NEW RIVER CROSSING REPORT

REPORT ON TUNNEL ALTERNATIVE

APRIL 2024

BDO

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Ben Rogers
Director of Transportation and Mobility
City of Fort Lauderdale, Florida
290 NE 3rd Avenue
City of Fort Lauderdale, FL 33301

Dear Mr. Rogers:

We ("BDO" or "BDO USA P.C.") are pleased to present this report for the scope of services performed by our team. This report encompasses the findings and recommendations regarding the New River Crossing (the "Project"), resulting from our execution of the limited statement of work. This report is presented to the City of Fort Lauderdale ("Client" or "City") for its exclusive use.

In performing the specified research for this report, we have accumulated data, prepared various analysis for our own use and the use of other members of the team. In addition, we have had various meetings and telephonic discussions with representatives of the City. All other data was obtained from publicly accessible sources at the time of publication, and are cited, when possible, throughout this document.

All figures, renderings, and costing within this report are approximations only. All design, construction timelines, costing estimates, and impacts will require additional effort. The delivery of a project of this scope will need significant work from various experts in several professional fields.

We stand by the information within this report to represent the situation facing the Project currently. This report should be used by the Client as a guide to future planning and better understanding of the challenges and opportunities associated with the Project. It has been an honor working with the City on the development of this report.

Again, this report is intended solely for the use of the City and should not be used by those who have not taken responsibility for the sufficiency of the procedures for their purposes. No other party, other than the Client, is authorized to utilize this report, or the data within, without the consent of the Client. No one should rely upon the information within this report for any management or financial decisions without additional support.

Very truly yours,

BDO USA, P.C.

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The data included in this report has been extracted from information provided to us by the Client.

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We do not warrant any assumption or projections to materialize.

We assume no responsibility and make no representations with respect to the accuracy or completeness of any information provided by and on behalf of the Client or any third-party related to the Project including but not limited to, technical, legal, etc. We are not required to give testimony or be in attendance at any court or administrative proceeding with reference to the business appraised unless additional compensation is agreed to, and prior arrangements have been made.

Our engagement is related to developing an initial Project alignment, provide cost estimates and develop an initial layout plan for project funding.

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LIMITATIONS ON OUR FINDINGS

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DEFINITIONS, ABBREVIATIONS AND GLOSSARY OF TERMS

Abbreviation	Meaning
AACE	Association for the Advancement of Cost Engineering
BCR	Broward Commuter Rail
BDO & Advisors	Includes BDO, Gall Zeidler & Ice Miller
BDO	BDO USA P.C.
BLVD.	Boulevard
CITY	City of Fort Lauderdale
CLIENT	City of Fort Lauderdale
COUNTY	Broward County
CRISI	Consolidated Rail Infrastructure and Safety Improvements
DDA	Downtown Development Authority
FDOT	Florida Department of Transportation
FECR	Florida East Coast Railway
FSP NATIONAL	Federal-State Partnership for Intercity Passenger Rail Grant (National denotes projects outside Northeast Corridor)
FRA	Federal Railroad Administration
FT	Feet (unit of measurement)

Abbreviation	Meaning
FTA	Federal Transit Administration
FY	Fiscal Year
IIJA	Infrastructure Investment and Jobs Act
INFRA	Nationally Significant Multimodal Freight & Highway Projects program
LCC	Life Cycle Costs
MEGA	National Infrastructure Project Assistance program
MN	Million
MPH	Miles per Hour
NATM/SEM	New Austrian Tunnelling Method/Sequential Excavation Method
NE	North-East
NW	North-West
O&M	Operations & Maintenance
PROJECT	Commuter Rail Infrastructure for New River Crossing
ROW	Right of Way
RRIF	Railroad Rehabilitation & Improvement Financing
SW	South-West

Abbreviation	Meaning
TBM	Tunnel Boring Machine
TIFIA	Transportation Infrastructure Finance and Innovation Act
US	United States (of America)
USDOT	US Department of Transportation

Abbreviation	Meaning
WE	BDO and its advisors
WHITEHOUSE REPORT	Final Report, NEW RIVER CROSSING Assessment of Alternatives Enabling Commuter Rail to Cross the New River on the FEC Corridor Issued: August 17, 2023
YoE	Year of Expenditure

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The purpose of this report is to support the City in development of an alternative Project alignment for New River Crossing, which is part of the larger initiative, BCR. This report provides an initial project alignment for a new tunnel alternative, which is shorter and thus more fiscally viable than the precedent tunnel alignments while addressing key issues related to resiliency, impact on existing train operations of the FECR, Brightline, and public and private properties. Additionally, a Level 4 Cost Estimate has been developed that includes the tunnel construction costs and O&M costs of the asset over its expected life as per the design. Lastly, this report provides an initial review of the potential funding options, which can be explored for this Project.

This report is divided into two distinct parts, the earlier part focuses on the technical details of the tunnel alignment, and the latter focuses on the cost aspects of the Project. This report begins with the assumptions used to develop the alternate tunnel concept and limitations on the information used to conduct the analysis. Subsequently, the report explores the technical details, including drawings and diagrams of the alternative tunnel alignment and station layout. The report then examines additional factors and essential criteria identified through stakeholder engagement, contributing to a holistic solution that is vital for the Project's sustainability and functionality. The report progresses to evaluate the Project's financial aspects, considering both costs and potential funding mechanisms to assess the economic viability of the approach. The concluding section of the report summarizes the findings and outlines future actions. Supplementary materials are included in the appendices to offer further detail and enhance understanding.

It is pertinent to note that the technical aspects of this report have focused on findings uncovered during critical stakeholder meetings with the County, MPO, FDOT, Brightline, FECR, and affected property owners. The Project parameters were established during these meetings and feedback was obtained. This feedback has remained an important input in the development of the tunnel alignment.

Project Alignment

The Project Alignment identifies the short tunnel conceptual design including the entry and exit portals. This tunnel alignment differentiates from other alternatives as it addresses the City’s and stakeholders’ priority that the marine industry, rail operators, businesses and communities are allowed to conduct “business as usual” during the construction phase, thereby minimizing any impact on operating systems, the neighborhood, and the public, and has limited impact on properties along the FECR’s corridor. Considering the Project is in the urban core of a very busy city, understandably, these requirements are the largest priority to allow continued growth in downtown Fort Lauderdale.

The technical aspects of this report, including the Project alignment and station configuration, focus on designing the infrastructure in a manner that considers how the infrastructure will interact with its environment, flow of pedestrian and commuter traffic, and minimizes impact on operations of FECR and Brightline, the marine industry, businesses, residents, and tourist experiences.

EXECUTIVE SUMMARY

The refined alignment presented in this report addresses the pilings under the existing bascule bridge over New River (shown in Figure 1), and the existing Brightline station located on 101 NW 2nd Ave, Fort Lauderdale, FL 33311. The new commuter station platform is proposed to be constructed using the innovative SEM to avoid any disruption to FECR and Brightline operations, and surface connectivity on Broward Blvd.

Figure 1: Bascule bridge on New River

Other Factors

As part of this report, issues pertaining to resiliency of the tunnel alternative and impacts on property in the downtown area were also evaluated. The City faces environmental challenges such as hurricane and severe thunderstorms and recently in 2023, the City saw unprecedented flooding. Modern tunnels are built for resiliency and the proposed tunnel can be a completely sealed system using flood gates, which are estimated to cost around $2.34Mn (including contingency) with underground water drainage systems to protect the tunnels in case of any unforeseen events. In addition to flood gates, tunnel sump/pump systems are also used to enhance resiliency.

The report also addresses the potential impacts on surrounding properties along the tunnel alignment only. While the entire Project alignment stays within the existing at-grade FECR corridor, however, to avoid the pilings of the existing bascule bridge, underground easements may be required on properties located NW, NE, and SW corners of the New River. Properties on the NW and NE corner of the New River are owned by the City and tunnel would be almost 55ft – 60ft under the ground level, therefore, subterranean access rights would be negotiated with the City. The owner of the property, which is located at the SW corner of the New River, is a private entity and the impacted area is not planned to be part of any future development. As per an initial conversation, the developer is highly positive and supportive of the tunnel and open to support the subterranean access required at the edge of the property. Additionally, options for staging areas required during construction were also evaluated and an estimated cost is incorporated in the capital cost of the Project.

Project Costs

This report provides the current Level 4 cost estimate for the short tunnel which is estimated at approximately $888Mn (2023 dollars) with an O&M cost of $1.9Mn annually (2023 dollars). In addition, costs related to various options such as Brightline platform and access to the existing train station, and an alternate excess to bus station for commuters are also developed. The Capital Cost YoE is provided for the Project and

EXECUTIVE SUMMARY

O&M for the entire life of the asset is also presented along with present value in today's dollar terms. As the tunnel design is based on the asset life of 125-150 years, the present value of the O&M is $240Mn (for 125 years) in today's dollar terms.

The report briefly touches on the potential funding options that require further exploration to develop a definitive plan. In addition to the FTA funding route, the report includes a non-FTA federal funding option along with federal and private financing options.

Conclusion and Next Steps

This report presents its findings and includes next steps, laying out activities needed to be undertaken to move the Project from concept to development. The next steps identify the broad stages the Project will move through to develop from concept to operations. Finally, the Appendices details further information.

In conclusion, this report demonstrates that crossing the New River by a tunnel with an underground commuter station is viable and economically feasible. The report covers the refined tunnel alignment and shows the station configuration, giving a clear picture from start to finish and explaining how the infrastructure will act with its surroundings. This is important to envisage and address at this stage to understand the urban environment and conditions the Project will operate under. The technical details regarding how the Project will be built and designed show how much thought has gone into making sure businesses and daily life in the City are not disrupted during construction. Importantly, the Project will stand up geotechnical and environmental challenges like poor ground conditions and flooding. Further, the Project will impact the property values and surroundings. The financial portions of the report clearly state how much the Project might cost and how it could be paid for, pointing out ways to save money and make the Project more viable.

SECTION 2

INTRODUCTION

INTRODUCTION

Purpose

The purpose of this engagement is to support the City on further defining the New River Crossing (the “Project”). The City considers a tunnel as a locally preferred alternative, subject to fiscal viability. This report proves that the tunnel is viable and fiscally feasible by providing a shorter tunnel alternative with a lower cost compared to previous studies that rendered the tunnel concept more challenging due to the high cost. The report not only addresses a new project alignment and provides a Level 4 Cost Estimate but also addresses significant design areas such as pilings and impact on private properties. Additionally, the report proposes a path to a funding solution, which requires significant additional work but an assurance from federal agencies exists to support the Project if all parties can agree to a unified solution. This report is a first step towards developing innovative solutions for Project conceptualization and delivery and not the final plan.

Background

The initial scope of the engagement included the development of Project definition including route alignment, entry points, location of a station and development of order of magnitude capital and operating cost estimates including a high-level land acquisition cost (if applicable), ancillary project development costs. In addition, the scope intended to identify studies required to facilitate federal application requirements or Project development, coordination with federal agencies, development of a broad project structure, stakeholder feedback and summarizing findings of an alternate tunnel concept.

This report presents a comprehensive overview of the modified tunnel system, which addresses the feedback obtained. The result is a revised project alignment that is sensitive to the needs and concerns of key stakeholders. This report includes an updated station configuration, showcasing a design that ensures the uninterrupted operation of the existing railroads. The station platform has been planned to be entirely underground within the existing ROW, and includes a new platform location, strategically moved to avoid existing piles situated beneath the Brightline station.

The future Government Center, located on 201 W Broward Blvd, is anticipated to serve as the location for the station entrance, featuring an access building on the surface to house the necessary facilities. From there, escalators and elevators will lead to a lower-level mezzanine. The mezzanine will connect to a central platform station with two tracks, one on each side. The construction will utilize the NATM known in the US as SEM, ensuring that the current station and the railroad operations remains fully operational during the construction phase. The station location and configuration provide an opportunity to create a muti-modal transportation hub with direct connection to Brightline, the bus center, and potentially adjoining developments.

INTRODUCTION

Methodology

The focus for developing a tunnel alternative included the exploration of the feasibility and planning for the Project, specifically aimed at enhancing transportation connectivity while addressing concerns related to urban development, environmental impact, and community quality of life. This report broadly looks at three different areas such as the:

- Refined Tunnel Configuration: Proposed tunnel alignment avoids the potential interference with the piles supporting the existing bascule bridge. The proposed conceptual design meets the railroad design criteria in term of grade, curvature, and clearances. However, it would require for a short distance of a 4% grade over 600 feet on the south side exceeding Brightline's preferred maximum grade of 3%. Based on track design, it is acceptable for passenger trains to exceed the 3% grade for a short distance. This was later confirmed by Brightline's operations team. The tunnel alignment was developed to be completely within FECR ROW with no tangible impact on other private properties. The design was developed to allow the construction of the tunnel with no disruption to FECR and Brightline operations, and a minimal impact on existing street traffic and the public.
- Other Factors: The report incorporates solutions to address South Florida's weather-related challenges so that resiliency is at the core of the infrastructure design. To address the resiliency issue, the proposed design incorporates flood gates similar to Port of Miami Tunnel and many other tunnels in the United States such as the Hugh Carey and the Queens Midtown Tunnels in New York, Bankhead Tunnel in Mobile, Alabama, the Blue Line subway in Boston, and several of Hong Kong Metro Tunnels, etc. The report also looks at impacts for property owners, transportation agencies, and the community at large. Positive interactions with stakeholders, including discussions on subterranean property access rights and potential impacts, are emphasized as crucial for the Project's success.
- Financial Considerations and Funding Solutions: The financial aspects of the tunnel project are addressed, with a focus on the capital cost estimates, O&M estimates and other cost scenarios, potential funding sources, and innovative financing strategies. The report includes details regarding federal grants, and value capture mechanisms to support funding the Project.

Overall, the report aims to present a comprehensive overview of the proposed tunnel Project. The tunnel concept presented takes into account critical input received by the County, MPO, FDOT, FECR, Brightline and other stakeholders for Project development. This helped refine the BDO's understanding of the Project goals and to look at viable solutions that satisfy all stakeholders.

SECTION 3

ASSUMPTIONS

ASSUMPTIONS & LIMITATIONS

Throughout this review of the Project, BDO relied on a specialized set of assumptions to provide a baseline for this work. These assumptions are standard industry practice for a study at this level, and any additional information can be provided upon request. Investigations and additional data collection will be required in future phases of the Project. For this report, we relied on the following primary assumptions and bounds by the limitations of scope, available information, ability to perform additional studies, and tight timeline and budget allocated by the City. The technical study which was conducted to arrive at the tunnel alternative has been summarized in this report.

Tunnelling design

- No topographical survey was done or available, Google Earth was used for the alignment layout.
- No geotechnical investigations were done. Any geotechnical information is based on USGS and boring data from two adjoining development sites.
- No utility drawings or data from FECR or the public and private utility owners were available.
- No design drawings of the bascule bridge or Brightline Station and platform were available. We relied on information conveyed verbally or publicly available information.
- Initial coordination meetings were held with FECR and Brightline railroads. Further in-depth coordination and interfacing is needed to further refine the alignment.

