 2003.

Figure 4-10 (A and B). The Port Road separates Charles Helou Station, on the left, and the Port of Beirut on the right; Businesses line the road as it curves away from Charles Helou at the Port's entrance

4.5 Nahr, Gouraud, and Pasteur Streets (and the neighborhoods of Gemmayze and Nahr)

One block to the south of the main highway is Nahr Street (Rue Fleuve, River Street). This road traces the southern border of the St. Michel Station and continues west until it splits into Gouraud Street (one-way eastbound) and Pasteur Street (one-way westbound). Nahr Street is one lane in each direction with parking on both sides of the street. It is lined with medium density mixed-use buildings, mostly two to five stories high. Near the western end of Nahr Street is the Electricité Du Liban building, once the garage for the city's electric trolley system, which went down Gouraud to Martyr's Square, and up Nahr Street and across the Beirut River. Between the western end of Nahr Street and the edge of Downtown is the neighborhood of Gemmayze. Gouraud Street centers this neighborhood along a spine, bounded on one side by a steep hill (Achrafieh) and on the other side by the Charles Helou Station and Avenue

Figure 4-11. Nahr Street looking east (left) and west (right) near the Electricité du Liban building

Pasteur Street varies in width considerably, from the intersection with Nahr; it is approximately the width of one lane of traffic with parking on each side. Where the road from Charles Helou Station merges Pasteur widens to a square, currently used as an informal parking lot. The road narrows again, to about two lanes of traffic with parking on both sides. Gouraud Street has more regular width than Pasteur, with one travel lane and parking on both sides, except toward the eastern end where there is only one side of parking. Other than Accaoui Street, leading from Achrafieh, which feeds into it near the Pasteur/Nahr intersection, there are no through streets to the south of Gouraud Street. However, five alleys and five pedestrian stairways lead to off-street residential buildings and up to Achrafieh. The largest one, St. Nicholas Stairway, is home to a popular annual art exhibition and fair.

Businesses along Gouraud provide neighborhood oriented and generally more varied services than those on Pasteur and Nahr Sts., which focus on two narrow markets: balcony curtains and restaurant equipment. Pasteur also had a higher number of vacant stores than the other two. Gouraud Street boasts several small groceries and sandwich shops as well as a bakery, flower shop, small electronic store, a bike shop, and even a yoga studio. A church and school is located just two blocks east of the Downtown border.

Figure 4-12. Gouraud Street (left) is narrower and has a stronger business district than Pasteur Street (right)

4.6 Spur Rail Right of Way

One spur rail right of way (the rails having mostly been removed) leads from the station property, south to the Port. This spur was built in the early 1970s, just before the war, and apparently was never used. It is now a dirt road between apartment buildings, across an open lot, and behind a carpentry and auto shop before it descends into a tunnel under Charles Helou Avenue to the Charles Helou Station and the Port. Due to considerable overgrowth the tunnel is almost invisible from both entrances. In fact, the Feasibility Study does not mention its existence. Most maps show the spur ending just before Charles Helou Avenue It is interesting to note that the single track inside the tunnel has remained intact and is dual gauge, since the coastal railroad was standard gauge and the one crossing the mountains to Damascus was narrow gauge. The following photographs are in geographical order from east to west.

Figure 4-13 (A and B). A spur rail right of way between St. Michel and Charles Helou Stations passes between residential buildings and empty parcels

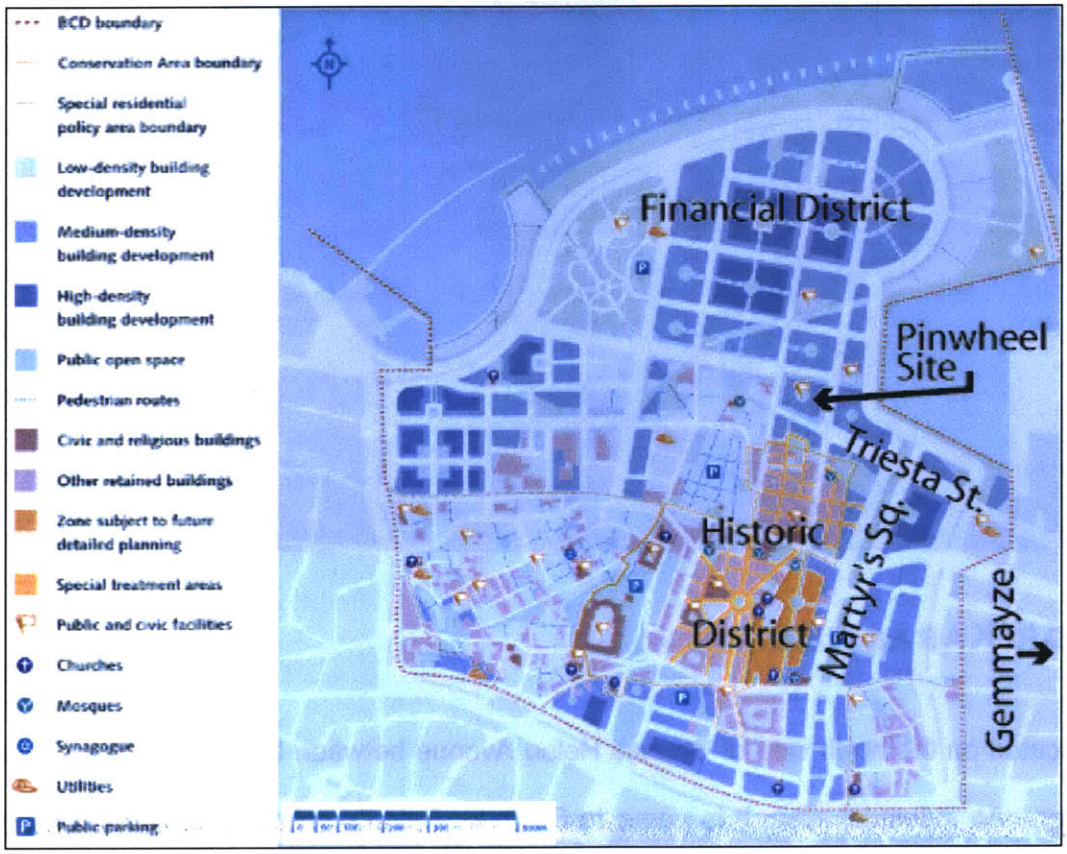
Figure 4-14 (A and B). The ramp into the tunnel is overgrown and has been used for dumping; a single narrow/wide gauge track remains inside the tunnel

Figure 4-15. The Port Road and rail right of way, from Charles Helou Station

4.7 Triesta Street and Downtown Beirut

Triesta Street is the continuation of the Port Road as it enters downtown. It is the closest road to the Downtown's waterfront. The BCD area is under the control of Solidere, the development corporation charged with rebuilding Downtown Beirut. Twelve years into the project, the BCD is only about one third built. All major and most minor roadways exist, however the northern-eastern portion is still mostly empty. While much of this area has already been planned, the fact that construction has not yet started, means there is much more flexibility for the construction of an exclusive transit route, if planning for it begins early.

Figure 4-16. Solidere's land use plan for Downtown Beirut



Source: Gavin, A. *Beirut Reborn*, pp. 101.

The Pinwheel Site, located at the end of Triesta Street has been identified by Solidere[32] as a good potential site for the transit terminal. The site is currently reserved for a performing arts center, but has not yet been developed; it is shown in the Solidere's land use map, above, as a public facility. The two uses could be mutually supportive, and the site is ideally located between the north and south portions of Downtown, as well as at the ends of two major roads.

Figure 4-17. Triesta Street from the Port entrance (middle right) to the Pinwheel Site upper left)

4.8 KHODR/KARANTINA

This area is located on the north side of Charles Helou Avenue between the Port of Beirut and the Beirut River. An industrial area, it is home to Sukleen, Beirut's solid waste management company, the Fire Department, Sleep Comfort, a mattress manufacturer, as well as trash and

[32] Interview with Angus Gavin, Head of Urban Planning for Solidere, July 2003.

compost transfer stations, and the popular nightclub B018. While none of the summer 2003 site visits included this area, it appears from the building grain on the orthophotos that there are residential buildings on the western side of Khodr. Nevertheless, due to the employee population, particularly because it is likely a lower income population, it is important that pedestrian access is provided across Charles Helou Avenue in the forthcoming plan.

This page intentionally left blank

5. NEW ROUTE ALTERNATIVES

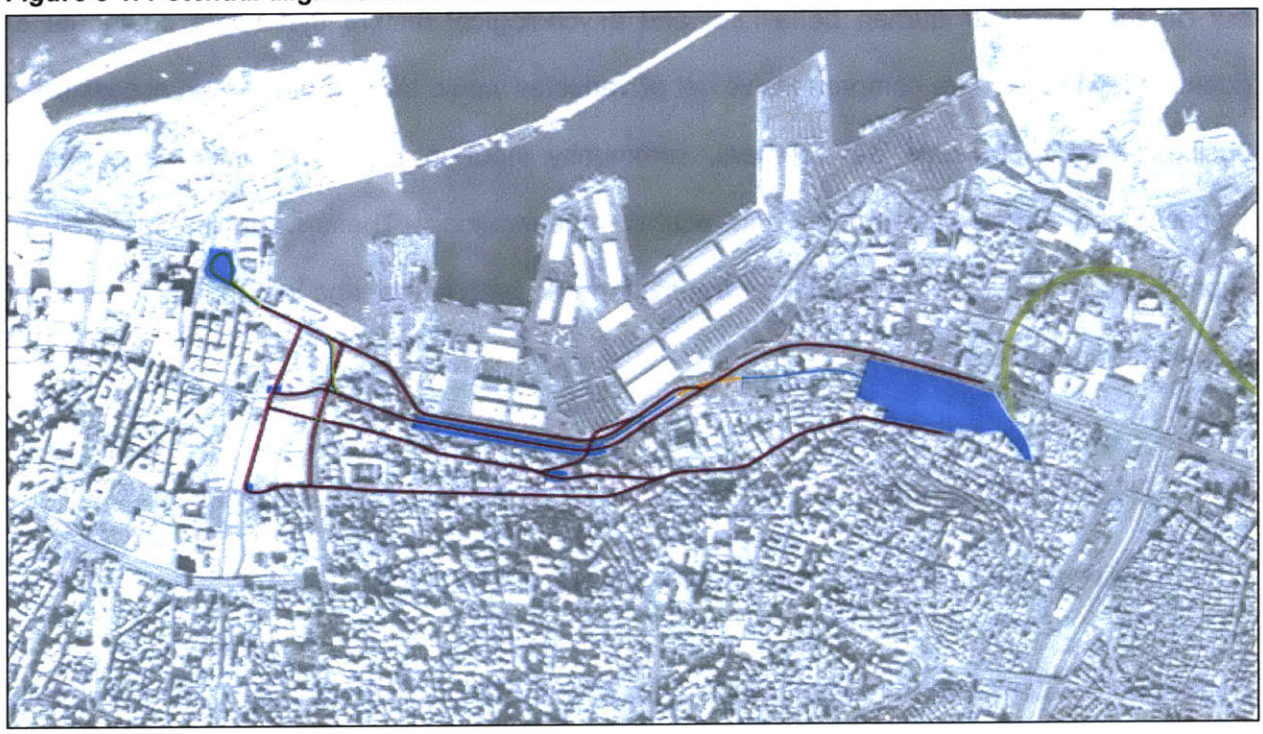
The alternatives presented in this project seek to address issues of construction cost and transit service quality, while leveraging the transit capital and operational investments to the maximum social, environmental, and economic benefit. In order to do this, one must look beyond the variables typically used in transportation routing decisions, such as origin-destination trip surveys and demographics. While traditional variables are useful and important, they neither provide a complete picture of the potential impacts of the project, both beneficial and harmful, nor do they consider human behavioral and psychological factors that might contribute to ridership levels. A more comprehensive set of variables would include pedestrian accessibility, business and real estate development, community input in the development and design process, and storm water runoff and aquifer regeneration. These variables, as well as improving connectivity within the larger transit network, both formal and informal, are important to maximizing mode shift.