Railroad System Design

- Size, configuration and clearance diagram of the rail vehicle and the locomotive are unknown at this stage.
- Train configuration, number of cars per train, the propulsion system, track system, signal system, etc. are unknown at this stage.
- Rail operation system and rail operating plan are unknown at this stage.
- Tunnel dimensions (diameter) were developed assuming a comparable commuter railroad vehicle.

Station Design

- The station for commuter rail is proposed at the new Broward County Government Center. However, we received no confirmation from the County whether a Government Center or a commuter rail station will be developed at this location. It is noted that the County is still considering whether to build a station at this location or not.

ASSUMPTIONS & LIMITATIONS

- Platform length is indicative and based on final requirements provided by the Commuter Rail and Brightline. The current platform length is based on standard practice across different metro and inter-city rail systems within US and other stations along the project alignment.

Project Cost: Capital and O&M Costs

- Level 4 Cost Estimates are based on the Project alignment presented in this report and are based on initial design.
- Year of Expenditure Cost: An indicative forecast of expenditure has been developed which is in line with projects of similar nature. A more realistic spend forecast can only be developed once the design levels have advanced significantly.
- Staging Site Cost can vary from $0 - $20Mn, depending on the preferred location agreed and whether the sites are leased or purchased.
- Within this report the total Project costs, for neither a tunnel nor bridge solution, include FECR ROW access costs.
- Within this report all New River Crossing options consider a static County financial contribution to the Project.
- Within this report all New River Crossing options consider a static FDOT/State financial contribution Project.
- Within this report all Federal Grants related to tunnel are from Non-Federal Transit Administration sources.
- Notably funding options are laid out and in no way conclusive at this early stage of Project development unless pursued with a strategic approach. Due to strong community connectivity and social justice components, it is our opinion that the case for federal funding is strong due to its impact and importance on the North-South connectivity in the City and the County.
- In the case of utilization of federal financing or adoption of innovative delivery mechanism for project procurement, creative revenue streams such as value capture, inter-local agreements and other revenue sources can be utilized to support the project's funding needs.

SECTION 4

PROJECT ALIGNMENT

TUNNEL ALIGNMENT

Introduction

The rise in tunneling and underground construction within urban areas globally is driven by factors such as population growth, urban migration, the pursuit of resilient and sustainable cities, and the demand for efficient, cost-effective, and eco-friendly transportation and infrastructure solutions. Constructing underground minimizes environmental, property, and visual impacts while reducing surface disturbances. Moreover, there's an increasing public interest in leveraging subterranean spaces for infrastructure, freeing up surface areas for parks, recreational facilities, and public amenities with minimum disruption to the development happening in the downtown Fort Lauderdale.

Given that the Project is in the urban core Fort Lauderdale downtown area, the Project methodology had to be driven by construction methods that don't disrupt traffic, and necessitate utility relocations or support, create serious impact on local businesses and residents, and expose the community to noise, dust, vibrations, and overall reduce the quality of life during the construction phase.

These challenges can be overcome through the application of planned tunneling techniques, leveraging advanced tunneling technologies, enhancing safety measures, and optimizing construction efficiency, employing strategic excavation and support sequencing, implementing necessary ground improvements, and utilizing comprehensive instrumentation and monitoring systems.

Alignment is a critical factor in tunneling projects, it dictates the path the tunnel will follow, both horizontally and vertically, and is influenced by factors including the geometrical requirement of the railroad, railroad operation requirements such as speed and length of train, geological conditions, the location of proposed rail stations, connections to existing infrastructure, and the presence of existing underground structures and utilities and the available or ROW space. The importance of alignment stems from its impact on the feasibility, safety, and cost-effectiveness of the tunnel construction. In developed urban settings, where space is limited and the underground landscape is filled with existing structures and utilities, horizontal alignment must avoid underground obstacles yet meet the railroad geometrical and operational requirements. This approach allows the project to minimize disruptions to the surface and avoid the need for extensive above ground or sub-surface property acquisition, which can be costly and time-consuming.

The choice of alignment directly influences the selection of construction methods and tunnel structures. In developed settings TBMs are often favored. These machines are adept at tunneling through all different soil types with minimal risk to adjacent buildings and utilities. However, SEM may be more suitable in certain conditions, such as when dealing with non-circular or large diameter openings such as a station or cross passages, poor subsurface conditions, or specific obstruction constraints[1]

[1] STRUCTURE magazine | Geo-Structural Challenges for Advancing Tunnel Design and Construction

TUNNEL ALIGNMENT

The underground station configuration explains how this infrastructure will interact with its environment. The station configuration provides a detailed overview of the new underground station design and features ensuring operational continuity of the existing railroad. Also, within this section, specific concerns are addressed that consider the existing infrastructure and how the infrastructure can complement the Brightline Station, new development and freight operations without disrupting existing Brightline station piling.

While the construction of the tunnel is proposed to be with a TBM, the station construction method SEM is proposed to be used to minimize disruption to FECR and Brightline operations. For businesses, this means that access to storefronts, customer traffic, and delivery routes can be largely maintained, preventing economic losses. For tourists, since the construction is underground, there will be limited noise and air pollution above ground, this is important for a city like Fort Lauderdale that hosts the annual boat show and welcomes over 13,000,000 visitors annually[2]. The focus of the technical approach has been to integrate the infrastructure and work within existing parameters, this section answers how the goal can be achieved. Furthermore, SEM's adaptability to different ground conditions makes it viable for the Project's urban settings where underground utilities and existing infrastructure must be protected and economic vitality of the area can continue, all while progressing toward the timely completion of the critical infrastructure. Several drawings and views are presented in this section to better illustrate the technical aspects.

Some key terms used in this section are defined below:

Tunnel-Boring Machine

A TBM is a sophisticated machine that can dig full-face tunnels underground and install the tunnel structural liner at the same time; this means it is done in a single mechanical operation by drilling and installing the concrete support structure. They work in a variety of terrains and geological settings, from sedimentary and volcanic rock to sandy or clay soils.

Cut & Cover and Open Approach (U-Section)

Cut & Cover tunnelling method is as its name implies, is the construction of the tunnel by excavating from the top, building the tunnel structure, then backfilling over the tunnel structure. The Open Approach (U-Section) is similar to the Cut & Cover in that the surface is excavated from the top, and the structure is built within it in a U-Shape configuration to allow the tracks to descend/ascend from underground to the surface.

[2] Visitors | City of Fort Lauderdale, FL

TUNNEL ALIGNMENT

SEM Method

- SEM or referred to it in Europe, as the New Austrian Tunnelling Method (NATM) is construction of tunnels and underground structures using mining methods without excavating from the surface (Cut & Cover) and without a TBM. It relies on the capability of the ground to support itself (or enhancing its capability to support itself) until the final tunnel support is placed.
- SEM is a concept that is based on the understanding of the behavior of the ground as it reacts to the creation of an underground opening. In its classic form the SEM mobilizes the self-supporting capability of the ground to an optimum thus achieving economy in ground support.
- The SEM offers flexibility in geometry such that it can accommodate almost any size or shape of opening. The regular cross section involves generally a curvilinear shape to promote smooth stress redistribution in the ground around the newly created opening. By adjusting the construction sequence expressed mainly in the excavation round length, timing of the initial support installation and type of support, it allows for tunneling through rock, soft ground, and a variety of difficult and mixed ground conditions.
- The SEM offers several advantages including flexibility in dealing with various ground conditions yet minimizing surface disruptions.
- Its phased approach allows for immediate ground stabilization, which is essential for the safety and efficiency of the construction process.

Understanding that one of the challenges can be construction in the urban core, Appendix F graphically shows various stages of construction and explains how the Project will move from existing state to completion.

PROJECT ALIGNMENT - FROM SISTRUNK BLVD. TO SW 7TH ST.

Tunnel Alignment

As shown below, the short tunnel alternative initiates its alignment at SW 7th Street. With this alignment, the existing northbound and southbound tracks will be split using rail switches and placing new tracks on the outside of the existing at-grade FECR tracks, terminating before Sistrunk Boulevard (NW 6th Street). The new tracks will start at the surface by placing railroad switches, then descend underground using open approach "U-shape" structure until its depth reaches a point where a top slab can be placed, and the structure becomes a Cut and Cover.

The strategic separation of the existing tracks, with additional tracks to the east and west of the existing FECR tracks placed on the outer sides allows the construction of the new tracks within the existing FECR ROW with no impact on the existing railroad operations. Furthermore, the placement of the new tracks east and west of the existing tracks allows the alignment to avoid the existing bascule bridge's piling. To achieve that a slight variation in the horizontal alignment using large radii curves at the New River Crossing allow the alignment to bypass the bridge piles. This will ensure that there is no interference with the structural integrity of the existing pilings*; additional details are provided within this report*. Thereafter, the tracks reconverge, running parallel to each other once again, and continue seamlessly through the station area. This approach not only preserves the existing infrastructure and the railroad operation but also enhances the operational aspects of the tunnel system.

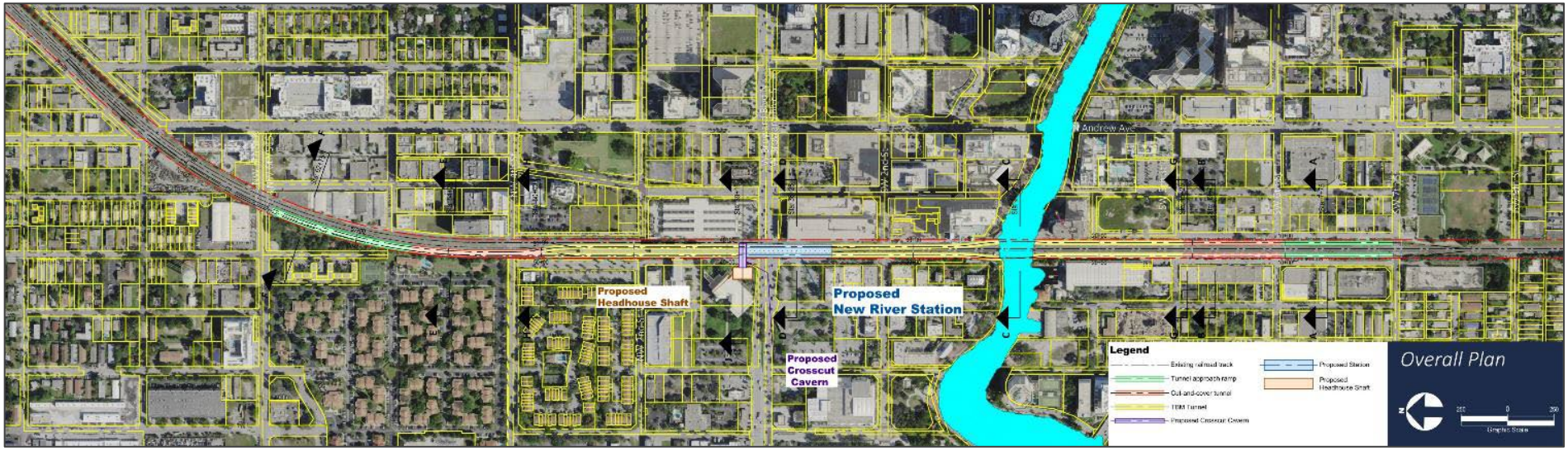


Figure 2: Tunnel Alignment from Sistrunk Blvd. to SW 7th St.

TUNNEL PROFILE

The tunnel's profile is a strategic design to allow ease of operation, minimal impact on existing railroad operation, and minimal impact on cross streets. The tunnel profile provides for near level conditions at the point where the station platform is situated beneath Broward Blvd. At the deepest point the track level is at elevation -55 (55 ft below mean water level). The gradient of the tunnel then increases beyond the mezzanine level of the station toward north with a maximum grade of 3%. The only deviation from the 3% grade occurs at the entryway on the south side of the tunnel, where the gradient slightly increases to nearly 4% for a short distance between SW 7th Street and SW 6th Street. This limited increase in grade is acceptable to stakeholders and is in line with industry standards.

The Northern and Southern Segment profiles can be found in Appendix C.

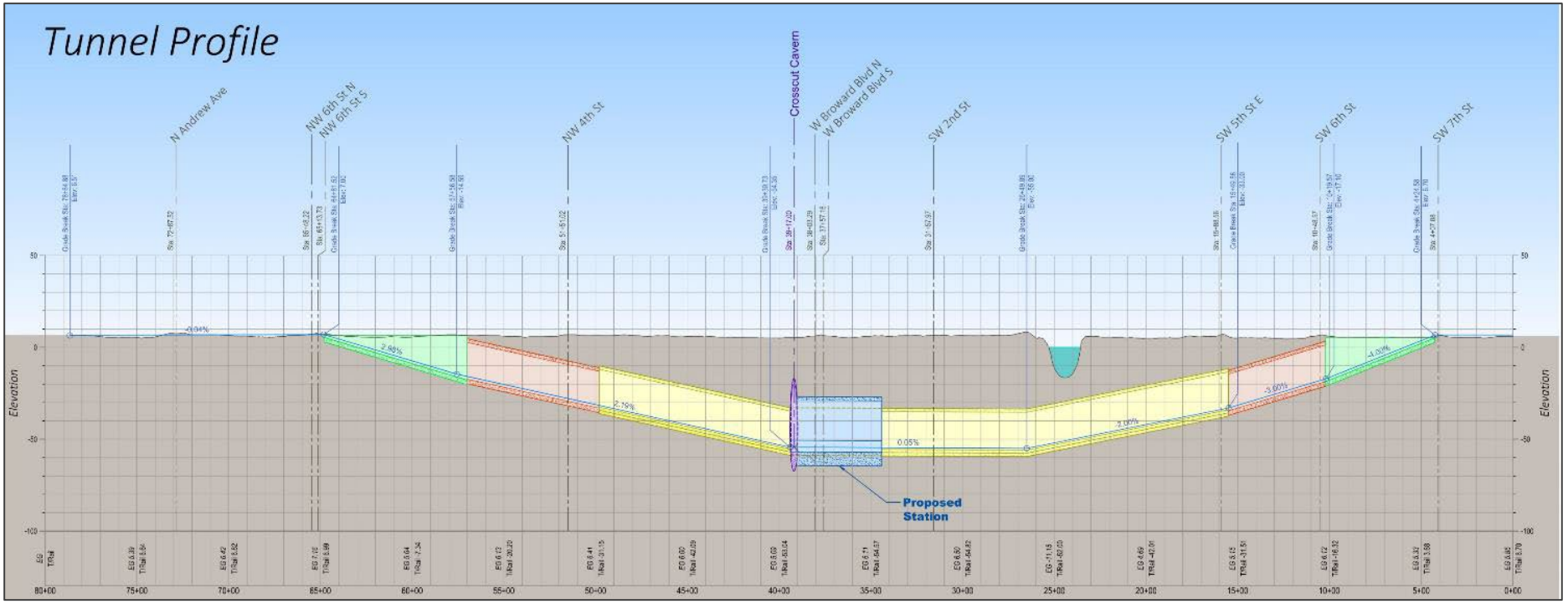


Figure 3: Tunnel Profile

SOUTH SEGMENT – STARTING AT SW 7TH ST.