5.1 DISCUSSION OF ROUTE DEVELOPMENT METHODS, CRITERIA, PROCESS, AND ASSUMPTIONS

Routes were determined to run between the St. Michel Station, where the BRT line is currently planned to terminate, and the BCD. Existing roads were assessed for their potential to carry exclusive or semi-exclusive rights of way, and the conditions necessary for this. Station or stop locations were then determined along these links. Within the BCD, station locations in the BCD will ultimately be determined by Solidere, however two potential locations have been identified: Martyr's Square and the "Pinwheel Site". Martyr's Square has historically been the central transportation node for the city of Beirut, and the entire country. Over the centuries, roads were

built to converge on this square and as such, there is excellent access to and from it from most parts of the city. This is useful in the development of a feeder and distributor system as well as for the potential expansion of a backbone BRT system. The other site, identified as the Pinwheel Site, is located between the historic district of Downtown and the not-yet completed business district. Access to and from this site is more difficult particularly from areas along the Damascus Road, but is better from the Main Highway corridor, the Port, and Ras Beirut. It also provides excellent pedestrian accessibility. Routes were then determined along these links and nodes.

Figure 5-1. Potential alignment and station locations



Red: existing roads; Green: infasture to be constructed; Aqua: surface right of way; Orange: rail tunnel; Blue-area: potential station locations

Two guiding criteria were used to determine potential routes in the study area: minimization of construction costs, and maximization of transit service quality. In the developing country context, large needs and small budgets dictate that cost efficiency is essential. The more construction costs can be decreased, the greater likelihood that a project will reach implementation. In this case, minimizing construction costs will further enable a quicker return

on the capital investment, and will ultimately allow more rapid expansion of the transit system. The largest costs usually derive directly from right of way expropriation and subway or elevated platforms. Subways and long tunnels also require ventilation systems or use of electric vehicles that can further increase the system cost. Wherever possible, potential routes will be at grade, and use existing structures and rights of way.

Due to the pricing structures of alternative modes[33], travel time is an important component in incurring a mode shift toward transit. Maximizing mode shift necessitates provision of high transit service quality. In terms of route location and design this is indicated by minimization of door-to-door travel time, which includes access to and from the station, wait time, travel time, and transfer time. Ease of access, safety and security are also important service quality components. Travel time and dwell time can be minimized by prioritizing exclusive rights of way, the fewest grade crossings and by providing space for level-boarding and pre-pay stations. Potential routes and station locations will also prioritize transit system connectivity within the current and possible future network, and proximity and pedestrian access to origins and destinations, to minimize access and transfer time.

Lane configurations were determined to minimize construction costs, travel time costs, traffic disruption on the routed facility and intersecting roads, vehicular grade crossings, and to maximize safety. Stop locations were determined by several criteria, including integrity with the regional network, neighborhood access, stop distance, and existing available space. The final

---

[33] Automobile pricing structures include high upfront costs that are not dependent on usage, as well as social and environmental costs that are not incurred directly by the user. Thus drivers usually calculate only time and out of pocket costs, such as fuel, tolls, and parking. For public transportation, user costs include time and fares. An entire area of research relies on the premise that restructuring the costs of transportation will more directly affect a mode shift to transit.

route as the first, and potentially the backbone, of a wider rapid transit system in the future, must serve to integrate transit options for users to best promote a mode shift away from the automobile. As access points to the network, stations should not only serve the greatest residential and employment populations, but also nodes and access points for greater and smaller scaled networks, such as international and intercity systems as well as the local Beirut bus system. While it is impossible to always precisely locate the stops at these nodes, minimizing the distance between them will make transfers more possible and quicker. Transfers can contribute significantly to trip times. In fact, considerable research has looked into ways to reduce the proportion of trip time taken by transfers in an attempt to improve the efficiency and attractiveness of transit. The two main elements of transfer time are walk time and wait time. Reducing wait time involves working with route schedules such that routes with heavy transfer ridership are synchronized. Reducing walk time involves reducing the distance between the stops that users will likely transfer between, and providing adequate way-finding signage. Unlike wait time, reducing walk time occurs at the routing and design stage of transportation planning. By minimizing distance between two transfer stops, a significant portion of transfer time, and thus of trip time can be reduced.

Attempts are also made to locate stations or stops in every neighborhood the route passes through; this will ensure that residents and businesses in the area will benefit from the transit service. This is also politically essential if closing lanes or the entire road is contemplated to provide transit exclusivity through these neighborhoods. Rather than choosing stop locations based on distance, they were determined based on appropriate locations for passenger access and demand.

5.2 Description of Potential Routes

Eight routes were developed using the guiding criteria outlined above. Using these criteria, several potential routes and station locations were identified. They are described from east to west.

Route 1: Nahr to Gouraud to Martyr's Square (Purple). This route exits St. Michel Station onto Nahr Street, and proceeds along the south side of the street, allowing a single lane of westbound traffic to remain; eastbound traffic is rerouted to Charles Helou Ave at Street 2[34]. It continues on Gouraud Street with a single vehicular grade crossing at Accaoui Street, which is the only road in the area that descends from Achrafieh. There would be no vehicle access to Gouraud Street but the sidewalks would be widened and Pasteur would become a two-way street. This would cater well to the growing business district, and would a permit a friendlier pedestrian environment. Alternatively, loading access could be provided for residents and businesses during certain hours. One stop would be located adjacent to the St. Nicholas Stairs, where a small parking lot could provide space if needed. The route would then cross Haddad Street and terminate at Martyr's Square.

Route 2: Nahr to Gouraud to Haddad Underpass to Triesta (Aqua). Route Two is the same as Route One, except that at it turns north onto Haddad Street, using the underpass, before again heading west onto Triesta to the Pinwheel Site.

[34] Streets with unknown names will be referred to with a number, i.e. Street 1.

This page intentionally left blank

Figure 5-2. Right of way alignment alternatives, eastern section

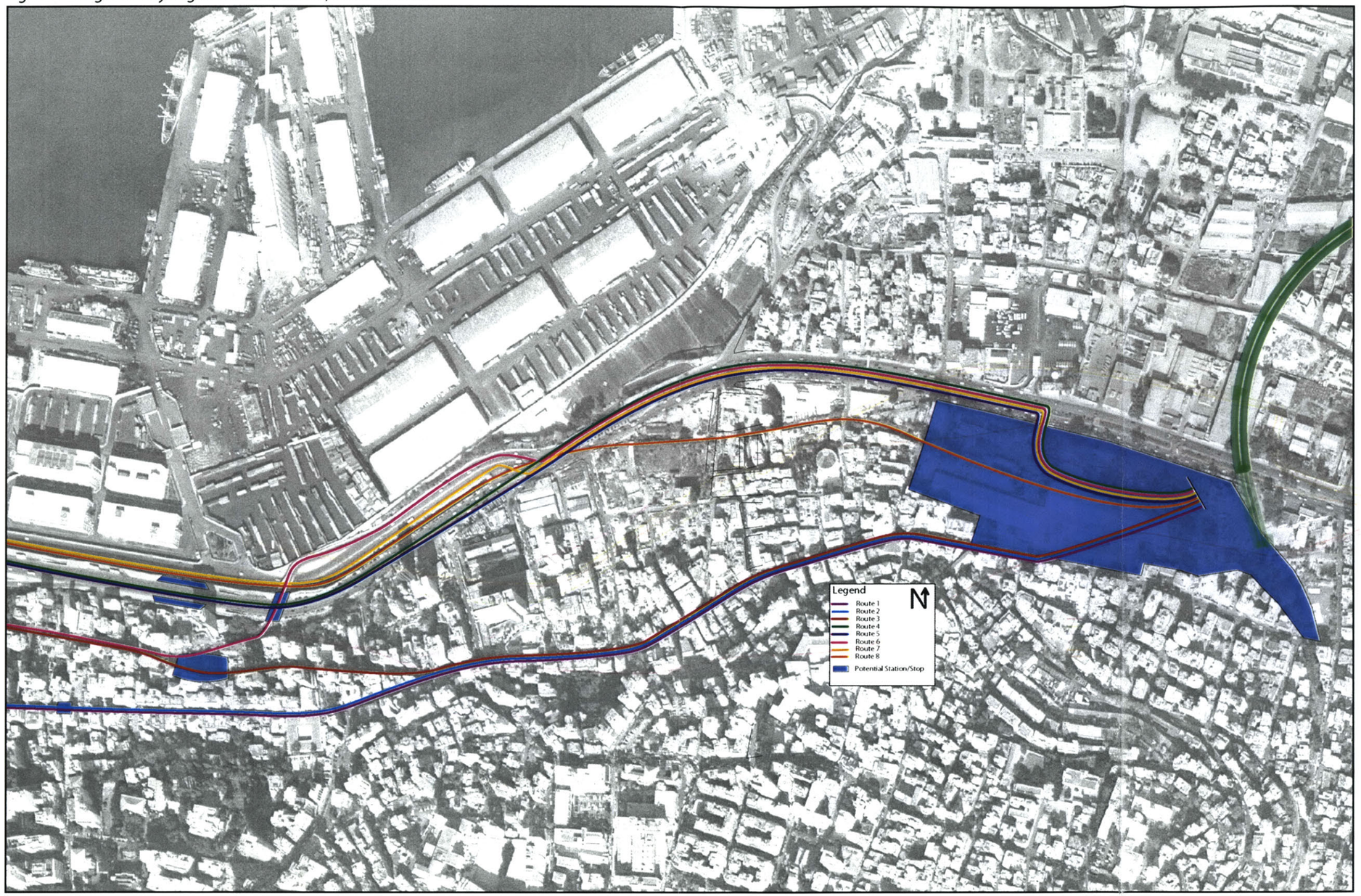
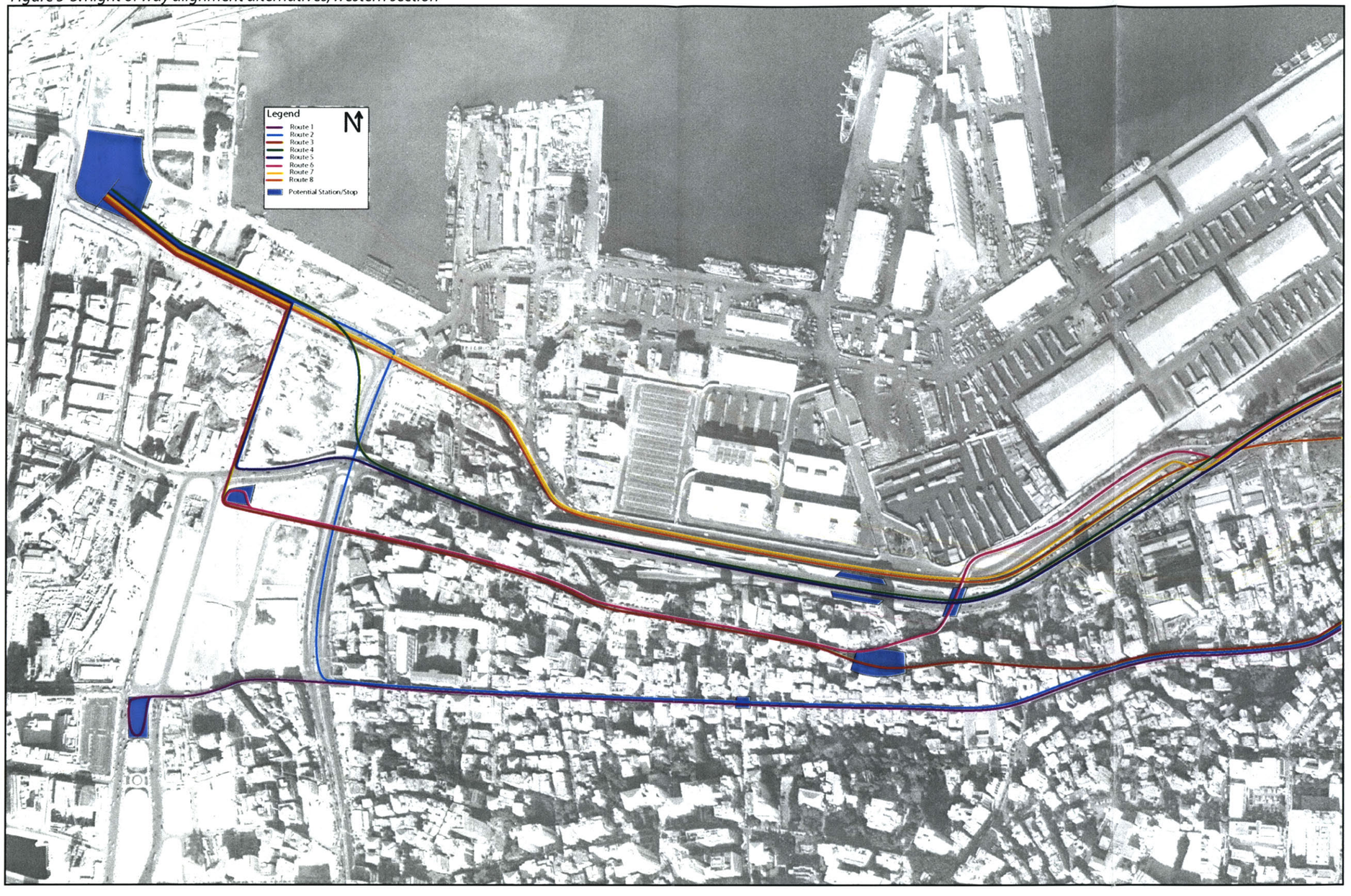


Figure 5-3. Right of way alignment alternatives, western section



Route 3: Nahr to Pasteur to Street 3 to Martyr's Square to Triesta (Red). Exiting St. Michel Station onto Nahr Street, this route uses the same initial alignment as Routes One and Two. There is a vehicular grade crossing at the three-way intersection of Nahr, Gouraud, and Pasteur Sts. where it crosses from the south side of Nahr to the north side of Pasteur Street. It thus crosses the Gouraud Street eastbound traffic as well as the single lane of westbound traffic on Pasteur St, both of which continue to or from Nahr Street and Street 2. The route continues on Pasteur Street with one stop at Pasteur Square, which provides enough room for small station platforms, just before the intersection with the Charles Helou Through-pass. The through-pass intersection constitutes the second at-grade vehicular crossing. At the end of Pasteur Street the route crosses over the Haddad Street Underpass, on a bridge that would need to be constructed; and then uses a short local street segment (Street 3) to reach its next stop at a corner parcel across from Martyr's Square. The route then turns north onto the Martyr's Square Blvd. to Triesta Street, terminating at the Pinwheel Site.

Route 4: Charles Helou Avenue to Ramp (not constructed) to Triesta (Green). This route exits St. Michel Station directly across from the Fire Station and travels along the outside lanes of Charles Helou Avenue Stops are located on the Charles Helou viaduct where bus bays currently exist; depending on the design, there may be space for raised platforms. The route continues along Charles Helou Avenue to the Haddad Street overpass; from here a not-yet-constructed ramp (approximately 200 meters long) would descend to the north, connecting to Triesta Street, and terminating at the Pinwheel Site. There are two major vehicular crossings in each direction: at St. Michel Station and the Port Road intersection traveling westbound; and at the Charles Helou on-ramp and at the Haddad Street Overpass intersection traveling eastbound. Several smaller intersections and vacant parcels between the viaduct and St. Michel Station present a challenge to an exclusive bus lane. It may be politically difficult to

close these roads, and the parcels are appropriate for more dense development, including commercial space along Charles Helou Avenue

Route 5: Charles Helou Avenue to Martyr's Square to Triesta (Blue). This route is similar to Route 4, except rather than descending on a newly constructed ramp at Haddad Street, it would continue on Charles Helou Avenue to Martyr's Square There would be a stop at Martyr's Square and continue on the extension of Martyr's Square Blvd. to Triesta Street terminating at the Pinwheel Site. This route would add an at-grade vehicular crossing at Martyr's Square (crossing Charles Helou Avenue) for eastbound buses but not for the westbound ones.

Route 6: Charles Helou Avenue to Charles Helou Through-pass to Pasteur to Street 3 to Martyr's Square (Pink). Exiting on the north side of St. Michel Station, both directions of this route use the north side of Charles Helou Avenue and would require removal of the landscaped median. The bus route turns onto the Port Road before quickly exiting onto the Charles Helou through-pass. This facility is a ramp from the westbound direction of the Port Road that threads through the third level of Charles Helou Station, with access to Charles Helou Avenue and Pasteur Street. It currently is a one-way facility, but would convert to a two-way facility accessible only to the bus route and vehicles using the taxi terminal on the third level of the station. Buses stop inside the station before proceeding to Pasteur Street. The configuration on Pasteur will leave one lane of traffic open, with an exclusive bus lane in each direction, and no on-street parking. Like Route 3, this route will cross the Haddad Street underpass on a not-yet constructed bridge. It will then terminate at a parcel directly across from Martyr's Square, using Street 3. The parcel will provide turnaround space as well as a station platform.

Route 7: Charles Helou to Port to Triesta (Yellow). Both directions of this route will exit St. Michel Station to the north and use inside lanes of Charles Helou Avenue to avoid conflicts with intersecting streets, and to allow west bound traffic to easily access the Port Road The route will

cross Charles Helou just before the viaduct and use the south side of the Port Road, allowing westbound access to the Charles Helou Throughpass. Two options are available for the portion of the route along the Charles Helou Station. The first closes the Port Road to through traffic, allowing bi-directional access to the southern Port entrance and the Charles Helou Through-pass from the east, and access to the Portside Blocks and the Charles Helou on-ramp from the west. The second option leaves one lane of westbound traffic open to public access on the north side of the Port Rd, crossing the rapid transit alignment at the same location as the western Port entrance. Bi-direction access to the Portside Blocks will also be available on the southwestern side of the Port Road with a turn-around/passenger drop off at or adjacent to the Charles Helou Station. The Charles Helou stop will be located on the current Port Road alignment beyond the Port of Beirut entrance. There are then three options for the segment along Triesta.

- Option A: the alignment descends into a partially covered trough adjacent to Triesta Street, avoiding a vehicular grade crossing at the western entrance to the Port of Beirut. The partial covering of the trough would allow continuation of the waterfront plaza from Martyr's Square.

- Option B: the route uses the northern half of Triesta Street, requiring a single at-grade vehicle crossing at the western Port entrance.

- Option C: the alignment continues adjacent to the Triesta Street, on a portion of what is planned to be the waterfront plaza. This option would also require an at-grade crossing at the Port entrance.

- The route will terminate at the Pinwheel Site.

Route 8: ROW to Port to Triesta (Orange). This route exits St. Michel Station on the west side using the Railroad Spur right of way. Two minor roads cross the right of way; one directly adjacent to the St. Michel property and the other one block to the west. One or both of these would be closed in order to minimize at-grade vehicular crossings. A third road passes over the route on an existing bridge; however the right of way needs to be graded to its original level for buses to pass under this bridge. This begins a descent into an existing single-vehicle-width tunnel under Charles Helou Avenue, which emerges on an alignment between the Port Road and Charles Helou Avenue. The ROW becomes a single lane just before the bridge, and returns to a double-lane just after the tunnel. Just after the Charles Helou Through-pass ramp the alignment merges onto the southern half of the Port Road From Charles Helou Station, the alignment options are the same as for Route 7, terminating at the Pinwheel Site.

5.3 Route Evaluation Criteria

Many of the typical engineering-based route evaluation criteria, including depth-to-groundwater, soil type, and grade, were not necessary in this process because the potential routes for the most part use existing rights of way and structures. Triesta Street is the only portion where earthworks are proposed as one of three options. The soil at this site is fill, which presents issues in soil stability; however, there are no archaeological resources on this site, which could serve to increase costs and delay construction.

Because the route segment is only about two kilometers long, the importance of origin-destination demand surveys is reduced. Transportation Analysis Zones (TAZ) used in the Feasibility Study are refined enough for use on this short segment, particularly in terms of comparing trips to the Gemmayze neighborhood (and along Nahr, Gouraud, and Pasteur Sts.) to trips to the Port of Beirut, the Portside Blocks and Downtown. However, because of the level

of development not yet completed Downtown, trip counts are not stable. Also, physical and psychological barriers such as the large hill between Gemmayze and Achrafieh and poor pedestrian access across Charles Helou Avenue and to the Charles Helou Station will contribute more to the number of passengers who use these stations than will the short walk distances themselves. Regardless of the route alignment, these barriers will have to be contended with.

Routes were evaluated based on the following criteria:

- **Route length and elevation.** There will not be a significant difference in the route length; however shorter routes will generally have shorter travel times. Route elevation impacts vehicle efficiency as well as travel time. Within the project area, there is essentially a lower elevation and a higher elevation, the number of times the route passes between these will give it a low, medium or high rating.

- **Ridership capture.** Ability of the line to capture passengers from different neighborhoods based on walk distance, barriers to access, and the potential for reduction in those barriers.

- **Potential for service disruptions.** This includes the number and severity of vehicular and pedestrian grade crossings, and the impact they may have on operating speeds and travel time.

- **Negative and positive impacts on adjacent uses.** These include noise, traffic circulation, and access to businesses and residences. A Gouraud Street alignment would likely hurt businesses, as no vehicular access would be permitted. The rapid transit line would carry a regional passenger base, for which Gouraud Street is not a draw; but would prevent access for local customers. Pasteur Street will be less

sensitive, since the road is wider and a single access lane could probably be provided, however this would be a sensitive endeavor, and should only be attempted with careful planning and a much community involvement and support.