The image below illustrates the tunnel approach from SW 7th Street. It depicts the new track splitting from the existing tracks using rail switches located on the surface between SW 9th St and SW 7th Street. The green portion illustrates when the new tracks start descending in an open cut (U-Shape) structure north of SW 7th Street (in green). At the south side of SE 6th Street, the tunnel will be in cut and cover configuration allowing traffic on SE 6th Street to be over it (in red) and enter the portals (portal entry at the point where red lines meet green lines). The portal location is where red lines meet yellow lines. The existing FECR tracks will remain at grade and SW 7th Street will also be at grade allowing free flow of traffic.

Figure 4: Tunnel Approach

CROSS SECTION – SOUTHERN APPROACH STRUCTURE - SW 7TH ST. TO SW 6TH ST.

- The cross section illustrates the depressed section when the rail starts to depress before entering into the tunnel portals.
- The FECR ROW Line is defined in blue lines.
- It is important to note that the construction of these structures will be within the FECR railroad ROW and will have no impact on the existing railroad operation or private properties.

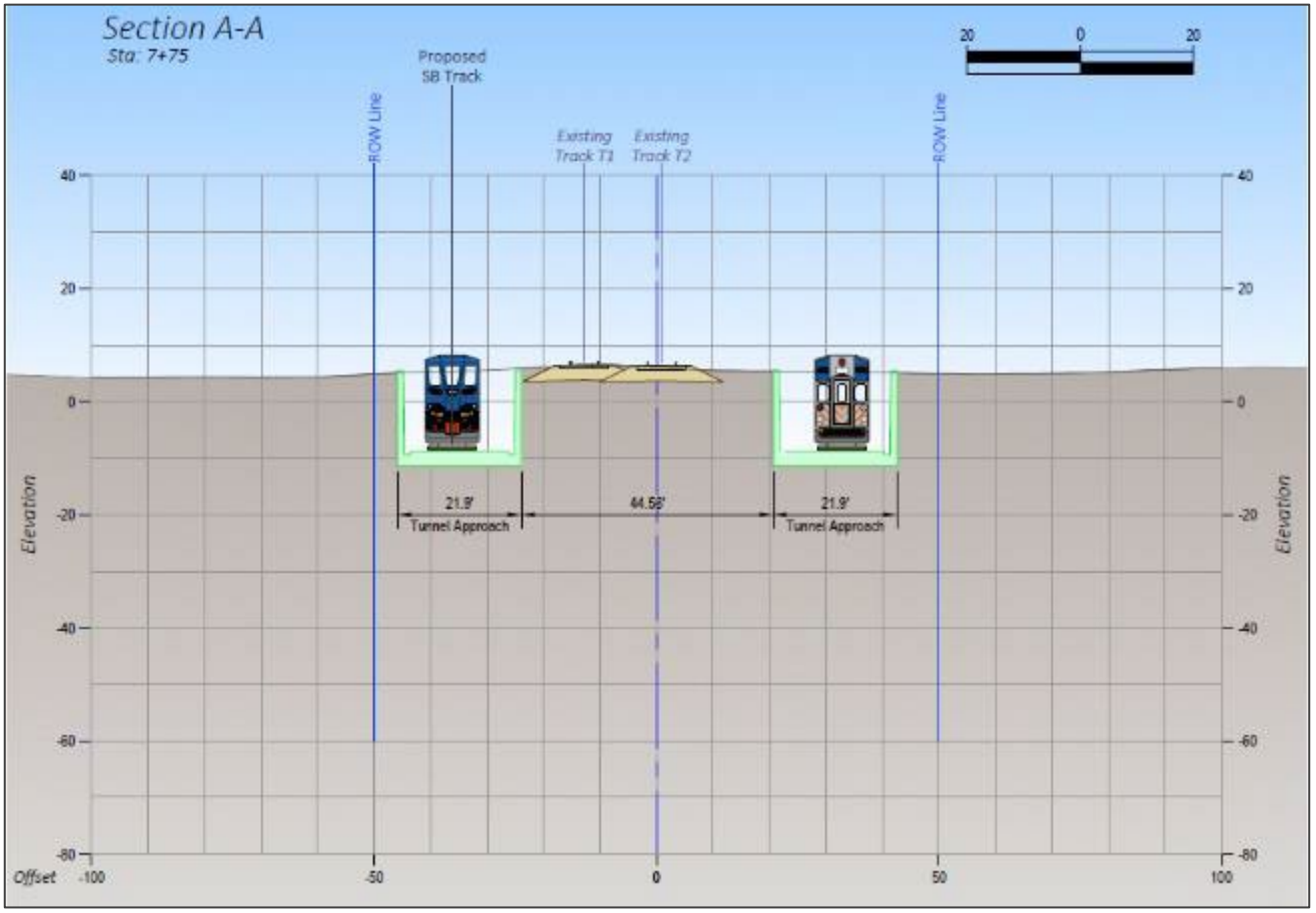


Figure 5: Cross Section A-A

CROSS SECTION – SOUTHERN APPROACH STRUCTURE – SW 6TH ST. TO SW 5TH ST.

- The cross sections illustrate the cut and cover sections with respect to the existing tracks and the existing ROW.
- It is important to note that the construction of these structures will be within the railroad ROW and will have no impact on the existing railroad operations and private properties.

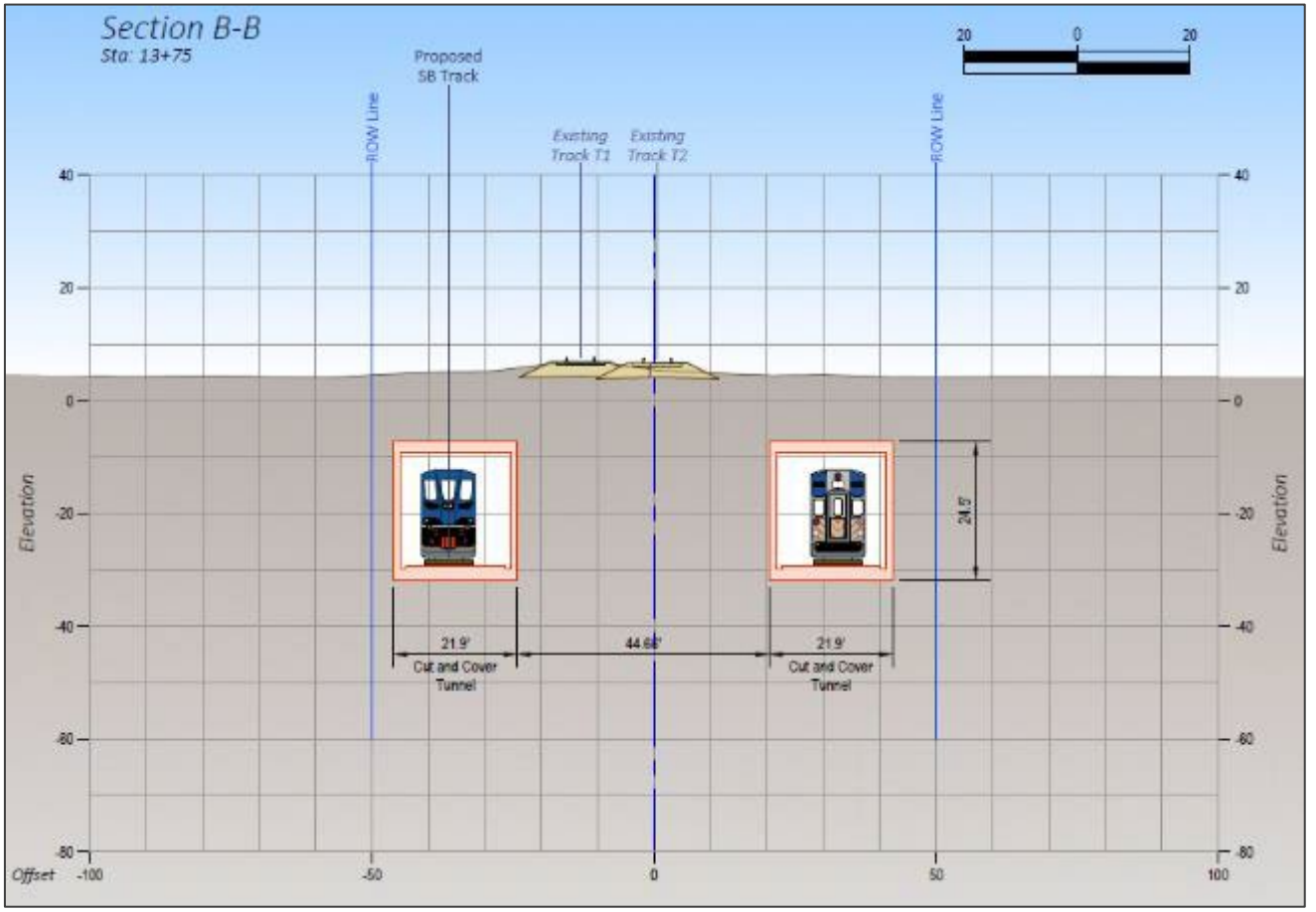


Figure 6: Cross Section B-B

CROSSING NEW RIVER & STATION LOCATION

The track alignment underneath the New River is shown below:

- This track alignment allows for the tunnel to avoid any conflict with the existing bascule bridge pilings leading to no impact on the piles supporting the existing New River bridge.
- This design is mostly in public or railroad ROW, with a minimum need for a single private subterranean access as shown later in the report.
- The tunnel construction under the river will be done using TBM with no impact on the marine traffic, existing structures, or adjoining facilities.
- The proposed station mezzanine and platform will be located under Broward Blvd and the mezzanine cross-cut cavern proposed at the site of entrance.

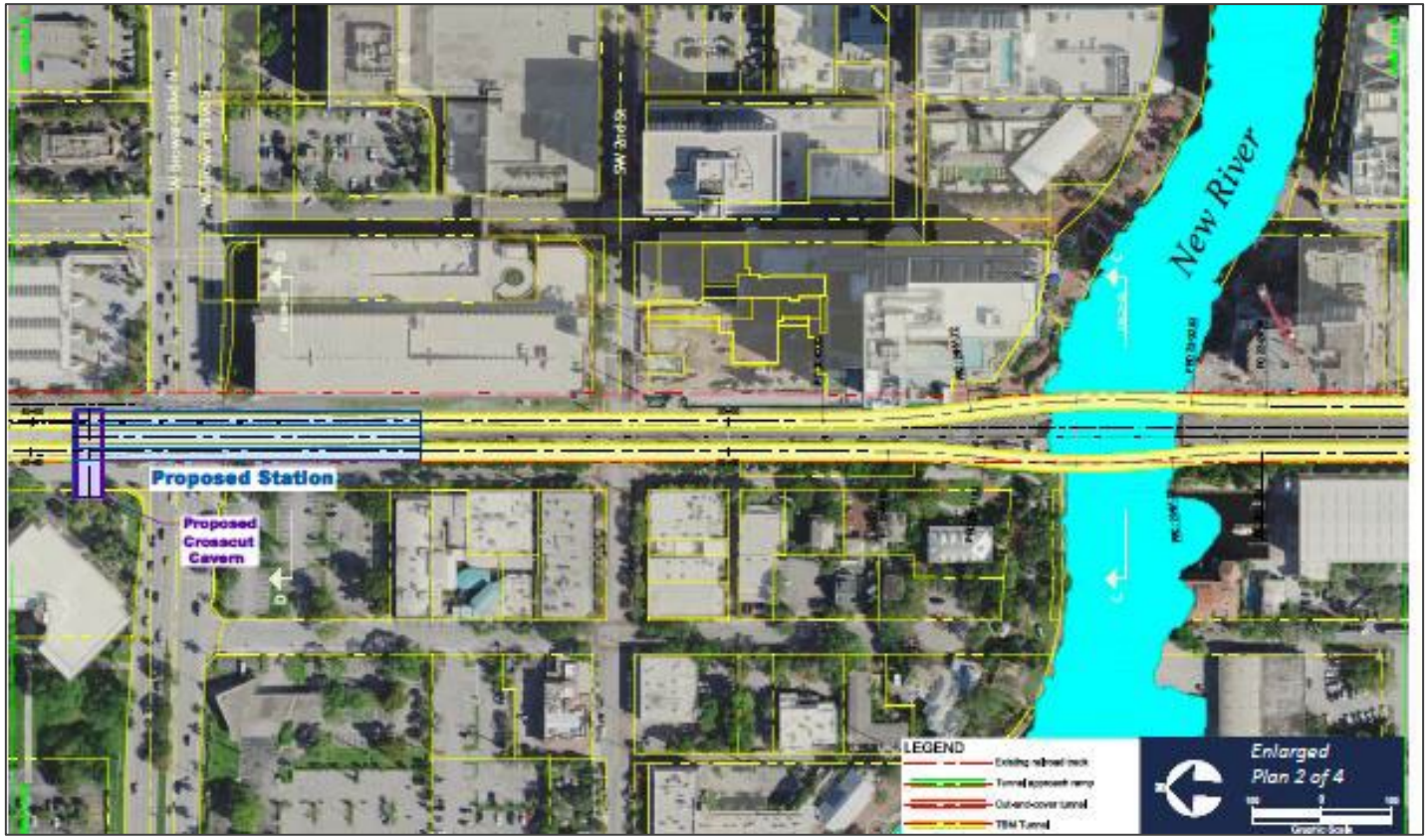


Figure 7: Alignment Under the River

STATION LOCATION

- The station will be constructed using SEM tunnelling. An access shaft will be located at the site of future County Government Building, connecting to an underground mezzanine, which connects to the platform area located under Broward Blvd.
- The construction of the station platform will not impact the existing traffic or facilities under Broward Blvd.
- For details, refer to Station Configuration

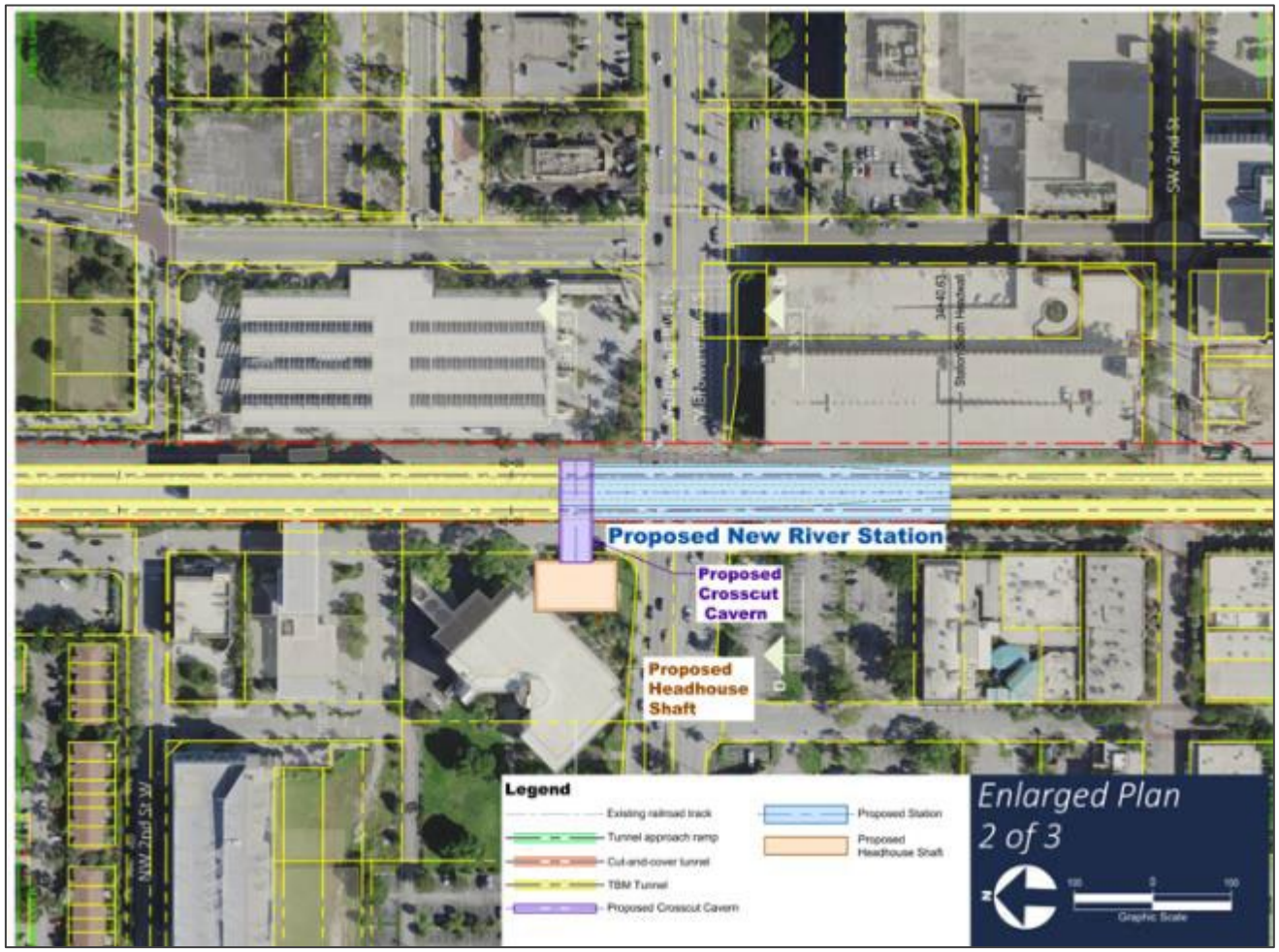


Figure 8: Station Drawing

CROSS SECTION – TBM TUNNEL CROSSING THE NEW RIVER

- Cross section shows the tunnels crossing the New River and diverting around the current bascule bridge pilings.
- This approach allows operation of the existing FECR and Brightline unhindered and no impact to existing pilings of the bridge.

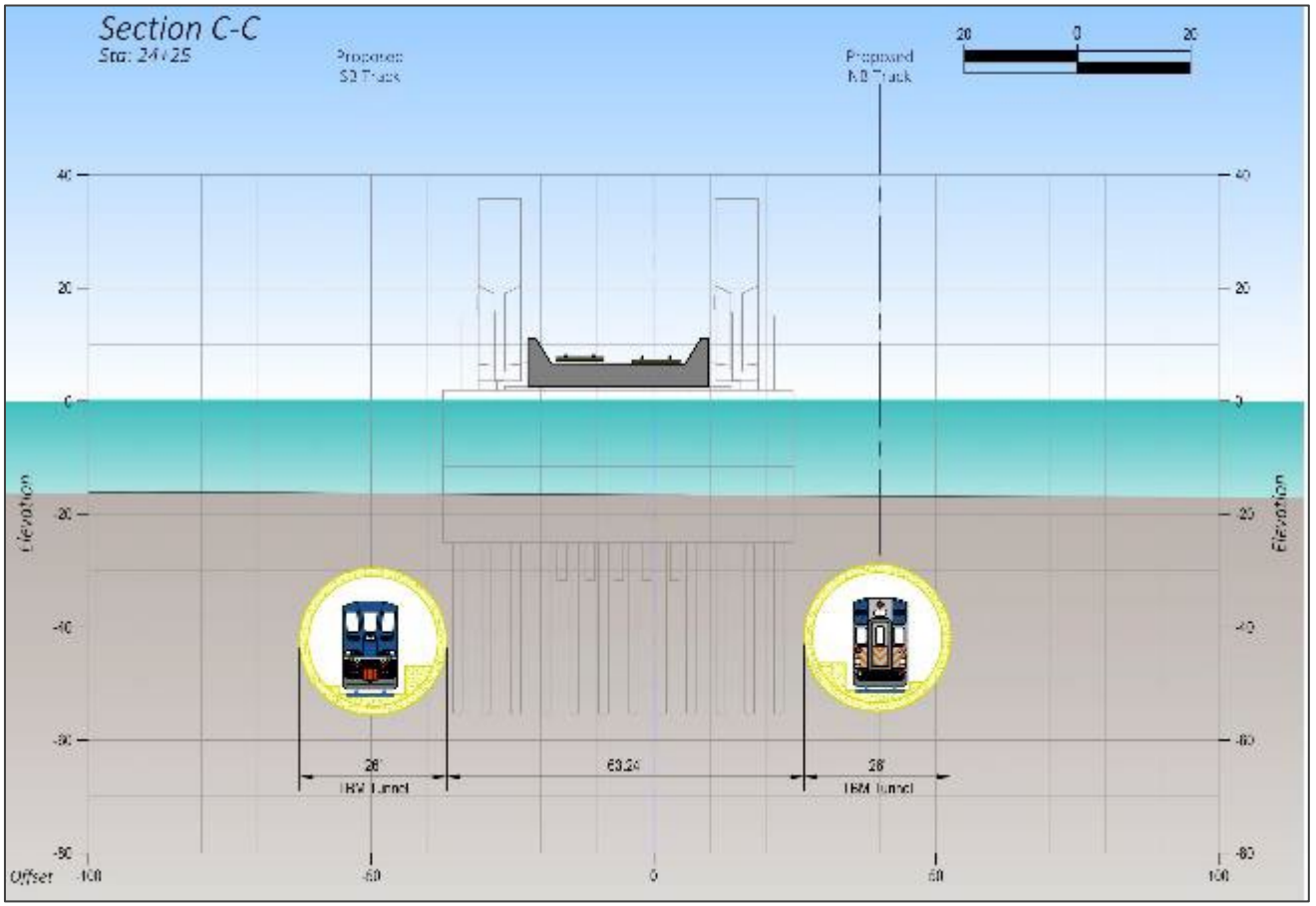


Figure 9: Cross Section C-C

CROSS SECTION AT THE STATION - SEM

The configuration of the rail at the station is shown.

- At this point, three tracks will be operational on the surface as the construction will take place underground.
- The two TBM tunnels will be constructed first, then the station will be constructed by enlarging the tunnels using the SEM method.
- Construction access, material handling, and muck removal will be done from an off-site site using a crosscut structure which will become the mezzanine of the station. More details are provided later in this report.
- The entire station platform, and mezzanine are located in the FECR ROW with no impact on the adjoining structures or private properties.

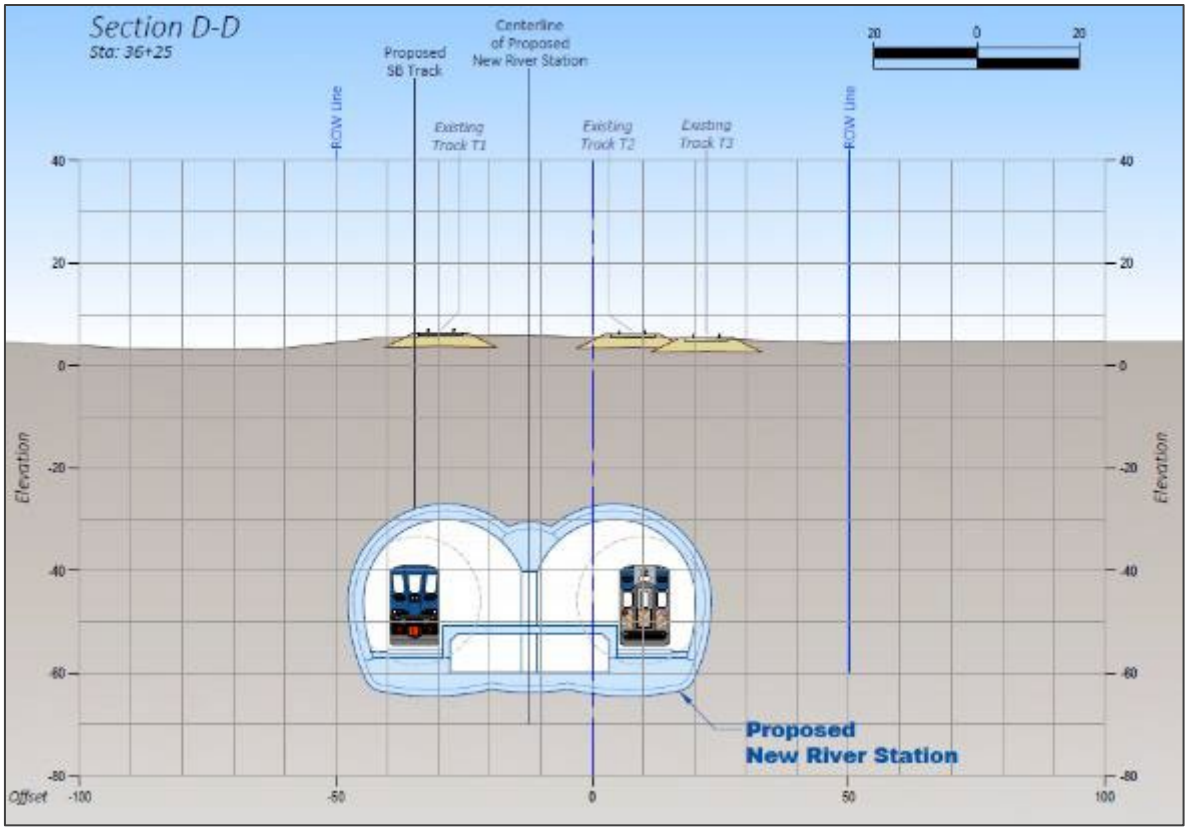


Figure 10: Cross Section D-D

NORTHERN SEGMENT JOINT TRACKS

- In this section, the eastern track will divert westward and join the western tracks in a common cut and cover structure (red).
- This allows the existing railroad operation during construction interrupted and allows for having three tracks at the location of the existing Brightline station for FECR bypass track. The two new tracks will be in a common cut and cover structure and in a common open cut (U-Shape) structure. A single portal will be provided at the north between NW 4th Street and NW 5th Street. The portal location is depicted where the green and red sections meet.
- The open cut (U-Shape) structure terminates just south of Sistrunk Blvd., and the tracks will continue on the surface until they merge with the existing FECR tracks, north of NW 7th Street.

Figure 11: Northern Segment Joint Tracks

CROSS SECTION – NORTHERN CUT & COVER – COMBINED TRACKS AT NW 4TH ST

- In the cross section, the north bound and the southbound new commuter railroad tracks will be in one cut and cover box structure.

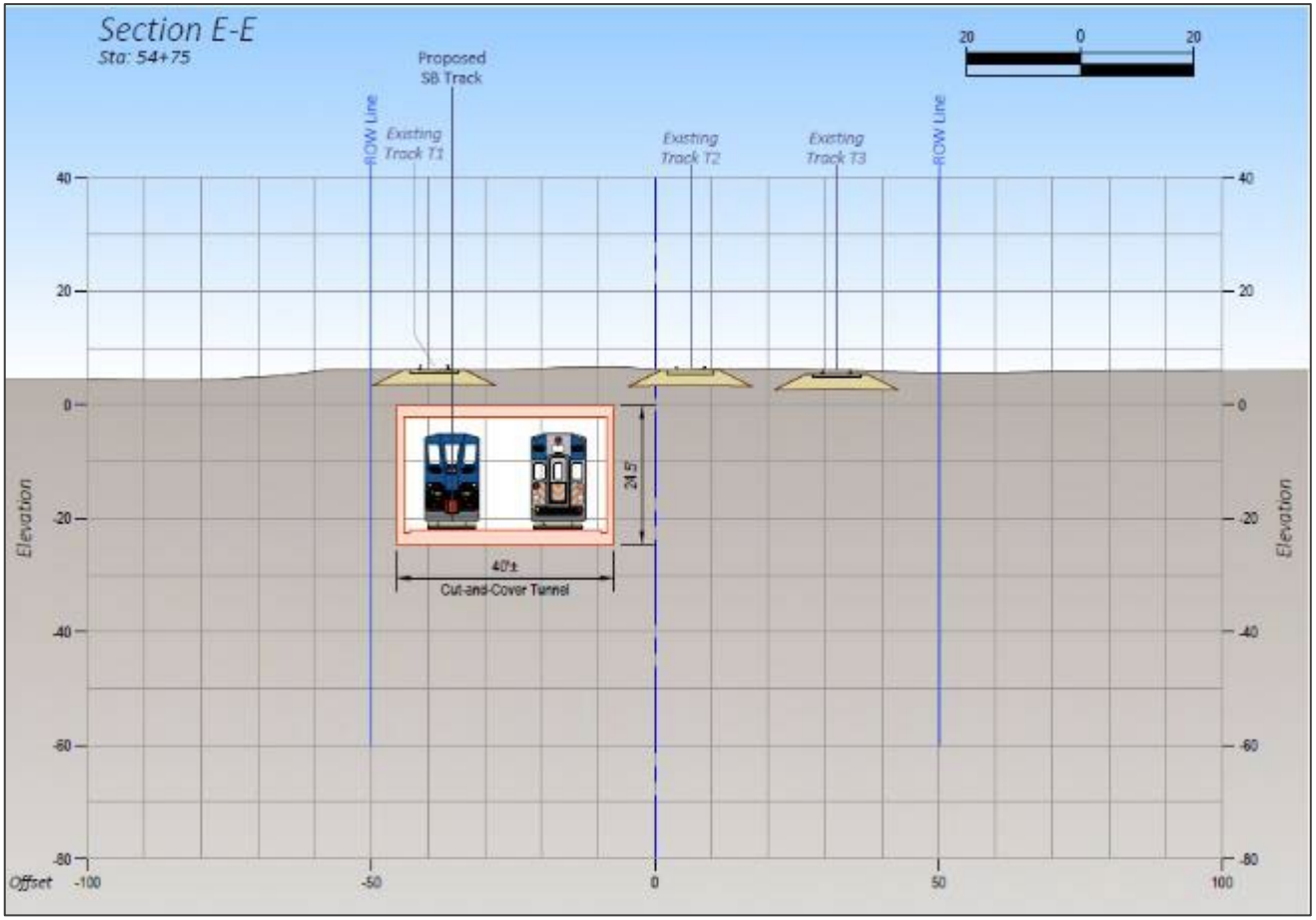


Figure 12: Cross Section E-E

CROSS SECTION – COMBINED TRACKS IN NORTHERN OPEN APPROACH

- In the cross section, the north bound exists the portals and approaches the Sistrunk Blvd in the depressed section before reaching at grade just south of Sistrunk Blvd.