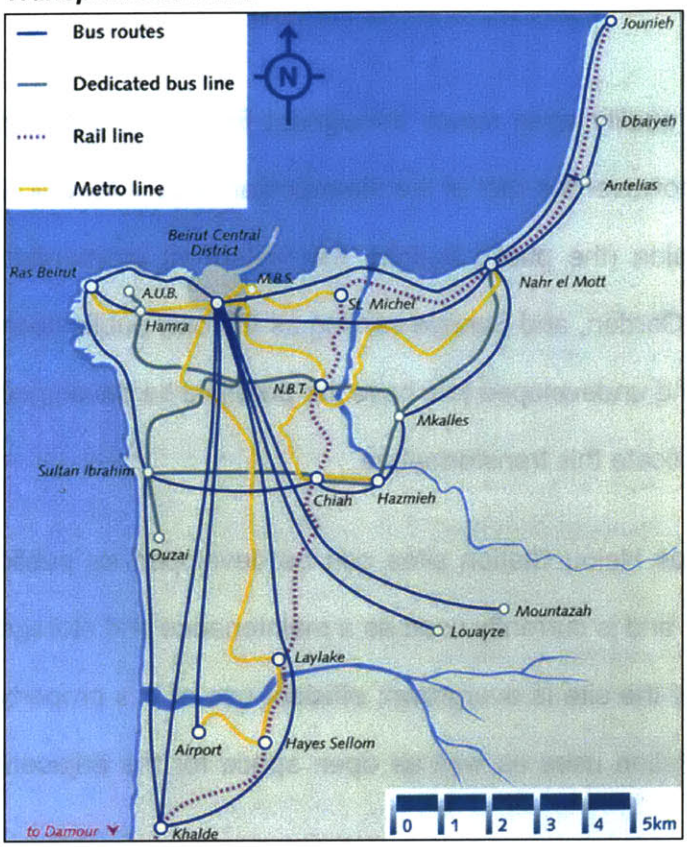
- **Problem alleviation in the project area (defined below).** Problem areas within the project area include illegal dumping; lack of open space; pedestrian access along Charles Helou Avenue, and at St. Michel Station, Charles Helou Station, and along the sidewalks in Gemmayze; Charles Helou Station operations and management; economic development, and parking.

- **Existing and future transit network coordination.** Minimizing transfer time and linking different scaled transportation networks. Essentially this is a combination of the distance and accessibility to the Charles Helou bus and taxi station and the potential for the Downtown terminal to be a transfer station for local and buses and *services.*

- **Traffic disruption.** This includes lane closures as a percent of lanes, traffic flow directions that are removed, and the traffic rerouting. Where applicable, it will also include traffic counts.

- **Implementability.** If the project is never built, it will never have a positive transportation impact on the city. Looking carefully at negative impacts, being sensitive to stakeholder needs, and maintaining flexibility in the project, is an important lens through which each of the potential route alignments should be viewed during the evaluation.

Figure 5-4. Transit networks planned for the Beirut Metropolitan Region, in the 1995 CDR Transportation Plan



Source: Gavin, A. *Beirut Reborn*, pp.123.

Problem Areas

In order to best leverage the capital input into this area, site needs have been identified. This list is not exhaustive, nor does solving these problems serve as a first priority in the routing and design of the transit line segment. However, it serves as a useful guide to the opportunities provided by each route alternative.

Illegal Dumping. During the Civil War, there was no reliable trash removal service; illegal dumping became not only common, but often necessary. Since the end of the war, the quantity of illegal dumping sites has decreased substantially, however some still exist. One of these sites is at the eastern entrance to the tunnel on the railroad spur right of way, and includes

industrial waste such as used tires. Use of the rail right of way for a transit route, would require the removal of this environmental hazard.

Lack of open space. There is a lack of quality open space throughout Beirut. Solidere is attempting to remedy this within the BCD; however the rest of the metropolitan area is far below international standards, with Ramlet al Baida (the public beach), the waterfront promenade along the Corniche, the Pine Forest, Sioufi Garden, and Sanaya serving as the only public open spaces. Outside of the BCD, abandoned and undeveloped lots have the potential be developed into parks; however ownership issues complicate this transformation.

Portions of both the St. Michel and Charles Helou Station sites can be developed as public parks. The St. Michel site is 6.84 hectares, and is currently used as a maintenance and storage facility, as well as OCFTC offices. Much of the site is overgrown; efficient use of this property can provide ample space for the transportation uses as well as open space for the adjacent community and transit users.

At Charles Helou, the station structure hugs a large rock formation that was once the shoreline, making Charles Helou Avenue on the top level approximately even with the ground level of Pasteur Street Between the station and the rock wall, a relatively large space overhung by the on-ramp is left vacant. A poorly maintained stairway descends to it from Pasteur Street but it is otherwise an unused piece of land. Landscaping this space, would not only make the station a more welcome place for riders and drivers, but would also improve pedestrian access to the station and could be designed commemorate the evolution of Beirut's development. Certain types of plantings, it could also serve to decontaminate storm water runoff from the roadway above.

Routes that use these stations could take advantage of the potential to improve open space in the project area. At Charles Helou, this is especially true of the routes that use the ground level,

as they are the ones that will have the greatest impact on station design improvements. Open space may not be considered an initial priority, however if not included in the beginning station modifications, they should be part of longer term improvement plans.

Pedestrian access. There are several locations where physical barriers prevent pedestrian access to potential station areas. This is a particular problem when attempting to minimize door to door travel time, especially where most users are captive. Furthermore, universal accessibility principles, or providing access to people of all abilities, should be applied when upgrading stations and vehicles. In keeping with this, stairways should not be the only pedestrian access route to or from stations, but should be augmented by elevators or ramps. Locations that are particularly lacking include the following:

- Charles Helou Ave: There are no surface pedestrian crossing locations anywhere along this road, and heavy traffic makes crossing difficult and unsafe. A single pedestrian bridge two blocks west of St. Michel Station, however it is inconvenient and not universally accessible.
- St. Michel Station: A large wall separates the St. Michel Station and Charles Helou Avenue preventing accessibility to the Station. Access through the station property is blocked by two large garage buildings.
- Charles Helou Station: Pedestrian access to the Charles Helou Station is practically non-existent. Except to the second level taxi station, the stairways that lead to the (unused) parking lot, and to Charles Helou Avenue above are blocked. An old stairway leads down to the station from Pasteur Street; however it is poorly maintained and filled with rubble and trash. Access from Charles Helou Avenue to Gemmayze are lengthy and difficult, as well as from the Portside Blocks connecting the Station and the BCD.

- Sidewalk Blocking: In areas with excess demand for parking, vehicles are often parked on sidewalks blocking pedestrian access. In the project area, this occurs mostly on Pasteur Street

Construction at the St. Michel Station should thus include removal of the wall on the northern side of the parcel and pedestrian crossings on Charles Helou Avenue. At Charles Helou Station, improvements should include installation of an elevator as well as a pedestrian bridge, or otherwise improved access to Gemmayze. The stairway to the Station's ground level should also be repaired, and sidewalks constructed along the Portside Blocks to the Waterfront Plaza (which is to be constructed by Solidere).

Charles Helou Station Operations. Currently the Charles Helou Station is operated by the Beirut Terminal Company under contract from the OCFTC. Despite its size and the requirement for all international routes to terminate at the station, operations and passenger volumes remain low. This is not surprising considering that it is extremely difficult to access; there are neither usable pedestrian facilities nor passenger drop off locations. Additionally, while the station was designed to accommodate offices, lounges, and other amenities, except for unclean restrooms, these remain unused.

Figure 5-5. Taxi drivers make coffee on portable gas burners before the return trip to Damascus

Bus rapid transit routes that use the station could provide the needed impetus to improve the management practices at the station. The rapid transit line operators could take over the station operations contract and be required to locate their offices in the station. Improved management has the potential to not only increase the station's passenger volume, but could serve as a catalyst for economic development at the station, the Portside Blocks and even in Gemmayze.

Parking. Parking availability is an issue throughout Beirut; the project area is no exception. Pasteur and Gouraud Sts. are both one-way roads with on-street parking on both sides; and Nahr Street is two-way with parking on both sides. Parking on sidewalks and in pedestrian areas is common due to the high demand. The Downtown area is currently riddled with surface parking lots awaiting building development. Already approaching capacity in some parts, development will further increase traffic levels on Downtown roads and decrease parking availability; alternative ways for people to access the area must be determined.

Charles Helou Station provides ample parking capacity, which could be used for the adjacent neighborhood, as a park and ride lot for transit users leaving the city, or as a remote lot for those entering the Downtown. Currently closed, the extent of the parking lot's usage is extremely flexible. Yet increasing parking capacity leaves little incentive for people to use transit. While adding remote lot would help improve traffic and parking capacity issues within Downtown and Gemmayze, it may merely be pushing the problem out of sight rather than solving it. One solution would use Charles Helou Station as replacement parking capacity instead of added parking capacity. This would make driving downtown possible, but because of the increased walking or transfer time, less attractive. In Gemmayze removing parking could provide the space for added sidewalks, and possibly even outdoor cafes, which have become quite popular.

The transit routes will affect the parking problem in two ways: routes along Gouraud and Pasteur Streets would use the existing street space, requiring replacement of on-street parking. Routes that pass through Charles Helou Station would provide not only excellent shuttle service to Downtown, but would support management changes at the station itself, including the parking lot. Either way, transit service will reduce the demand for parking Downtown.

Economic Development. A business survey and further economic analyses must be completed before business needs within the project area can be fully understood. However, there are however several vacant plots along Charles Helou Avenue, as well as underused buildings in the Portside Blocks and on Pasteur Street that could benefit from proximity to a transit station, and which could be developed in concert with the transit line. As mentioned above, use of Charles Helou Station and improved management there could spur economic development. Alternately, Gouraud Street and to a lesser extent Pasteur Street businesses would be highly sensitive to reduced access from a transit line on the existing streets. Extending from the discussion above, replacing some of the parking on Gouraud and Pasteur Streets with parking at Charles Helou and widening sidewalks would likely support the businesses there by providing a more pleasant environment for customers.

Charles Helou Avenue has great potential for economic development, empty and underused parcels line the portion between St. Michel Station and Charles Helou Station. While development on these parcels would benefit from proximity to transit stations, the potential access conflicts from having an exclusive bus lane on the outside lanes of Charles Helou Avenue, could impact them negatively. If Routes 4 or 5 are built, these access issues may either prevent their development or sacrifice the exclusivity of the bus route.

Right of way reclamation. Reclamation of unused transportation rights of way is extremely important. Once constructed through sparsely populated areas, the cost of recreating them

through now dense urban areas is extremely costly. In Lebanon the rail rights of way, having been unused for more than thirty years, are prone to degradation. In fact, some portions have already been built on. Roads have been constructed on other segments of the right of way, making it politically difficult to return to public transit use. Reclaiming the right of way for transit use, not only gains a present return on previous government investments, some more than a hundred years old, but reduces the need for future outlays to develop new rights of way.

Also, since rights of way were originally created for rail usage, the alignment geometry, including grades and turning radii, is appropriate for eventual transition back to rail, should it occur.

5.4 Discussion and Comparison of Route Alternatives and Alignment Recommendation

A typical cost-benefit survey would assign a value to each of these variables, and choose the route with the highest aggregate value. A more complex survey would determine the net present value over a ten or twenty year period. Large amounts of time and effort can be dedicated to assigning values to variables that are essentially qualitative and too complex. Those that cannot be quantified are either under-valued or left out of the calculation. Not only are these important variables, but each individual will value them differently. Even variables that can be quantified may produce different impacts in different locations; for example traffic disruption will mean something very different on the Port Road, Charles Helou Avenue, and Gouraud Street

Rather than fall victim to the typical cost-benefit process, this evaluation will seek to determine the route that provides the most benefits, sacrifices the fewest, and minimizes negative impacts in a way that acknowledges the physical, social, and political complexity of the project. This will

be accomplished by summarizing the characteristics of the routes according to the variables where possible, and using our understanding of the project area to weigh each route against the others. The following tables provide a comparison of the some of the variables. Table 5-1 and Table 5-2 show basic physical route attributes including route length and elevation change, stop locations, and locations of vehicular and pedestrian grade crossings, traffic lane closures and traffic disruption, estimated parking removal, and potential ridership capture.