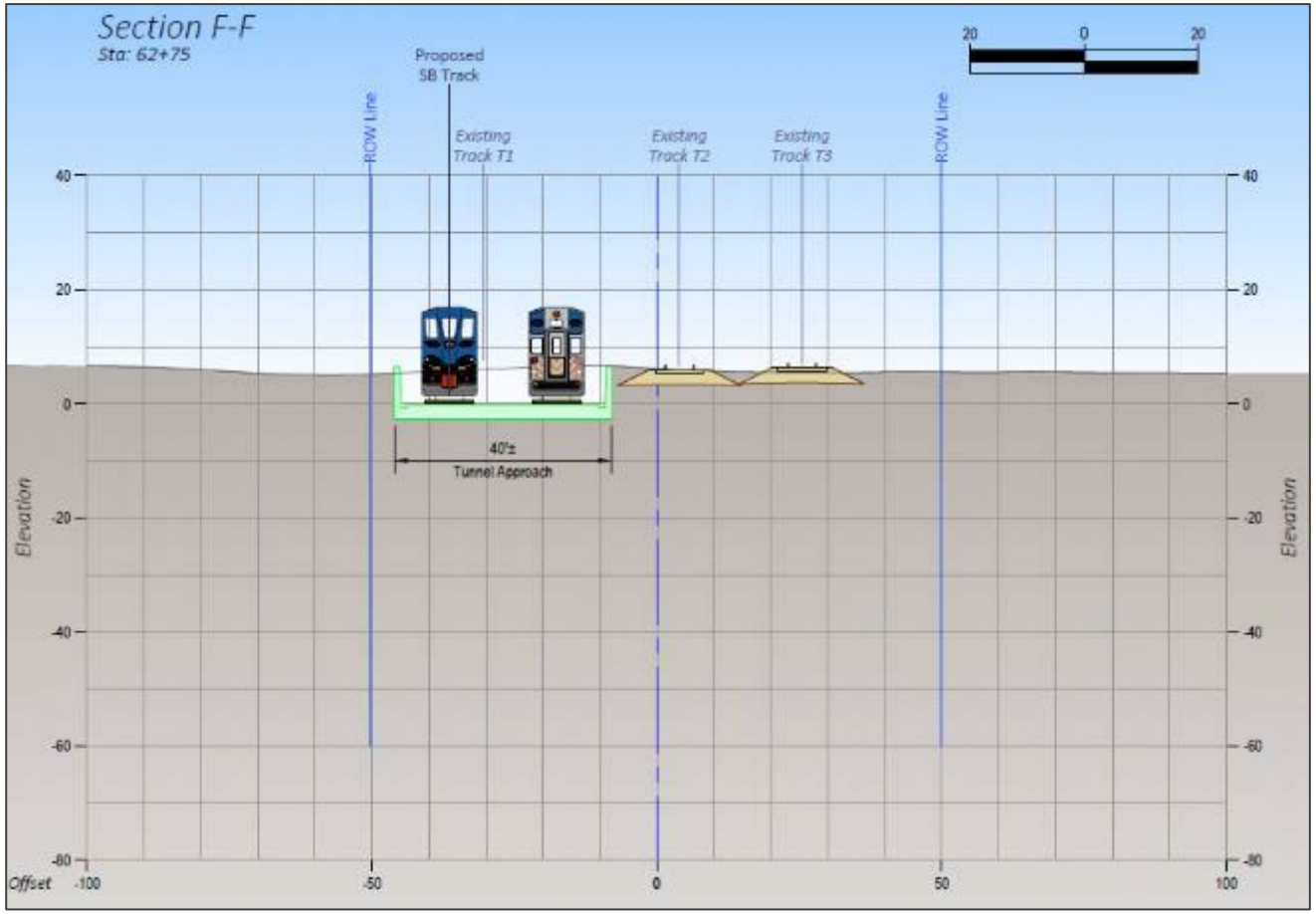


Figure 13: Cross Section F-F

NEW RIVER CROSSING – RETAINING EXISTING BASCULE BRIDGE OPERATIONAL

The initial design assumed that the tunnel would intersect with the piles under the existing bascule bridge to stay within the existing ROW. The proposed solution was to replace the impacted piles while strengthening the remaining piles with additional underpinning additional new piles. However, this was considered to result in a potential impact on the existing railroad operations and reluctance from the existing rail operators to accept this concept. Therefore, a new approach was adopted to locate the tunnel crossing the New River away from the bridge piles by adjusting the horizontal alignment by introducing horizontal curves.

Criteria used for horizontal alignment:

- Define the possible route alignment that would be most likely used for a crossing of the New River that will be feasible and have no impact on the existing railroad operations.
- Provide a suitable alignment that will not impact the existing bascule bridge structure, piles, and its operation, yet acceptable for commuter rail operations.
- Examining all existing subterranean ROW or underground easements required for the Project.
- Throughout this report, BDO has explored 'Encroachments' but they are merely underground easements/subterranean rights with no above the ground impact on the existing or future properties near the Project.

The next section of this report shows the configuration to avoid the existing bascule bridge piling requiring a subterranean ROW or underground easement. In order to avoid impacting the existing bridge pilings, we introduced horizontal curves of the northbound and the southbound tracks. The tightest curve has a radius of 1,100 ft allowing normal operating speed with suitable track superelevation and providing train speed of 45 MPH.

HORIZONTAL ALIGNMENT - OVER THE NEW RIVER

- The layout includes underground easements (highlighted in red) that extends into three properties: two are owned by the City, and one is privately owned. The most significant underground easement occurs on NW property, which is city-owned.
- The privately owned property on the south-west of the river, consists of a triangular shape underground easement that measures 9 feet at its widest point and extends 112 feet along the property's length.
- Encroachments are underground easements or subterranean ROW.

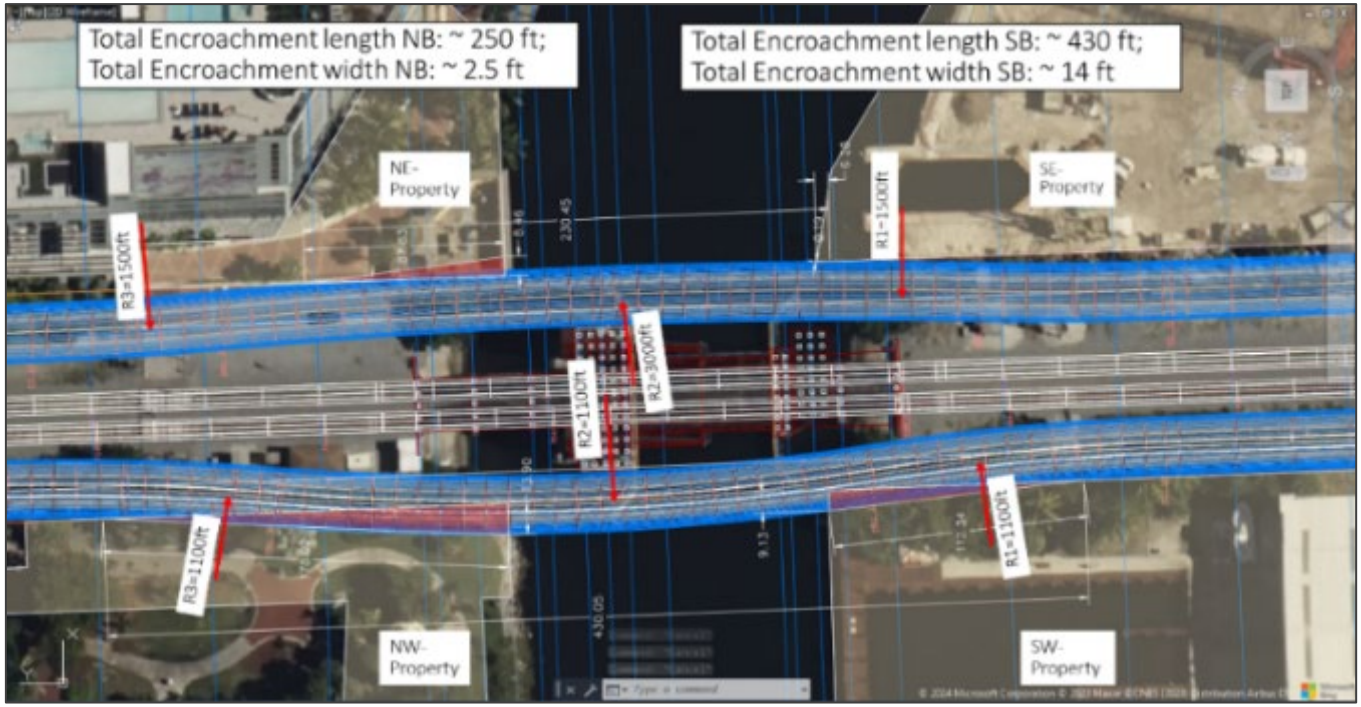


Figure 14: Horizontal Alignment Over the River

CROSS SECTION UNDER THE NEW RIVERBED

- This cross-section shows the tunnels under the New River with respect to the location of the bascule bridge and its piles.

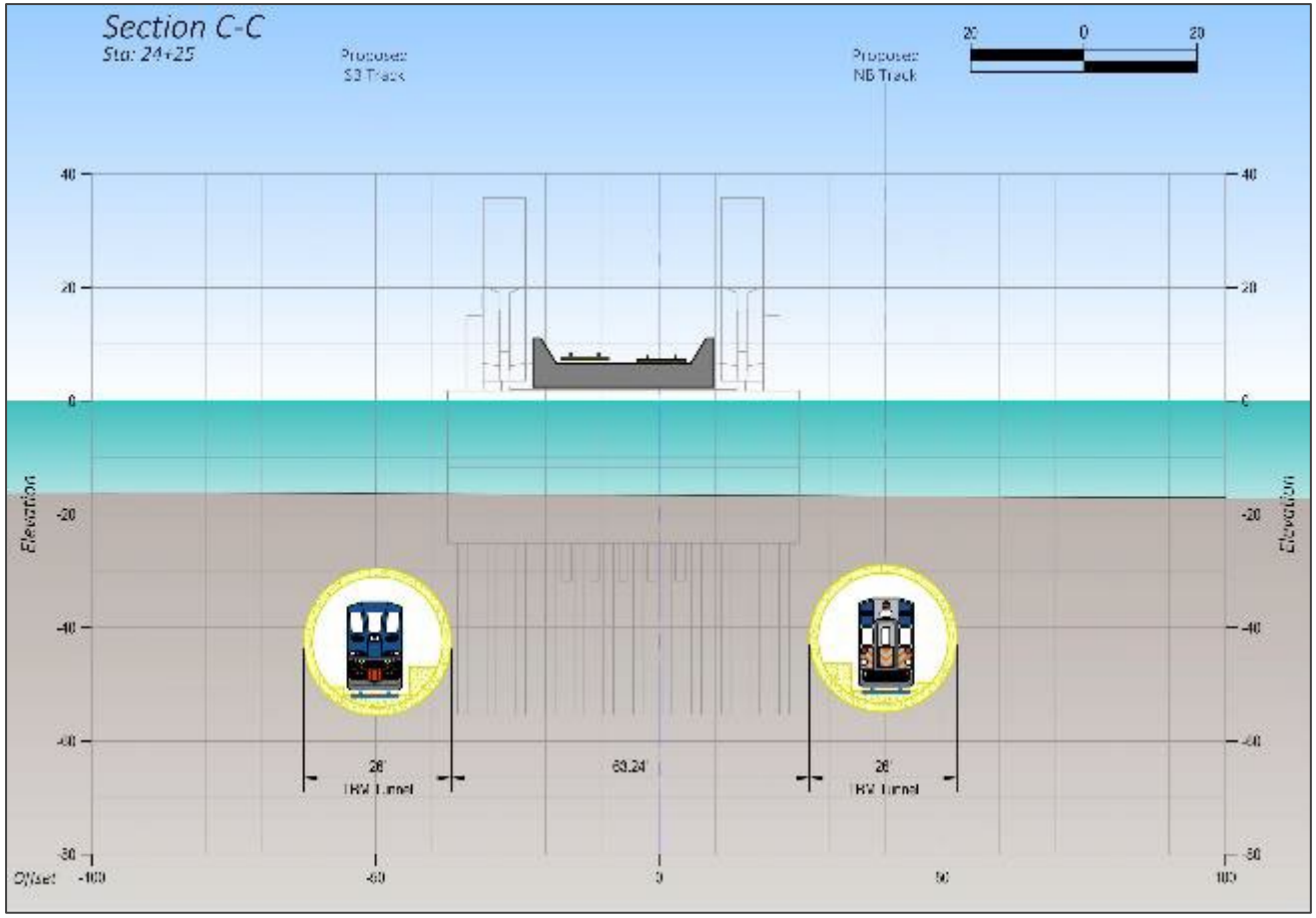


Figure 15: Horizontal Alignment Over the River

NW OF NEW RIVER - CITY OWNED PROPERTY

- The NW property is identified by red lines.

Figure 16: NW Property

HORIZONTAL ALIGNMENT - NW OF NEW RIVER

- The property located in the Northwest is owned by the City. A triangular shape underground easement measuring approximately 14 feet wide by 178 feet in length is needed. This easement is situated entirely within a grassy section of a park area.