Table 5-1.Comparison of route attributes

Route/ Criteria	Stop Locations	Elevation Change	Route Length	Vehicular Grade Crossing Locations	Pedestrian Crossing Activity
1	St. Michel St. Nicholas Martyr's Square (S)	low	2.45 km	Nahr @ St. Michel Gouraud @ Haddad Gouraud @ Martyr's Square Major crossings (Haddad, Martyr's Sq)	Nahr Gouraud
2	St. Michel St. Nicholas Pinwheel	Medium	3.05 km	Nahr @ St. Michel Gouraud @ Haddad Haddad @ Triesta	Nahr Gouraud Waterfront°
3	St. Michel Pasteur Martyr's Square (N) Pinwheel	Medium	2.95 km	Nahr @ St. Michel Nahr @ Gouraud/Pasteur Pasteur @ Haddad Charles Helou @ Martyr's Square Martyr's Square @ Triesta	Nahr Pasteur Waterfront°
4	St. Michel Charles Helou Pinwheel	Medium	2.40 km	Charles Helou @ St. Michel (WB) Charles Helou @ Port Rd (WB) Charles Helou @ Haddad (EB) Charles Helou @ Onramp (EB)	Waterfront°
5	St. Michel Charles Helou Martyr's Square (N) Pinwheel	Medium	2.55 km	Triesta @ Martyr's Sq Charles Helou @ St. Michel (WB) Charles Helou @ Port Rd. (WB) Martyr's Square @ Charles Helou (EB) Charles Helou @ Haddad (EB) Charles Helou @ Onramp (EB)	Waterfront°
6	St. Michel Charles Helou/Pasteur	High	2.15 km	Charles Helou @ St. Michel Pasteur @ Haddad	Pasteur
7	St. Michel Charles Helou Pinwheel	Medium	2.35 km	Charles Helou @ St. Michel Charles Helou @ Port Rd. Port Rd. @ Port Entrances * Port Rd. @ Bus Station Entrances*	Waterfront°
8	St. Michel Charles Helou Pinwheel	Medium	2.15 km	Ibrahim Bacha @ St. Michel Port Rd. @ Port Entrances * Port Rd. @ Bus Station Entrances*	ROW Waterfront°

°Depends on alignment option on Triesta Street
*Crossings are restricted to vehicles entering or exiting the Port of Beirut or Charles Helou Station.
EB, WB: crossings only affect the Eastbound or Westbound directions of the route.

Table 5-2. Comparison of route attributes

Route/ Criteria	Ridership Capture	Traffic Lane Closures	On-Street Parking Removal
1	Gemmayze BCD (S) Achrafieh Monot	Nahr: 1 lane (50%, 1 direction) Gouraud (Nahr to Haddad): 1 lane (100%) Gouraud (Haddad to Martyr's Sq): 2 lanes (50%)	Nahr: ~300 spaces (100%) Gouraud: ~315 spaces (100%)
2	Gemmayze BCD (N) BCD (S) Achrafieh	Nahr: 1 lane (50%, 1 direction) Gouraud (Nahr to Haddad): 1 lane (100%) Haddad (Gouraud to Triesta): 2 lanes (30-50%) Triesta°	Nahr: ~300 spaces (100%) Gouraud: ~315 spaces (100%)
3	Gemmayze BCD (N) BCD (S) Achrafieh Monot	Nahr: 1 lane (50%, 1 direction) Gouraud (Nahr to Haddad): 1 lane (100%) Unnamed: 2 lanes (100%) Martyr's Sq: 2 lanes (not yet built) Triesta°	Nahr: ~300 spaces (100%) Pasteur: ~350 spaces (100%) Triesta°
4	Gemmayze BCD (N) BCD (S) Achrafieh Port	Charles Helou (St. Michel to Haddad): 2 lanes (25-33%) Triesta°	Charles Helou: 30-40 spaces (100%) Triesta°
5	Gemmayze BCD (N) BCD (S) Port Achrafieh	Charles Helou (St. Michel to Martyr's Square): 2 lanes (25-33%) Martyr's Sq: 2 lanes (not yet built) Triesta°	Charles Helou (St. Michel to BCD): 30-40 spaces (100%) Triesta°
6	Gemmayze BCD (S) Port Achrafieh	Charles Helou (St. Michel to Port Rd.): 2 lanes (25-33%) Charles Helou Throughpass: 2 lanes Pasteur (Throughpass to Haddad): 1 lane (100%)	Charles Helou (St. Michel to Port Rd): 15-20 spaces (100%) Charles Helou Throughpass: 15-20 spaces (100%) Pasteur: ~350 spaces (100%)
7	Gemmayze BCD (N) BCD (S) Achrafieh Port	Charles Helou (St. Michel to Port Rd.): 2 lanes (25-33%) Port Rd.*: 6 lanes (100%) closed to through traffic Triesta°	Charles Helou (St. Michel to Port Rd): 15-20 spaces (100%) Triesta°
8	Gemmayze BCD (N) BCD (S) Achrafieh Port	Port Rd.*: 6 lanes (100%) closed to through traffic Triesta°	ROW: 20-30 spaces (100%) Triesta°

Triesta°: Parking and lane closure will depend on the alignment option used on Triesta Street. Options A and C will not cause any impact. Option B will close 1 traffic lane and 1 parking lane.
*Regarding closure of the Port Road to through traffic, access will be maintained to the east and west Port of Beirut entrances, Charles Helou Onramp (EB), and the Charles Helou Throughpass (WB).
Capture Areas: Gemmayze, Portside Block, Port, BCD (N), BCD (S), Monot, Achrafieh. It is assumed that all routes will capture Nahr and Khodr, due to their proximity to St. Michel Station.

The Table 5-3 below compares the potential of the routes to improve (•) or worsen (−) the problem areas. Since most of the problem areas, or their solutions can defined by specific

locations or instances, a single • or – refers to each instance. For example, there are four major pedestrian access problem areas defined above as Charles Helou Avenue, St. Michel Station, Charles Helou Station, and parking on sidewalks (particularly in Gemmayze). Each dot on the table represents one of these areas. A box with –/• means that the route improves the problem area in one instance but worsens it in another.

Table 5-3. Problem area comparison

Route/ Criteria	Illegal Dumping	Lack of Open Space	Pedestrian Access	Charles Helou Station Operation	ROW reclamation	Parking	Economic Development
1		•	••			–	–/•
2		•	••			–	–/•
3		•	••			–	–/•
4		•	••	•		•	–/•
5		•	••	•		•	–/•
6		•	•••	•		–	–/•
7		••	•••	•		•	••
8	•	••	•••	•	•	•	••

While these tables are important comparison tools for choosing the best route alignment, they do not provide information on the scale of each impact, positive or negative. They also speak little to the fact that some variables are essentially deal breakers and others are not.

In the process of eliminating route alternatives, like in medical practice, the most important charge is to "first, do no harm." Most transportation engineers would take this to mean that the efficiency, capacity, or level of service of the transportation system should not be reduced. However, in this process, as far as transportation systems exist to improve quality of life, their introduction or alternation should not serve to deteriorate it. The closest indicator of quality of life in the variables outlined above is economic development. The extent of the potential negative impact of the transit line on economic development in Gemmayze requires that the routes using Gouraud and Pasteur Streets should be eliminated. While Pasteur could likely withstand the route, combined with the possibility of strong public opposition that would reduce its implementability, and the existence of better routes justify their elimination as well. Thus, Routes 1, 2, 3, and 6 are eliminated.

Of the remaining four routes, the lane closures and major at-grade vehicular crossings on Charles Helou Avenue on Routes 4 and 5 will cause significant traffic disruption and transit service disruption. With such major traffic disruption, the implementability is reduced; in order to limit impact on the traffic capacity and appease drivers, it will be tempting to sacrifice the quality of the alignment towards semi-exclusivity or even non-exclusivity. With the existence of other alignments that do not bear this risk, reducing the transit service quality is unacceptable. Additionally, the ramp from Charles Helou Avenue to Triesta Street on Route 4 will be a high-cost, physically imposing structure that will limit views to the sea and degrade the pedestrian environment. With these impacts, Routes 4 and 5 are eliminated.

The two remaining routes use the same alignment between Charles Helou Station and Downtown. The lane configuration and alignment options provided for on the Port Road and Triesta Street segments aim at minimizing travel time along the route, maximizing road space efficiency and access to vehicles and pedestrians. At the same time they consider the needs and vision of Solidere and the Port of Beirut. As large and powerful actors in Lebanon, their

cooperation and endorsement could push the project to implementation. Because both Routes 7 and 8 use this alignment, the comparison between them will focus on the segment between St. Michel Station and Charles Helou Station. As a reminder, Route 7 exits St. Michel on the north and uses the inside lanes of Charles Helou Avenue before turning onto the Port Road. A third to a half of this road segment, depending on where the alignment exits St. Michel, has a wide landscaped median that could be converted into exclusive bus lanes. On the rest of the segment, vacant lots may provide the extra space needed to widen the roadway to provide the exclusive lanes, however will degrade the aesthetic quality of this gateway into the Downtown. Expropriation of the land will extend the implementation process and increase the cost, and widening Charles Helou on the north side will entail structural supports, due to topography. While the impact to the uses along Charles Helou Avenue will not be as great as with Routes 4 and 5, and the possibility of widening the road for bus lanes will cause less traffic disruption, there will be two major crossings, one in each direction on Charles Helou that will disrupt traffic and the transit service.

Route 8 exits St. Michel Station on the west side and uses the Spur Rail right of way and tunnel to reach Charles Helou Station. Traffic disruption on this route is minimal since it crosses no major roads; in fact the right of way crosses only two roads, one of which is minor enough that it could be closed. A third road marked on the map crosses the right of way as a pedestrian bridge. The route will impact adjacent residential buildings, as they are located on the edge of the property line. Mitigation for noise and maintaining pedestrian access across the right of way to prevent it from becoming a barrier makes these problems manageable. The impact on transit service quality of the single-lane tunnel and ramp should not be a problem; the single-lane section is approximately 340 meters long, so two-minute headway can be achieved with minimum operating speeds of 20 kilometers per hour. Capacity above this level will likely not be reached for several years, and can be extended by platooning buses or using accordion buses.

A signal system that allows buses to remain at the station platform until they can pass will further reduce the impact of the single-lane portion. The major costs of this route will be excavating the tunnel ramp and installing a signal system. While the right of way segment between St. Michel is not endanger of encroachment to the extent that other portions are, it is important to reclaim its usage as a transportation corridor, particularly since it serves as an important link between two major stations. Use of the rail right of way will further force the clean up of the illegal dumping site at the tunnel entrance. By taking advantage of existing infrastructure, it also gains a return on previous government investments.

While Route 7 is a workable solution, the benefits of Route 8 far outweigh it in terms of traffic and transit service disruption. The positive impact of Route 8 in terms of right of way reclamation and trash removal, the potential for mitigation of negative impacts, and the feasibility of the single-lane portion, make it the best and most implementable alignment in the project area. The following section will look at Route 8 in greater detail and propose preliminary site plans that will serve to provide high quality transit service and ameliorate the problem areas. By including route criteria that extend beyond transportation and designing circulation patterns, station areas, and other aspects that exploit economic and environmental synergies, a higher quality project that is supported by the adjacent community and serves to attract ridership will result.