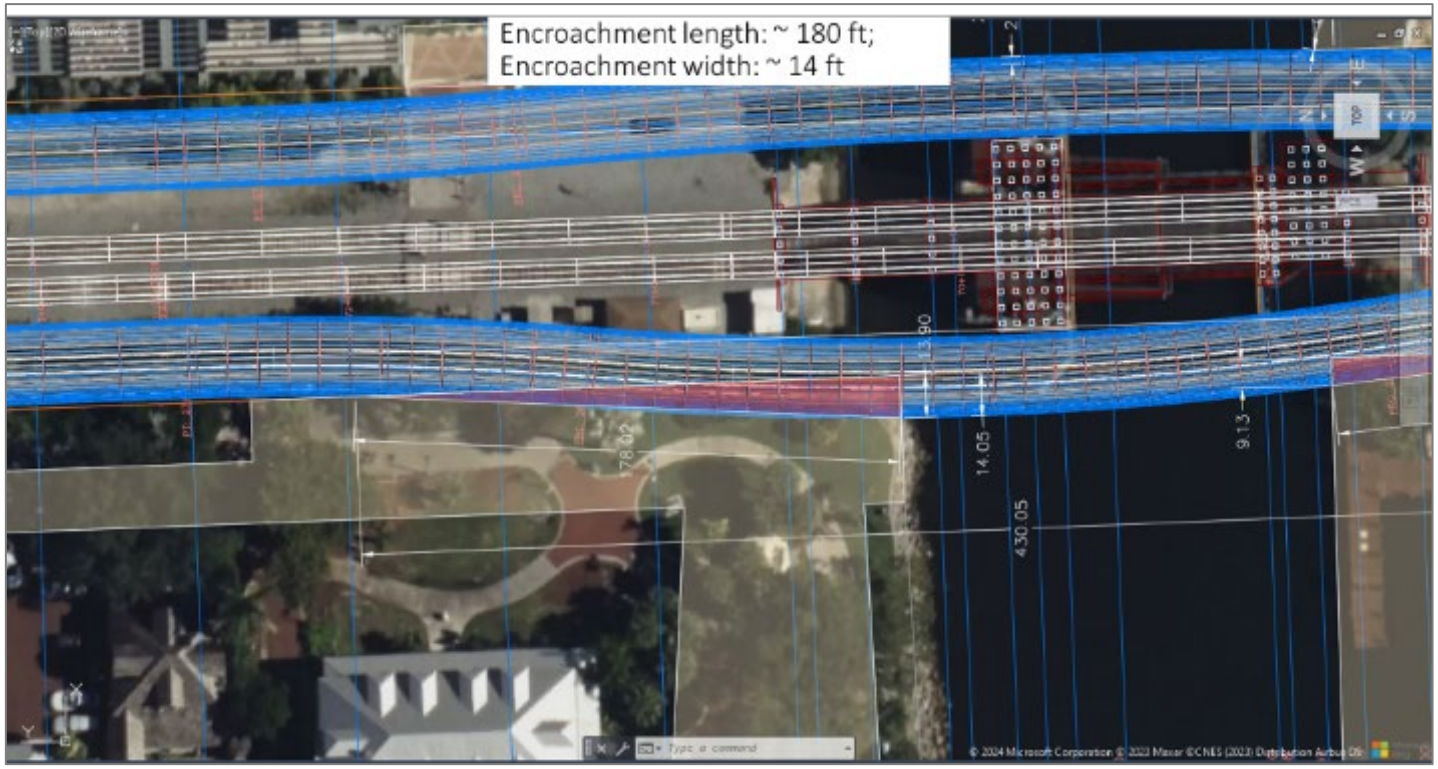


Figure 17: NW of the New River

Notes:

1. Encroachments are defined as underground easements.
2. Track depth at underground depth is approximately 60 ft. from the surface.

NE OF NEW RIVER - CITY OWNED PROPERTY

- The NE property highlighted in red is city-owned.
- There is an underground easement required of 2.5 ft ft. by 87 ft.

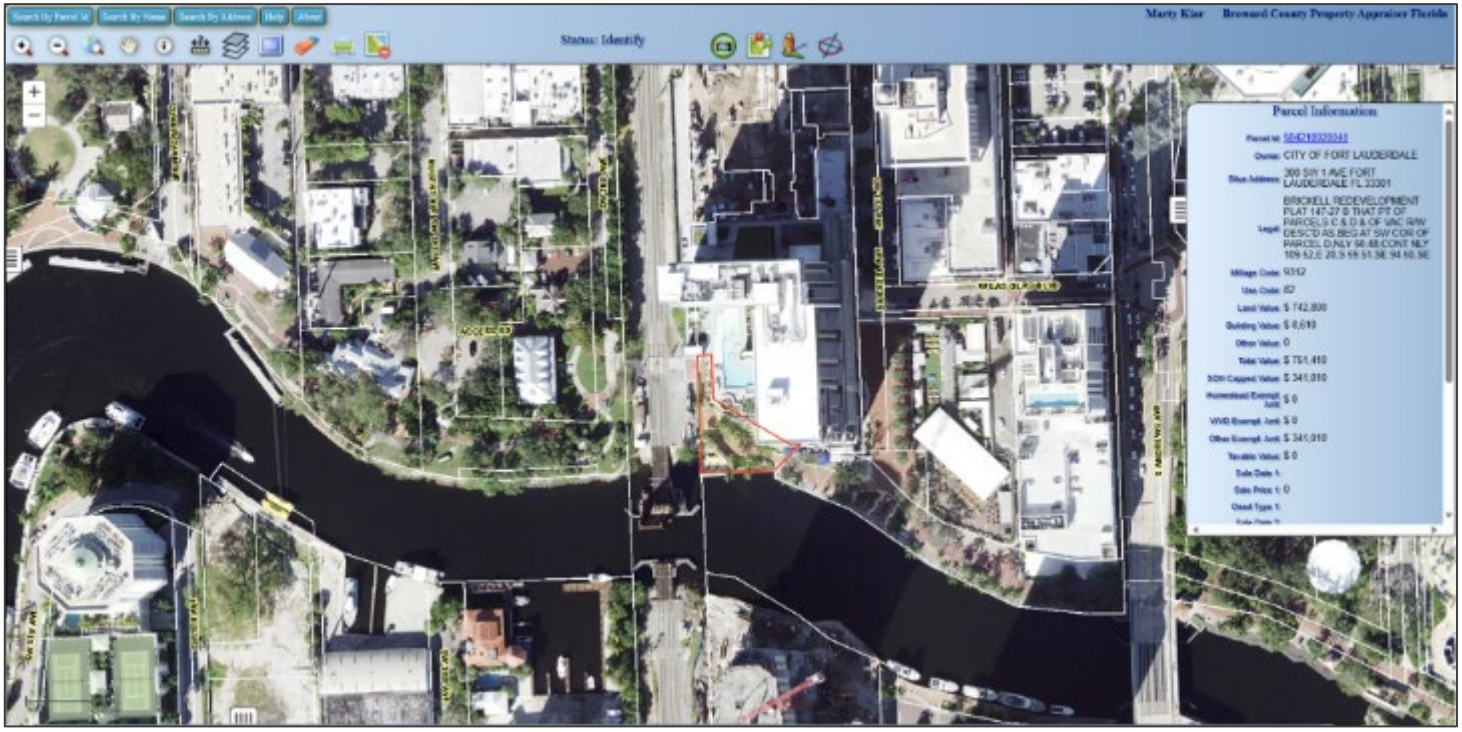


Figure 18: Horizontal Alignment

HORIZONTAL ALIGNMENT – NE ROW

- Minor underground easement of triangular shape 2.5 ft by 88 ft.

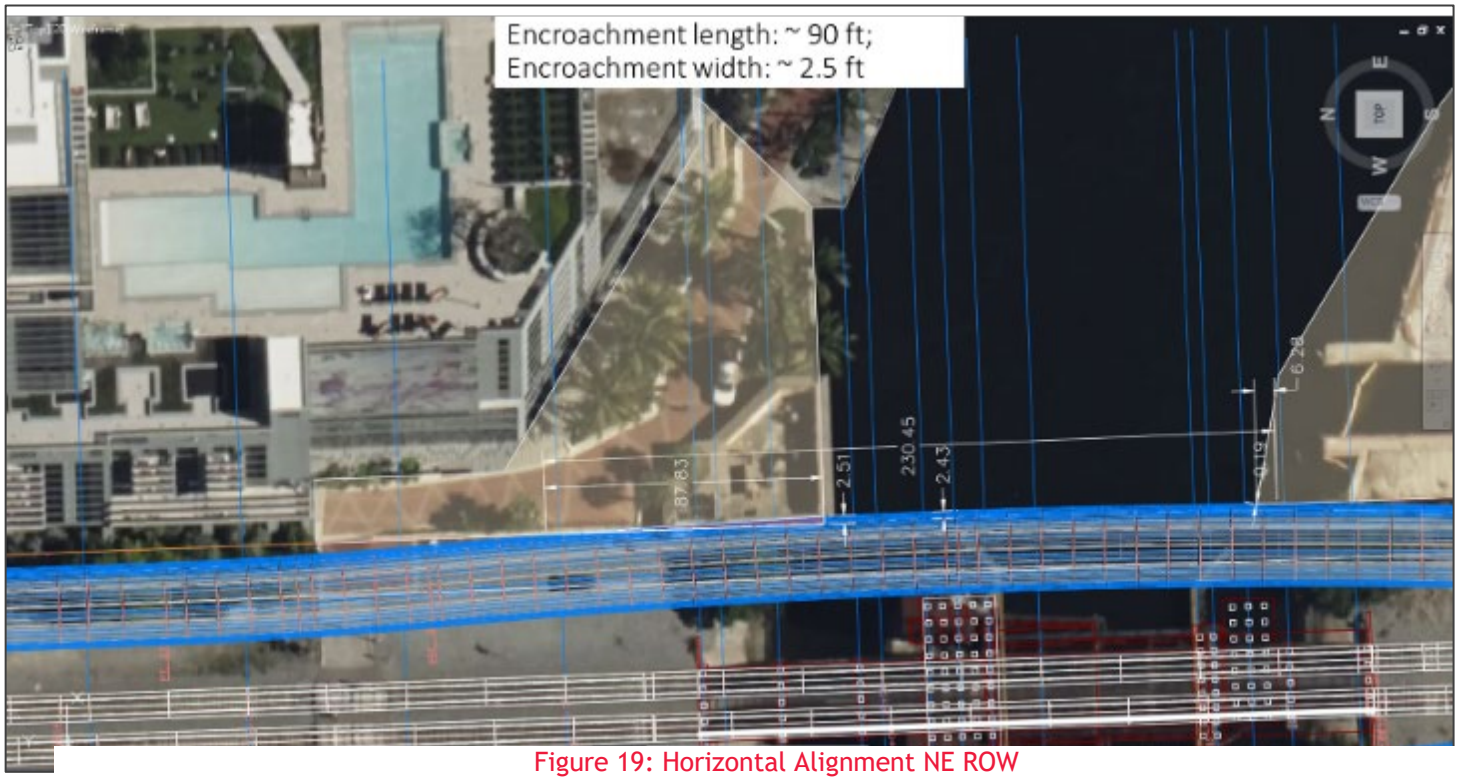


Figure 19: Horizontal Alignment NE ROW

Notes:

1. Encroachments are defined as underground easements.
2. Track depth at underground depth is approximately 60 ft. from the surface.

SW OF NEW RIVER

- An underground easement of around 10 ft by 115 ft at the North-East Corner of the privately owned property will be required.
- The underground easment required in an area with no devlopment plans anticipated.

Figure 20: Horizontal Alignment SW

HORIZONTAL ALIGNMENT – SW PRIVATELY OWNED PROPERTY

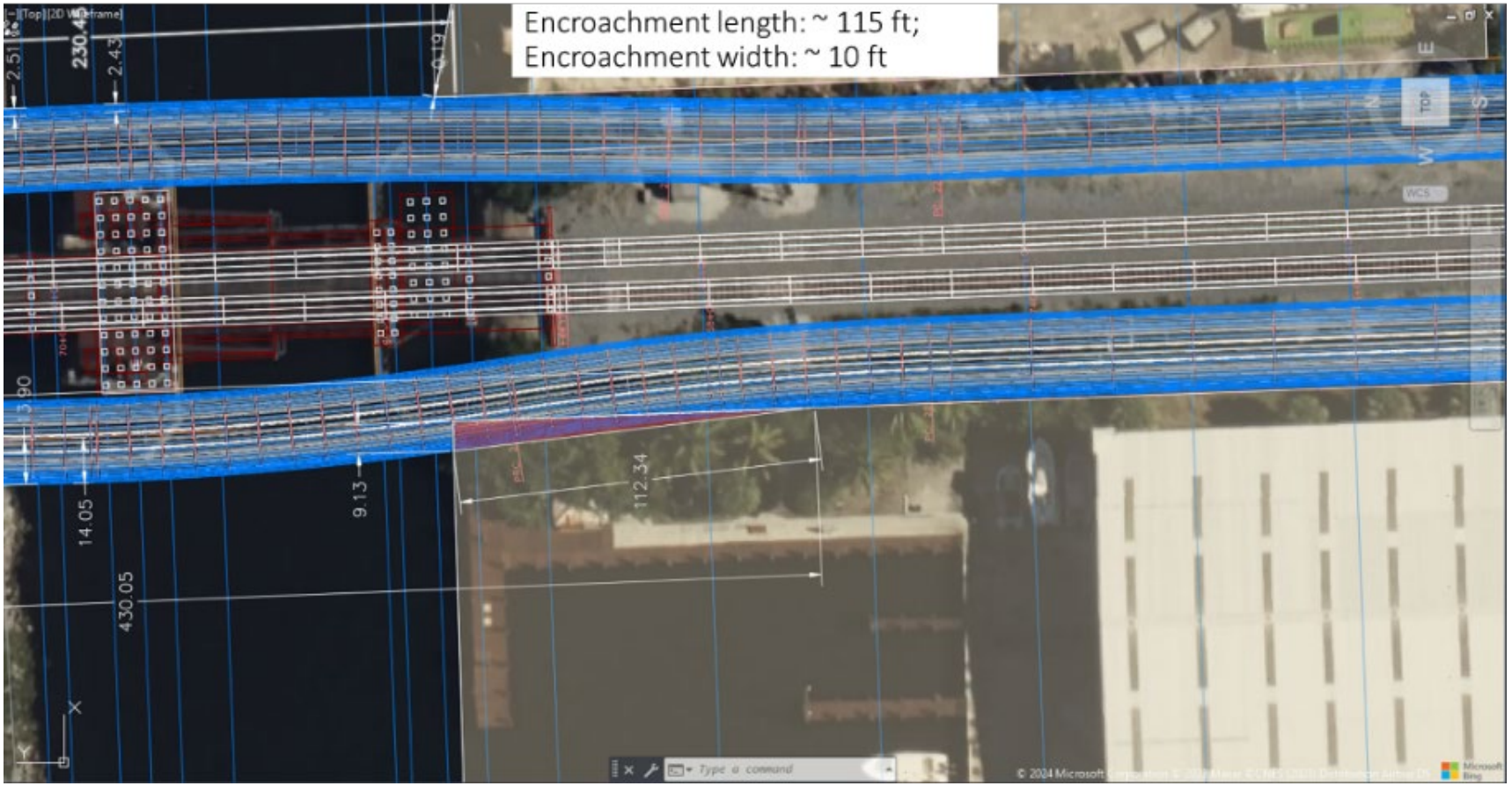


Figure 21: Horizontal Alignment Encroachments

1. Track depth at underground depth is approximately 60 ft. from the surface.

HORIZONTAL ALIGNMENT – SW UNDERGROUND EASEMENT

The area marked in red is identified as the potential location of the needed underground easement. Currently, there are no developments at this location, as it primarily consists of green space. The image below shows designs that have been approved (marked in blue) and others that are still being reviewed by the City (marked in green). The buildings marked in pink color are existing developed sites/buildings.

Figure 22: SW Underground Easement and Property Impacts

The area where an easement is needed does not interfere with the current design or project that is “In Review”, as shown in Figure 22.

The underground easement has been planned to fit well with the rest of the Development Project, making sure it doesn't cause problems for any part of the design of the development now or in the future.

It is noteworthy to mention that the selected technology for this Project involves the use of a TBM which is a closed-face machine known for its minimal external noise and low vibration levels. In every project, an analysis is conducted to assess the potential for ground settlement and its effects on nearby structures. For this location, the measures can be in place to ensure that any settlement stays within acceptable limits. The development, indicated in green, is positioned at a sufficient distance from the tunnel, which will be deep enough to prevent any structural impact or disturbance to existing or adjacent buildings.