Route 8's connections to the current and potential future transportation network are excellent. The terminal Pinwheel Site affords easy access for connecting local routes and services to the east, west, and south, downtown shuttle routes, and as the anchor for a loop that would pick up and drop off passengers in several locations within the downtown area. It also provides excellent pedestrian access to both the Historic District and the unfinished Financial District.

The alignment's direct connection between the Pinwheel Site and Charles Helou Station will increase the viability of both stations. Charles Helou Station can serve as the turnaround and rest area for local bus drivers between runs, instead of the Pinwheel Site; and accessibility to Charles Helou will increase substantially. St. Michel Station also is well integrated into the larger transit network, lying at the crossroads of Charles Helou Avenue, Corniche En-Nahr, and the southern portion of the coastal rail right of way that connects St. Michel with the NBT Station and yards facility along the Beirut River and on to the south. This is the connection to the Southern BRT Corridor, as proposed in the initial phase of the feasibility study.

While it was not included as a criterion in this assessment, the Ministry of Public Works and Transport has communicated the desire to eventually revert the transit corridor back to rail usage. The alignment and engineering of the St. Michel to Jounieh portion of the route has thus been designed to minimize the costs of this conversion. Since the Spur right of way was originally built for rail operations, it perfectly situates this segment to be converted back to rail in the future. This was not the case with the other alignments.

This page intentionally left blank

6. RECOMMENDED ROUTE AND STATION PLAN

The route evaluation and selection process attempted to determine the alignment that would provide a high quality transit service, and the greatest value to the adjacent uses and the larger region, at the lowest cost. Determining the route that can best achieve these results sets the stage by making them possible. But only through employing specific design and implementation strategy can these results be achieved. The station and alignment design will translate the criteria and preferences into an actionable and feasible plan, and will show how the route will look and operate.

6.1 St. Michel Station

The site plan for St. Michel Station allows the OCFTC flexibility to increase their office space, while also allowing further commercial development and more formal use of currently unused land. The plan focuses on providing adequate space for transit operations and maintenance functions, enhancing pedestrian accessibility to and through the site, and providing quality open space and locations for commercial development.

As mentioned in Section 0, the St. Michel Station site has an area of 6.84 hectares, and is currently being used for bus storage and maintenance as well as OCFTC offices. Rail rights of way access St. Michel on the southeastern side (towards the NBT Station) and the western side (towards Charles Helou Station). Another right of way, which has been decreed by the government and is planned to be expropriated for the rapid transit line enters the north side of the site, passing under Charles Helou Avenue.

Figure 6-1 is a diagram of the St. Michel Station site plan including the circulation pattern for both the rapid transit and local bus routes. The current buildings, including the two large garages, will be maintained to the greatest extent possible to minimize the project costs. As shown, the northeastern garage will be remodeled as the bus station, with space for the rapid transit line and local bus routes, enabling quick and easy transfers. The southwestern garage will continue to be used for maintenance but will be shortened by approximately 45 meters (out of 150 meters). The steel-frame construction of the garages will make remodeling and shortening them a relatively simple and cost-efficient job.

By shortening the maintenance garage, an open space area of approximately 40 meters by 60 meters is provided on the south portion of the property. This will serve as local open space for the adjacent neighborhood and as an open pedestrian corridor through the property, to the station building, OCFTC offices, and to Charles Helou Avenue. A larger open space of approximately 270 meters by 60 meters is provided on the northern portion of the property. With the removal of the northern wall and installation of pedestrian paths and crosswalks on Charles Helou Avenue, this open space area will be a valuable asset to the region, particularly due to the existence of mature trees and its connection to public transit. Old rail cars still on the property could be incorporated into the park as markers of Lebanon's transportation history. It will also provide short and long-run flexibility to expand operations and possibly provide a small park and ride lot. The majority of parking, however, should be directed to the Charles Helou Station, to take advantage of the high parking capacity that already exists there.

Commercial space has been situated to take advantage of proximity to both the adjacent roads and the open space. The commercial space on the south side of the station, directly adjacent to the smaller park, is an ideal location for local businesses and outdoor cafés, as has become popular downtown. They should aim to serve both the Nahr neighborhood and the bus station.

Commercial space on the north side can take advantage of its visibility from Charles Helou Avenue and should be more regionally oriented.

Because the site has been used as a railroad station and maintenance area for upwards of a hundred years, the likelihood of contamination on the property is high. Inasmuch as other uses are introduced to the property, particularly public open space, environmental contamination should be studied and clean-up efforts incorporated into the development process. Recognizing that planning and construction may take several years, the potential for phyto-remediation, or using plants to absorb contamination, is a potential solution if acted upon quickly, since this process typically takes several years to adequately decontaminate.

The future expansion of the bus rapid transit system towards the NBT station and continuing to Lebanese University and the Southern Suburbs is incorporated into the site plan by including the southeastern right of way in the circulation plan. This is an important feature for implementation as it advances the southern extension project, gaining the support of the more Muslim constituencies in the areas it serves. This will be discussed further in the section on implementation strategy.

Figure 6-1. Site plan for the St. Michel Station

6.2 St. Michel to Charles Helou

The route will follow the spur rail right of way west from St. Michel Station, crossing Ibrahim Bacha Street, which is directly adjacent to the station property. This street will remain open, however the next road, Street 1, will be closed to through traffic. The ramp will begin on the west side of Street 1, and will continue as a bidirectional facility until just before Madrid Street. At this point the right of way becomes a single lane to pass under a pedestrian bridge and through the tunnel; a signal system and a stop line will be installed to ensure safety on the single-lane section. The grading of the ramp follows the original elevations as shown in Figure 6-2.

Figure 6-2. Map showing the depressed portion of the Spur right of way

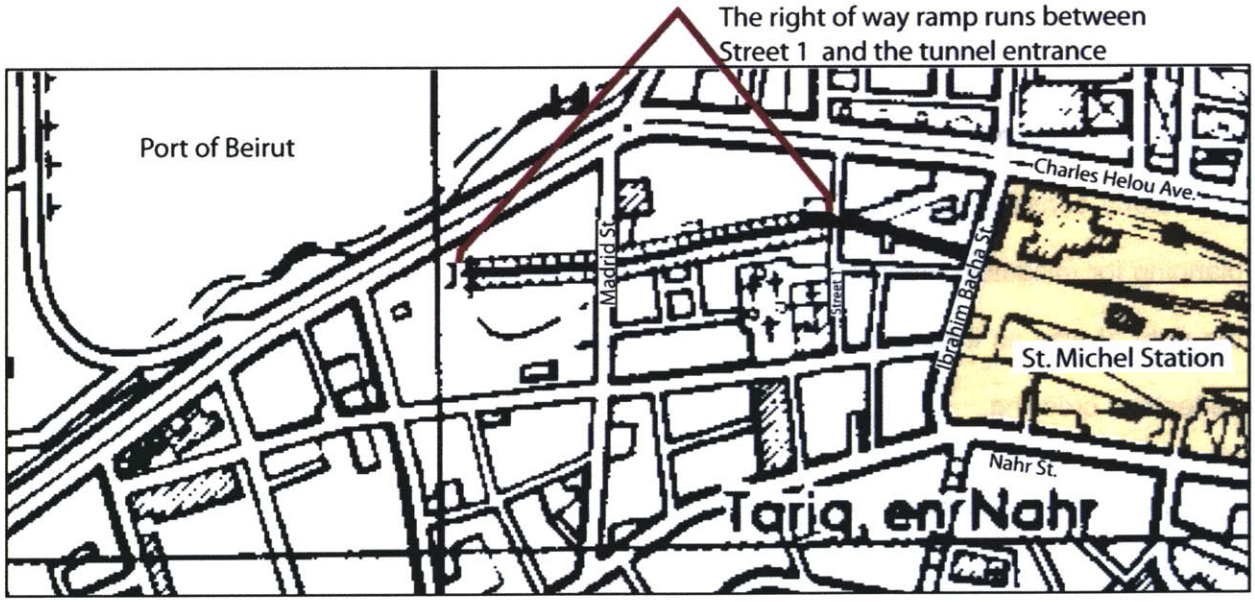
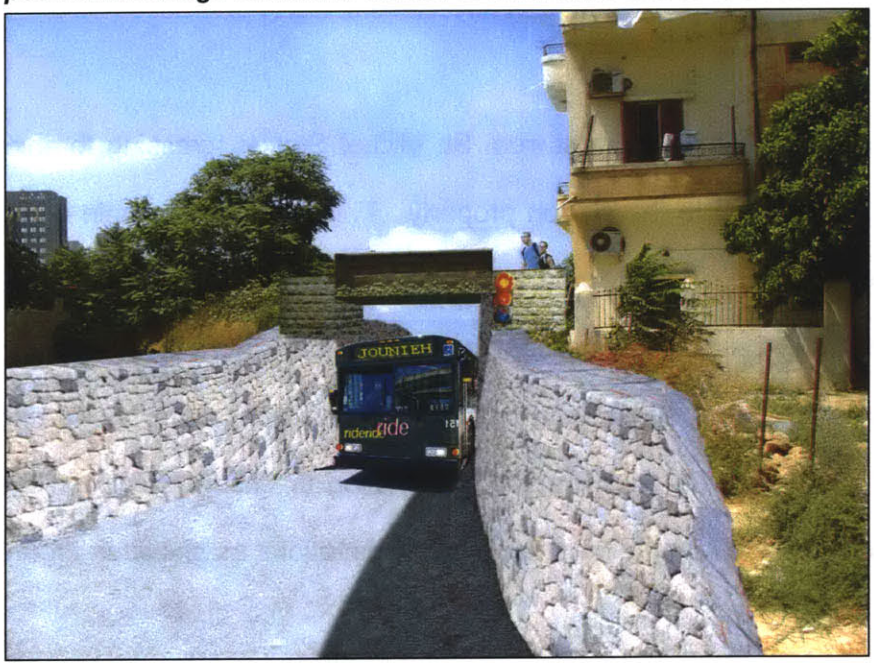


Figure 6-3 (A and B). A shows a mock-up of the transit line passing under the existing single-lane pedestrian bridge at Madrid Street. B shows the site as it exists currently.



In fact, the ramp foundation likely still exists, but has been filled; this is more apparent between Madrid Street and the tunnel, where overgrowth and trash conceal the ramp rather than dirt.

As the only segment of the route directly adjacent to residential buildings, this portion must be particularly sensitive to noise, privacy, and access issues. Residents should be involved in planning for mitigation measures. Noise and visual barriers may be installed along the sides of the right of way as it runs next to buildings; where at grade, the right of way should allow for pedestrian crossing.

The single-lane portion of the alignment will end directly west of the tunnel, where another signal will be located for eastbound buses; this will provide bi-directional service into Charles Helou Station. Excavation is not needed on this section since the western tunnel entrance is at the same level as Charles Helou Station.

As mentioned in Section 5.4, the single-lane segment of the route will allow for minimum headways of two minutes at operating speeds of 20 kilometers per hour. If this becomes a

capacity-limiting factor, increased bus size, platooning, and other operating changes can be used before additional infrastructure is constructed. Signals placed on either side of the single-lane segment, as well as at the eastbound Charles Helou platform and the westbound St. Michel platform will make operations safe and efficient, as buses can remain at the station until the tunnel is open for them.

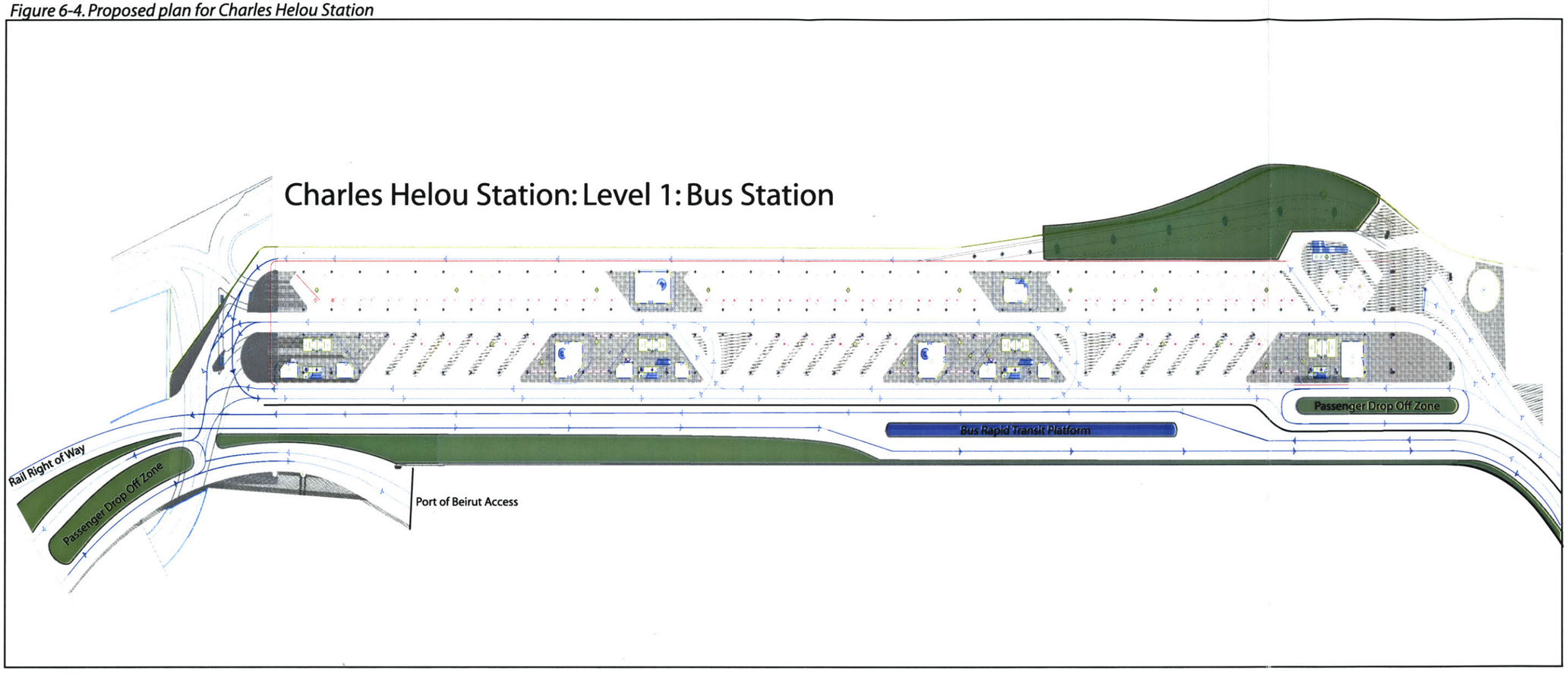
6.3 Charles Helou Station and the Port Road

The Charles Helou Station site plan focuses on providing adequate access to and from Charles Helou Avenue, the Port of Beirut, the Portside Blocks, and the station. The plan also improves station amenities, provides open space, and extends the waterfront promenade.

Figure 6-4 shows the circulation and site plan for the Charles Helou Station area.

Since the main segment of the Port Road serves only the Charles Helou Station and the Port of Beirut, and through traffic can be served by Charles Helou Avenue, the Port Road will be closed to through traffic. Traffic count calculations on the Port Road show that traffic diverted to Charles Helou Avenue will be more than offset by the capacity gains provided by the rapid transit line. On the east and west sides of the station, bidirectional access to passenger drop-off locations will be provided; and vehicular access to eastbound Charles Helou Avenue will remain open from both sides of the station via the Charles Helou Throughpass and On-ramp. Vehicles will access the Port of Beirut by the existing west and south entrances, both of which will be bidirectional; only the west entrance will cross the rapid transit alignment. An optional at-grade vehicular crossing will provide access to the buildings directly adjacent to the Port just across from the Portside Blocks. Access to the Charles Helou Station will cross the alignment only on the eastern side of the station.

Figure 6-4. Proposed plan for Charles Helou Station



The rapid transit line itself will enter the station area via the spur rail right of way and merge onto the Port Road just west of the station entrance. The alignment will follow the southern portion of the Port Road until it splits to make way for a center platform. As the two directions reunite on the west side of the platform they use the northern portion of the Port Road, and continue along it for the remainder of the segment into Downtown. Wide sidewalks along the northern side of the Port Road will serve as a visual and functional extension of the Corniche to this important terminal.

The rapid transit route will serve as a catalyst for beautifying and developing Charles Helou Station and the adjacent areas and as an important gateway to the Downtown area. By bringing the rapid transit line to the heart of the Charles Helou Station, it provides the impetus to renegotiate the station's operations contract. Poorly managed, the station currently does not take advantage of its facilities, with offices, commercial space, and lounges left empty. With through traffic removed from the Port Road, space is available to extend the waterfront promenade which, when the Downtown is portion is completed, will extend 8.6 kilometers from the west Port entrance to Ramlet Al-Baida, the public beach on the south side of Beirut. Adding the Charles Helou portion not only lengthen it by 1.1 kilometers, but will provide essential pedestrian access to the station, improving the commercial viability of the station and the Portside Blocks. It also suggests the possibility of eventually creating a pedestrian facility that rings Beirut by extending the promenade to the Beirut River, tracing the River past the NBT Station and crossing back over to Ramlet Al-Baida by way of the Pine Forest, the Sports City, and the newly constructed park on Adnan El Hakim Street in Jnah.

The empty space on the south side of Charles Helou Station, shown in Figure 4-8, will be developed into quality open space. The traditional sandstone stairway will be maintained to

provide direct access to Pasteur Street and Gemmayze. The park area itself will provide a more comfortable rest area for bus and taxi drivers as well as for passengers.

6.4 Triesta Street and the Pinwheel Site

The portion of the rapid transit line between the west Port of Beirut entrance and the Downtown terminal at the Pinwheel Site is incredibly dependent on how Solidere chooses to develop the waterfront. Curb to water, this area is approximately 75 meters wide. Since the final design for this area has not yet been determined, the inclusion of an exclusive transit lane can be incorporated from the beginning. In fact, Solidere should include this as a requirement in the Martyr's Square design competition, which is scheduled to be released during the summer of 2004.

The alignment will be located approximately halfway between Triesta Street and the water line. It can be incorporated into a pedestrian mall that houses commercial space on the Triesta Street side, leaving the Martyr's Square view corridor as an open plaza. It will lead directly into the Pinwheel Site, which has been planned as a performing arts center. Arts and entertainment centers have been synergistically combined with major transit stations in other cities, such as Boston's Fleet Center and North Station. The transit station can be located either on the ground level or in the basement, but should be visible and easily accessible for passengers and vehicles. Creatively incorporated into the building's architecture the transit station will literally serve as the center of the Downtown "pinwheel". This terminal station need not be large, but should be of an adequate size to accommodate platforms for each direction of the rapid transit line, a bus turnaround, stop locations for local buses, and a taxi/*service* stand. As the main Downtown station, it must anticipate expansion of the rapid transit network to the south via Martyr's Square and the airport, and west toward Ras Beirut, with the potential to add platform

capacity. Accommodation of downtown passenger pick-up and drop-off loops for the rapid transit line should also be planned for. Ridership volumes often depend on service extensions of as little as a block or two, even if travel time is lengthened slightly. Several downtown loop options can exit the Pinwheel Site and thread through popular Downtown destinations before returning to the rapid transit line alignment via Triesta Street or Haddad Street. By leveraging the terminal location downtown, and the operational flexibility of bus rapid transit, these terminal loops can multiply ridership volumes and further decrease vehicle parking and road capacity requirements for maximum Downtown development.

This page intentionally left blank

7. CONCLUSION

By using and enhancing the existing assets of the project area, including buildings, and abandoned and unused infrastructure and rights of way, the costs of developing the transit line are reduced considerably. At the same time, the project provides opportunities for economic development and environment both on site and the surrounding area, as well as network connectivity and accessibility. The recommended alignment and site plans leveraged the transit project and its capital investment to provide quality station locations that integrate with and enhance the adjacent uses. The following list provides an overview of key project features.

St. Michel Station

- Reuse of existing buildings for station and maintenance garage
- Provision of public open space and commercial development opportunities
- Vast increase in pedestrian accessibility to and through the site from Charles Helou Avenue and Nahr Street
- Anticipation of rapid transit system expansion to the south towards the NBT Station

Spur Right of Way and Tunnel

- Clean up of illegal trash dump
- Reclamation of right of way for transportation use
- Minimal traffic disruption
- Pedestrian accessibility across right of way

Charles Helou Station and Port Road Reconfiguration

- Vast increase in pedestrian accessibility from Downtown, Portside Blocks, Charles Helou Avenue, and Gemmayze/Nahr neighborhoods
- Continuation of waterfront pedestrian promenade from Downtown to Charles Helou Station
- Provision of public open space
- Parking resources can be leveraged to improve pedestrian environment in Gemmayze, as a remote lot for the BCD, and as a transit line Park and Ride
- Development of amenities for station users

Triesta Street, BCD waterfront, and Pinwheel Site

- Excellent pedestrian accessibility to all areas of Downtown
- Excellent accessibility for local bus routes, rapid bus distribution loops within the BCD, and potential future expansion of the rapid bus network
- Station terminal uses integrate well with uses of Charles Helou Station

Development and urban improvement is a dynamic process that must recognize and work within the complexity of the urban system. Developing route criteria and site plans that prioritize high quality transit service, coordination with the regional transport system, and improvement of the adjacent uses, while minimizing cost, serves to make these priorities possible. The socio-political intricacies of Lebanon complicate implementation of such plans. Developing a strategy that will gain the support of key decision makers will be essential to project implementation, and long-run, system expansion.

7.1 Implementation Strategies

Implementability has been mentioned several times in the course of route evaluation and site planning. The transit line can have no public benefit if it is not constructed. Gauging the site and political conditions that will ensure implementation and leveraging stakeholders to push the process through to completion is essential.

The importance of the route evaluation methodology and site plans to implementation

The route selection process and site plans aim to minimize detrimental effects to the adjacent uses and maximize the potential local and regional benefits of the transportation project. The project anticipates problems that might arise and seeks to address them in the plan, allowing less room for opposition to the project. Acknowledging stakeholders that are likely to oppose the project and seeking ways to best address their needs and preferences can turn opposition into support, or at least neutrality. For example, residents directly adjacent to the right of way should be included in the planning process, particularly when addressing noise and privacy mitigation measures. This is the same approach that should be taken with the Port of Beirut when addressing the issue of the Port Road and vehicle access.

The wider vision of a transit system that would extend to other parts of Beirut and to the South; and by incorporating aspects into the project beyond those directly related to transportation, constituencies are also broadened beyond those immediately impacted, positively or negatively, by the initial transit infrastructure or service. These constituencies can create positive force pushing for the implementation of the transit system and should be leveraged to the greatest extent possible in support of the project.