As part of stakeholder engagement, BDO reached out to the property owner to proactively identify if there are any potential issues with using the identified site as an underground easement. The property owner maintains an open door with regards to communication and is willing to support the tunnel option (at the time of issuing this report).

STATION CONFIGURATION

Station Platform Location Under Broward Blvd.

Station Configuration

The station design presented below has been developed to ensure that existing operations for Brightline and FECR remain uninterrupted. This design is based on successful implementations of other similar projects, such as the recently completed Chinatown station in San Francisco, which has been operational for two years.

- The new station will be constructed entirely underground within the existing FECR ROW. To avoid any interference with the current platform piles, the new platform will be positioned beneath Broward Blvd. The station's entrance will be situated at the future Broward County Government Center, as shown. This entrance will house all necessary facilities and provide escalator and elevator access to a lower-level mezzanine.

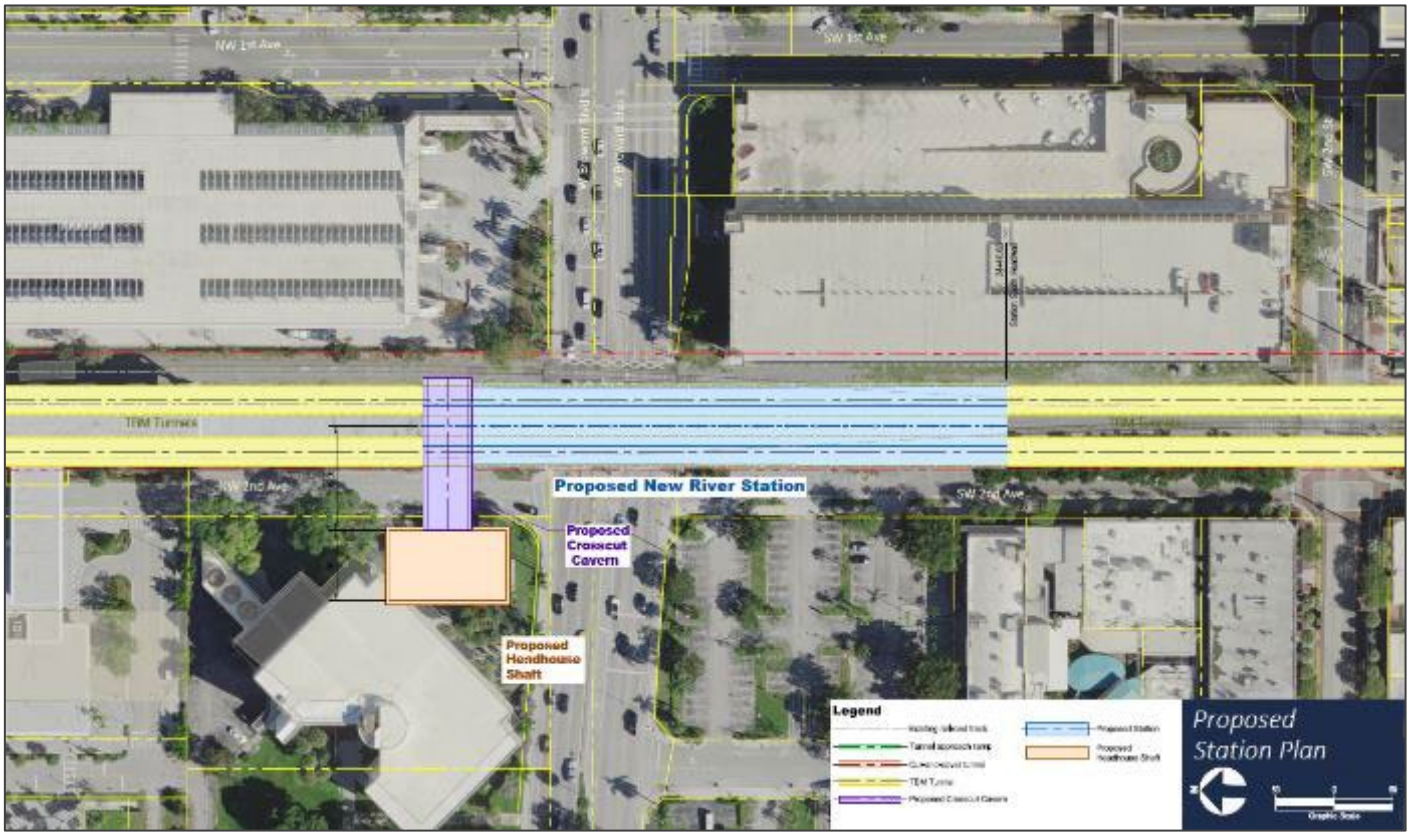


Figure 23: Station Configuration

- The platform length required for the Commuter Rail is estimated at 500 ft, whereas the enhanced platform length required for Brightline is estimated at 850 ft.

STATION CONFIGURATION

- The flow of foot traffic envisaged is that from the mezzanine, passengers will descend to a central platform station flanked by two tracks (one on each side) serving train movement northbound and southbound.
- The proposed design facilitates a multimodal transportation hub, allowing seamless connections to nearby bus terminals, the Brightline Station, and upcoming developments. These connections could be established through underground passages or aerial pedestrian bridges. The mezzanine, currently terminating within the railroad right of way, has the potential to be extended to provide an additional entrance near the existing bus terminal.
- The construction will employ SEM without excavating from the surface. This approach ensures that the existing station remains fully operational throughout the construction process.
- All construction activities such as material handling and delivery, muck removal, access, etc. will be done from the access shaft located in the future government center outside the railroad ROW to minimize impact on the railroad operations.

PROPOSED STATION PROFILE

The goal for pedestrian-friendly train stations is to provide comfort and safety, and to be designed in such a way that they can be used conveniently and be easily accessible, inviting and with clear wayfinding system. Further it should enhance the flow of movement so that there is no confusion for the facility' users. Below is the proposed station profile showing that the station's design ensures avoidance of the existing Brightline station pilings by initiating the construction south of these structures.

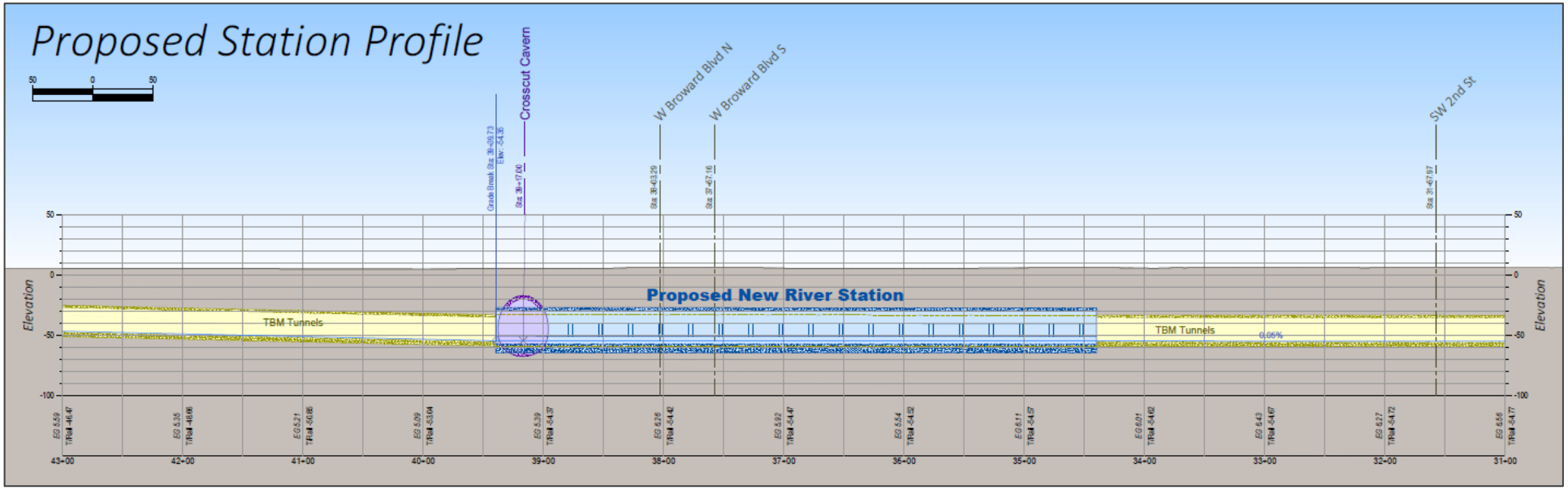


Figure 24: Proposed Station Profile

- The station cross section shown on page 43 illustrates the train room including a wide center platform and two sidetracks allowing train movement northbound and southbound.
- A mezzanine located in the elliptical shape crosscut provide access from the street level to the station platform.

PROPOSED STATION PROFILE

- The top of the station is over 35 ft from the surface. The depth of the station is sufficient to allow for future infrastructural developments, such as the potential addition of an underpass or overpass along Broward Blvd.
- This strategic positioning and depth ensure that the station's construction will not hinder any prospective modifications aimed at enhancing traffic flow over/under the freight tracks along Broward Blvd. In this way the design keeps in mind future expansions as may be required.
- No impact on existing infrastructure and operation of the FECR and Brightline railroads.
- Further examples of stations have been provided in Appendix D and E.

TWIN TUNNEL STATION DESIGN

- The station configuration provides wide open cavern with center columns, a wide platform, and two tracks.
- The station's layout involves the construction of the two tunnels using TBM, , followed by the excavation of the station cavern to house the mezzanine and the platform.
- To support the cavern structure, circular columns will be placed approximately 25 feet apart, with heavy beams spanning between them to carry the load.
- The station cavern will be constructed safely, yet be open space and inviting atmosphere

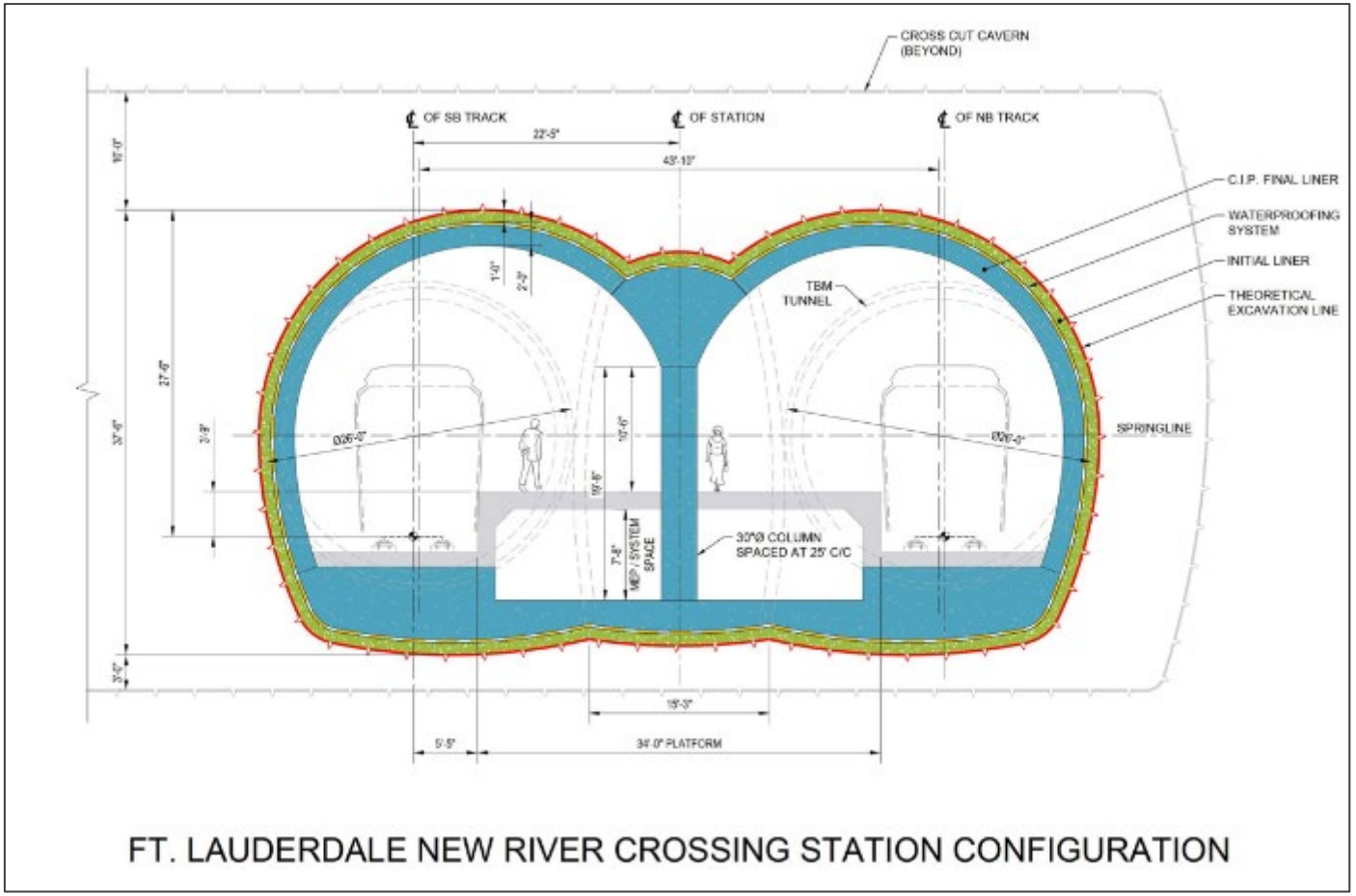


Figure 25: Drawing of the Proposed Station

TWIN TUNNEL STATION EXAMPLE

The twin tunnel design approach has been used on numerous stations in Europe, Canada, and the US. A similar example is the Fort Totten Station in Washington DC, showcasing a similar structural methodology (shown below) [3]

Figure 26: Example of Station

[3] Fort Totten lower level [01] | Lower level of the Fort Totte… | Flickr

TWIN TUNNEL STATION EXAMPLE

Figure 27: Twin Station Tunnel Example[4]

[4] Fort Totten Station https://www.flickr.com/photos/schuminweb/50026522086

‘BIRD’S EYE” VIEW OF THE STATION

Overview from a Bird's Eye View (Underground Perspective):

- Vertical Circulation Element: Identified in white, represents the vertical shaft where elevators/ escalators and stairs will be located. The shaft will also house the station “back of the house” facilities.
- A surface headhouse will be located for the entryway to the station.
- Mezzanine Area: Shown in green, positioned above the train level and provide access connection to the platform with suitable vertical circulation elements.