Timing factors

The implementation and expansion of the rapid transit system should be seen as a long-run endeavor for Lebanon. In order to gain acceptance and support, various stages of implementation should be timed and phased to build ridership. Initial implementation should focus on securing the right of way and station properties as quickly as possible to begin service provision. Station amenities such as commercial and open space can be constructed once service begins, and can take advantage of increased passenger traffic. Gains in ridership and ensuing constituent support should then push further improvement of station sites and expansion of service.

Cost factors

Capital costs have been extremely daunting for the Lebanese Government throughout the feasibility study process. The high capital costs of the light rail option, just over $425 million[35] were instrumental in its elimination as a modal option. Despite the considerably lower costs of bus rapid transit, as shown below in Table 3-1, the costs associated with it are still high considering the risk involved in constructing an exclusive transit line in a country where people are wedded to their vehicles.

The priority the government places on developing a viable transit system is an important indicator of what price it is willing to pay. Compared to the level of highway investment, these costs are modest, and yet there is no transit system on the ground. Moving beyond the transit system inertia in Lebanon will likely require a project that is too good to pass up, that is, a high

[35] Beirut Suburban Mass Transit Corridor Feasibility Study, Final Report, July 2003

passenger demand and level of service, minimal impact on traffic circulation, and very low costs. By creating a project includes aspects beyond transportation such as improvement of the local economy and environmental quality, among other things, reduces long run costs by providing a multi-problem solution. Reducing the capital costs as much as possible, not only increases the feasibility of this initial project, but also the financial and political feasibility of expanding the network in the future.

Sociopolitical factors

The Lebanese political system is precariously balanced between sectarian interests. One of the primary reasons for the 1975 to 1990 Civil War was the uneven level of power between religious groups and the resulting discrepancies in standard of living. While this is a gross oversimplification, the system has changed little. The geographic distribution of these sectarian groups has placed the majority of the Christian population to the north and east of Beirut, and the majority of the Muslim population to the south and west. While several reasons, including denser population and proportionally less road capacity have advanced the planning process of the northern corridor of the rapid transit line, it is important to seriously consider and plan for the next phase that will extend it to the south, thus serving the Muslim population. By including the right of way leading from St. Michel Station to the NBT Station and Lebanese University in the St. Michel Station site plan, and anticipating route expansion from Downtown and the Pinwheel Site south toward the airport, these interests are advanced. However a nod in their direction may not be enough. By shaping the operations and vehicle provision contracts to guarantee system expansion within a specified period of time, not only will the transit system benefit, but it will garner support from a large and important constituency. Transit has been the impetus for social change in the past, with labor protesters utilizing the electric trolley system. By ensuring

the expansion of the line to the south, transit can once again serve as a catalyst for social change and greater equality, but this time through more positive means.

Leveraging key stakeholders

Increasing the base of constituents is an important tool for garnering broader support; however the relative power of a few key stakeholders can make or break the project. As the entity with the most to gain from the rapid transit line, and the most influential stakeholder, Solidere will need to play a key role in pushing the project toward implementation. The current road system accessing the Downtown will not provide the capacity needed for it to fully develop. While transit was included in Solidere's Transportation Plan through the provision of space for subway stations and right of way, bus lanes on the major avenues, and bus stops, none of these services have proceeded to the next stage of planning. The rapid transit line provides the ideal opportunity for Solidere to advance the implementation of quality transit service both to and within the Downtown area. Bringing transit into the BCD at this point in the development process offers greater flexibility in the siting of transit rights of way and stations. It also allows the transit system to grow with the Downtown. With a direct line to the Council of Ministers and the Prime Minister, Solidere is ideally placed to push this project onto the national agenda.

The Port of Beirut, a major economic engine in Lebanon, is also an important stakeholder for this project. With the closure of the Port Road to through traffic, the Port of Beirut is likely to initially oppose the project. However, by working with them early in process and ensuring that access to the Port is maintained, but that the project could provide benefits, such as improving security and decreasing the need for employee parking. The support, or at least neutrality, of the Port of Beirut, coupled with Solidere will be crucial combination for the project to move forward.

Lebanese University is another important stakeholder to leverage. As a government-sponsored university that serves a large, primarily lower-income population, the need for affordable transportation options is essential. Located along the rail alignment to the south of the NBT Station, its campus was designed to incorporate transit service that it was anticipated would one day operate on the line. Transit service to the campus is a particularly important support for the newly expanded University, and would further improve the government investment in it, and the population to the south of Beirut.

The Lebanese Government, for better or worse, has embraced the private sector economy, and has privatized services typically provided by government agencies. Plans to fully privatize transit operations have been debated for several years, with no results. The privatization of operations and the relationship of the rapid transit line to the OCFTC will need to be determined prior to implementation. A successful privatization scheme will consider the complications of transferring employment, property ownership and development rights, regulation and enforcement of operational standards, and competition. The private sector can also be in important stakeholder in pushing the project toward implementation. Offering greater incentives such as development rights for commercial uses on station property and along the alignment, on vacant and under-used parcels, will increase competition for the contract and attract investment to the area.

7.2 IMPLICATIONS

As Lebanon's economy grows and it returns to its role as a major Mediterranean and Middle Eastern destination, the number of trips will also grow. Beirut's capacity to carry automobiles is approaching a limiting point. The need for a comprehensive high quality transit system is becoming urgent.

By employing urban planning and design methods from early in the route development process, the potential for creating a project that responds to the varied and disparate needs of the country, metropolitan region, and the adjacent neighborhoods is increased substantially. The purpose of transit facilities, or indeed transportation in general, to improve quality of life and accessibility, rather than as an end in itself is an important concept to incorporate into the planning process. Without it, there is the potential for transportation infrastructure to degrade the urban environment; unfortunately this potential is realized all too often. The concept of urban improvement can be taken one step further, beyond transit's purpose of improving quality of life through accessibility. By leveraging the transit investment to improve other aspects of the urban system within an integrated plan, synergies can be created; these not only allow the transit line to improve the functioning of the adjacent uses and wider metropolitan region, but the improvements in turn foster greater ridership and political support for the transit system. As support for the system grows, the government will place greater priority on its expansion.

8. CITATIONS

8.1 BIBLIOGRAPHY

Baaj, H (1999) A Plan for the Reform and Organization of the Land Public Transport Sector in Lebanon. Ministry of Transport: Republic of Lebanon.

Baaj, H. (2000). The Public Land Transport Sector in Lebanon. *Journal of Public Transportation,* 3(3).

Council for Development and Reconstruction. (1995) *Greater Beirut Transportation Plan.* TEAM International, IAURIF, SOFRETU. Beirut: Republic of Lebanon.

El Mkhalalati, M. (2001). Provision of an Adequate Public Transport System in Beirut. Canberra, Australia: Centre for Developing Cities, University of Canberra.

Fulton, L. (2001). Sustainable Transport: New Insights from the IEA's Worldwide Transit Study. Marrakesh: International Energy Agency.

Hanssen, J. (1998). "Your Beirut Is on My Desk:" Ottomanizing Beirut under Sultan Abdülhamid II (1876-1909). In P. Rowe & H. Sarkis (Eds.), *Projecting Beirut: Episodes in the Construction and Reconstruction of a Modern City.*(pp. 41-67). Munich: Prestel-Verlag.

Gavin, A., & Maluf, R. (1996). *Beirut Reborn: The Restoration and Development of the Central District.* London, England: Academy Editions.

Larwin, T. (1999) Urban Transit. In *Transportation Planning Handbook, 2nd Edition.* Publication # TB-011A. Washington DC: Institute of Transportation Engineers.

Ministry of Transport, Directorate General of Land and Maritime Transport. (2000). *Land Transport Policy Study.* Transport Systems Group, s.a.r.l. Beirut: Republic of Lebanon.

Ministry of Transport and Public Works (2003). Alternative Analysis and Preferred Alternative Report. *Beirut Suburban Mass Transit Corridor Feasibility Study: Final Report, Phase I.* DMJM+Harris Inc., IBI Group. Beirut: Republic of Lebanon.

Ministry of Transport and Public Works (2003). Mass Transit Plan for the Northern Corridor. *Beirut Suburban Mass Transit Corridor Feasibility Study: Final Report, Phase II.* DMJM+Harris Inc., IBI Group. Beirut: Republic of Lebanon.

Ministry of Transport and Public Works (2003). Evaluation of Options. *Beirut Suburban Mass Transit Corridor Feasibility Study: Final Report, Phase II.* DMJM+Harris Inc., IBI Group. Beirut: Republic of Lebanon.

Ministry of Transport and Public Works (2003). Network Analysis for Northern Entrance Corridor and Connectivity and Transfer Among Travel Modes. *Beirut Suburban Mass Transit Corridor Feasibility Study: Final Report, Phase II.* DMJM+Harris Inc., IBI Group. Beirut: Republic of Lebanon.

Mourtada, A. (July 1999) Rehabilitation of Public Transport. In H. Baaj (Ed.) *The Workshop on Land Transport Policy for Lebanon.* Ministry of Transport. Beirut, Lebanon.

Salam, Y. (July 1999). Institutional Set-up of the Transport Sector. In H. Baaj (Ed.) *The Workshop on Land Transport Policy for Lebanon.* Ministry of Transport. Beirut, Lebanon.

Transit Cooperative Research Program. (1996), *Transit and Urban Form (2). Report 16.* Washington DC: Transportation Research Board.

Transit Cooperative Research Program. (2000), Task 5 Report: Opening the Door to Fundamental Change. In *New Paradigms for Local Public Transportation Organizations. Report 58.* Washington DC: Transportation Research Board.

Wilson, T., Neff, C. (1983) *The Social Dimension in Transportation Assessment.* Cornwall, England: Gower Publishing Co.

World Bank. (2002). *Republic of Lebanon Update: Urban Transport Development Project.* Second Quarter.

Zegeer, J. (1999). Planning Approach to Capacity. In *Transportation Planning Handbook, 2nd Edition.* Publication # TB-011A. Washington DC: Institute of Transportation Engineers.

Sadek, S., Bedran, M., & Kaysi, I. (1999) GIS Platform for Multicriteria Evaluation of Route Alignments. *Journal of Transportation Engineering.*125(2). 144-151.

8.2 MAPS

Beirut: City Map and Guide. (2002). GEO Projects.

Charles Helou Station Plans. (1995). Gicôme, Antoine Salame & Associés, s.a.r.l.

Beyrouth. (1969). Ministère de la defense Nationale. Direction des Affaires Géographiques.

Orthophoto. MAPS Geosystems.

United States Central Intelligence Agency Map. (2004) Lebanon. Map #802857.

8.3 INTERVIEWS

All interviews took place in July and August, 2003, in Beirut, Lebanon.

Alam, Ghassan. Transportation Dept., Dar al Handasah, Beirut. August 2, 2003.

'Awad, Sayed. Property Manager, Office de Chemin de Fer et Transport en Commun. July 28, 2003.

Darwish, Fadi. Transportation Consultant. July 24, 2003.

Fawaz,Youssef. Operations Director, Al Majmoua; Former Transportation Engineer, Solidere. August 25, 2003.

Gavin, Angus. Urban Development Division Manager, Solidere. July 31, 2003.

Helou, Elie. Head of Transportation, Council for Development and Reconstruction.July 17, 2003.

Sarraf, Yacoub Riad. Governor, Mohafezat of Beirut and Mount Lebanon. August 2, 2003.

Semaan, Rami. Project Manager, Ministry of Public Works and Transport. August 27, 2003.

Massouli, Bassem. Head of Urban Planning, Dar al Handasah, Beirut. August 2, 2003.

Naaman, Ramzi. Project Director, Community Development Program, CDR. July 17, 2003.