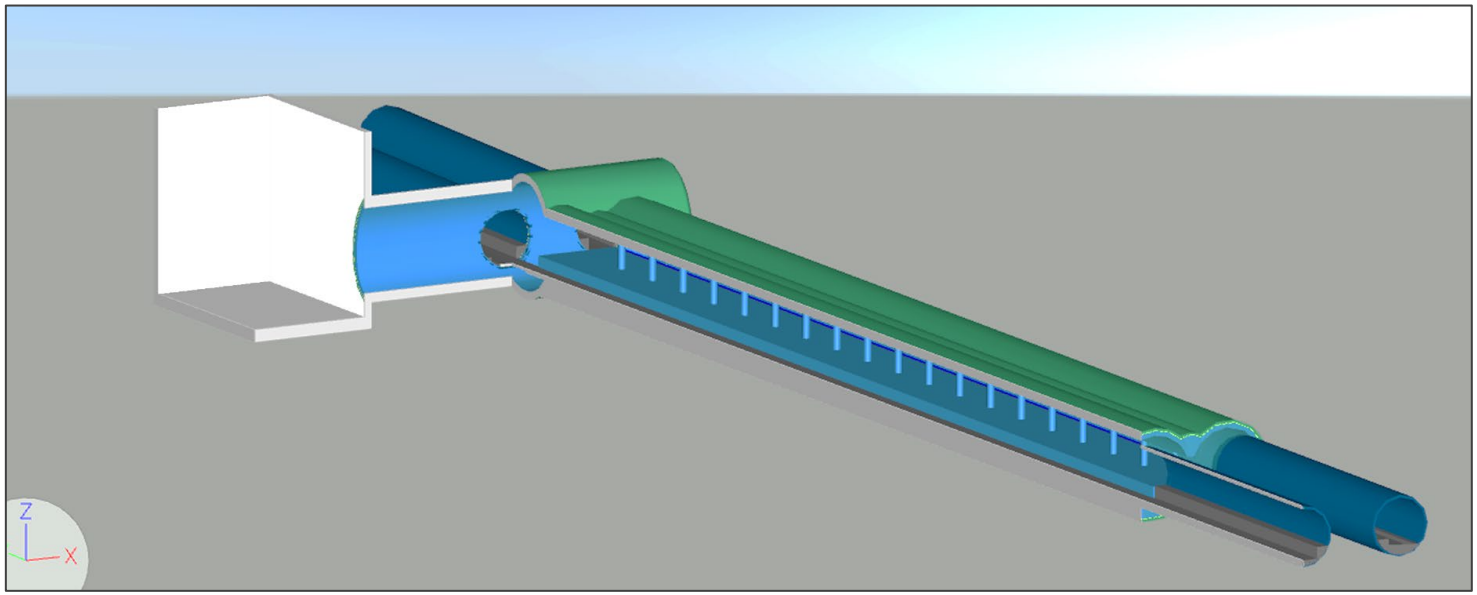


Figure 28: Bird's Eye View

- Platform Access: From the mezzanine, access leads down to a wide central platform.

Note: North and South end of the stations are depicted in Appendix A.

STATION CONSTRUCTION METHODOLOGY

SEM Construction

- The SEM Method developed in the late 1960s/early 1970s, represents a pivotal advancement in tunnel construction technology. This method has been applied globally, demonstrating its versatility and effectiveness across a variety of geological conditions and urban settings. The SEM is characterized by its phased approach to excavation, allowing for the precise control of ground conditions, which is crucial for minimizing disruptions in densely populated areas or near existing infrastructure.
- Notable implementations of the Sequential Excavation Method include Fort Totten Station in Washington, D.C., Chinatown Station, San Francisco, Regional Connector in Los Angeles, U5 Berlin Metro, Prague Metro, Northern Boulevard crossing in New York, Ontario Line Stations in Toronto, Confederation Line in Ottawa, and numerous stations in Vienna further showing the widespread acceptance and success of this method.

The adoption of the Sequential Excavation Method in these varied and complex projects underscores its reliability and efficiency in tunnel and station construction. Its ability to adapt to different geological and urban challenges makes it a preferred choice for modern infrastructure projects worldwide where TBM cannot be used. As an example, the design and construction processes of the Chinatown station has been used to illustrate the practical application of SEM in modern infrastructure projects.

- Initial Excavation Phase: The process begins with the excavation of two tunnels, as observed below:

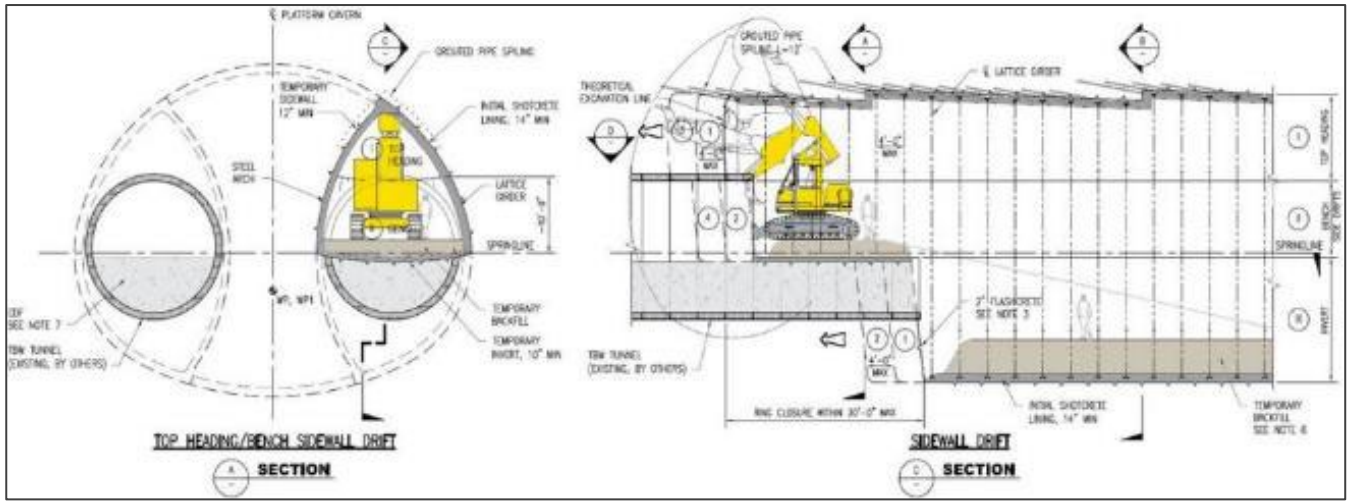


Figure 29: How SEM is Carried Out

STATION CONSTRUCTION METHODOLOGY

SEM Construction

- This initial step sets the stage for the sequential nature of the method, where excavation is carried out progressively in small drifts and short rounds.
- Sequential Excavation and Immediate Stabilization: With SEM, the tunnel is dug out in small sections or bites (drifts) using an excavator and cutting equipment. Following each excavation step, rebar cage called lattice girder is installed for structural reinforcement, as depicted in the image below. Immediately after, shotcrete is applied to the excavated surfaces to stabilize the ground, encapsulate the lattice girder and provide the initial support. This step is crucial for maintaining the integrity of the excavation site and ensuring the safety of the construction environment.

Figure 31: Construction During SEM Example 1

Figure 30: Construction During SEM Example 2

Completion of Excavation and Removal of Temporary Walls: The images below show the site once the entire excavation is completed. At this stage, temporary walls, which were initially erected to support the excavation sides, are removed. This allows for the installation of the waterproofing membrane and the construction of the interior structure to commence.

STATION CONSTRUCTION METHODOLOGY

SEM Construction

- Construction of the Interior Structure: With the excavation complete and temporary supports removed, the focus shifts to building the internal structure. This phase includes the installation of waterproofing membrane and the pouring of the final concrete liner. These steps are vital for ensuring the durability and longevity of the tunnel or station.
- Finishing: the station interior structures, platform, track beds, tracks, architectural finishes, electrical / mechanical systems, etc. are then completed.

Figure 33: Construction During SEM Example 3

Figure 32: Construction During SEM Example 4

SECTION 5

OTHER FACTORS

OTHER FACTORS: RESILIENCY

Resiliency

In the design of any infrastructure, planning for resiliency, particularly in the face of hurricanes and severe storms, is paramount. The potential for tunnel flooding during such events poses a significant risk, necessitating proactive measures to ensure the safety and integrity of these structures. Globally, flood gates have emerged as a widely accepted and effectively implemented solution to mitigate flood risks in lowlands and coastal cities. These structures serve as critical barriers, safeguarding tunnels from the ingress of floodwaters.

Notably, the Port of Miami Tunnel and several tunnels in New York have successfully incorporated flood gates into their design, demonstrating their efficacy in protecting against flood damage. It is also noteworthy that when the flood gates are shut, the at-grade tracks are still available, ensuring that train operations can continue on the surface without any interruption.

Cost Estimate for Flood Gates

- Our assessment indicates that the installation of flood gates at each entrance of the tunnel portal is a financially viable and essential investment for flood prevention. The cost for each flood gate, installed and operational, is estimated at about $450,000. Consequently, the total expenditure for implementing all required flood gates would amount to $1.8Mn. Taking into account a contingency for unforeseen expenses, the overall cost is projected for all flood gates to be about $2.34Mn. This estimate is included in the estimated capital cost.
- This investment in flood gates is a critical component of a comprehensive strategy to enhance the resilience of tunnel infrastructure against the increasing threat of hurricanes and flooding, ensuring their long-term viability and safety. Below are selected examples of implemented flood gates:

Port of Miami Tunnel

Location: Miami, FL

Project goal: Enhance safety & resiliency and meet all requirements and local, state and federal standards.

Project description: Given the location and dealing with hurricane season annually, it is no surprise that Port of Miami's tunnel design included floodgates. The tunnel, equipped with four 55-ton hurricane flood gates is the first Florida project designed with resiliency in mind.

Figure 34: Flood Gates Mid-Closing at Port of Miami Tunnel

OTHER FACTORS: RESILIENCY

It is estimated that 80% of the cargo traffic travelling in and out of the Port of Miami is using the tunnel, thereby avoiding the downtown areas and noticeably increasing quality of life for residents, while decreasing carbon emissions from congestion and idle time on city streets.

The flood gates can close and hermetically seal the structure within a few minutes.

MBTA

Location: Boston, MA

Project goal: Reduce risk of damage from flooding on the Green Line; fewer weather-related service interruptions.

Project description: This project entailed installation of steel doors at the Fenway Portal, located near Fenway Station, aiming to address the issue of flooding caused by the nearby Muddy River. In 1996, significant flooding resulted in extensive damage amounting to nearly $70 Mn and disrupted major sections of the Green Line for a period of 2 months.

Since then, temporary flood prevention measures were implemented. However, the introduction of steel doors serving as flood gates, significantly enhance the safety and resilience of the project.

Figure 35: Floodgates Installation

Flood gates enable a more prompt and efficient response in the event of a flood. By swiftly closing the doors, the potential damage caused by rising floodwaters can be minimized, thereby safeguarding the infrastructure, and reducing repair costs.

Additionally, this approach facilitates a quicker resumption of service once the floodwaters recede, minimizing the disruption to operations.

Overall, enhancing safety and resiliency via proactive measures aims to mitigate the impact of potential flooding, protect the infrastructure, and enable a faster recovery and avoid costs arising from uncontrolled events[5].

[5] https://www.mbta.com/projects/fenway-portal-flood-protection-project

OTHER FACTORS: RESILIENCY

NY MTA

The Queens Midtown Tunnel and the Hugh L. Carey Tunnel both installed bronze-colored flood dates in response to hurricane Sandy. The gates are designed to form a water-tight seal across the tunnel entrances when deployed. The MTA revealed that each gate weighs 44,600 pounds, measures 29 feet in length and 14 feet in height and is almost two feet thick at 22 inches thick. When the tunnel is operating in regular conditions, the flood gates sit on jacks that are mounted to the sidewalk at the side of the portals, as shown in Figure 36. In an impending storm event, a two-person crew can deploy the flood gates, with the help of a fork-lift or front-end loader. The crew will also remove the steel road plates that cover the gate receiver trough [6].

Flood gates are provided in several tunnels in the Norfolk area in Virginia including the downtown and the midtown tunnels, the Hampton Roads, and the Chesapeake Bay tunnels.

Figure 36: Floodgates Shutdown in NYC

[6] https://untappedcities.com/2018/02/22/44600-pound-flood-gates-installed-on-nyc-tunnels-to-protect-from-superstorms/

OTHER FACTORS: PROPERTY IMPACTS

Property Impacts

As part of this study, the City requested a comprehensive evaluation to understand the impact on private and public property associated with both bridge and tunnel alternatives for the corridor situated in the downtown area. This assessment is crucial for determining the potential effects on property values, land use, and economic activity within the vicinity of the Project, and also understanding the overall capital cost of the alternative to be built for Project.

- For the bridge alternative, without the availability of a bridge design or alignment, it is unrealistic to evaluate or assess any property impacts. The County has recently engaged a consultant to assist in development of bridge design. While the County has not shared a timeline for completion of bridge design, it is expected that a bridge design will take 4 – 6 months to complete. Once this information is available, a property impact assessment can be performed to provide an estimated range of cost of capital and ROW.
- For the proposed tunnel alignment, two separate sets of property impacts are required.
  - Staging Area which is a temporary requirement during construction of the Project. It is our understanding that some City-owned property can temporarily be used and returned to their original functions upon completion of the construction. Similar projects where public property has been used for staging areas have been completely rehabilitated after project completion and such costs are included as part of the project cost. This is usually considered as a win-win for the local government and the projects.
- Multiple privately owned property options were evaluated for potential use during construction. Based on the recent transaction data, the anticipated costs are given below.
  - If leased, the estimate is around $1.3Mn for the construction period.
  - If acquired, the estimated cost is $20Mn. Since the corridor has seen tremendous growth, the property can be sold upon project completion and can generate significant additional value on sale of the properties.
  - Subterranean Rights: The Project would have to enter into an agreement to acquire subterranean property access rights for two City-owned lots in NE and NW of the New River, and a private property located on SW of New River. As the impact is minimal to the identified properties and use of these properties, no major cost resulting from acquisition of these subterranean access rights is expected.
  - The tunnel alignment and configuration does not require acquiring any private or public property. The entire project lies under the FECR ROW.

OTHER FACTORS: PROPERTY IMPACTS

The underground station location and configuration will enhance foot traffic and connectivity to adjoining modes of transportation and the adjoining properties and future developments. This is likely to stimulate economic activity, leading to higher revenues for local businesses resulting in opportunities to create revenue for “value capture”. Some of the value capture will be increase in property value and growth in business opportunities. This is based on similar projects that have successfully benefited from similar projects.

OTHER FACTORS: STAKEHOLDER ENAGEMENT

Stakeholder Engagement

Active stakeholder engagement has been a priority, with outreach efforts focusing on all parties critical to this infrastructure project including the County, MPO, FDOT D4, FECR, Brightline and other community stakeholders including DDA. These stakeholders have participated in multiple open and constructive discussions. We have presented the new tunnel alternative and each one of them have been very receptive by providing valuable feedback.

In January 2024, the BDO and its advisors met with the County to explain the initial alternate tunnel alignment. Following these meetings, the BDO and its advisors met with the FDOT. During these meetings, both the County and FDOT expressed different concerns regarding the initial layout. Meetings with FECR and Brightline were constructive and each one identified their own considerations for the Project. FECR expressed it needs to have business continuity without interruptions are the primary concern whereas Brightline shared their platform and station access requirements.

The table below shows all meetings with various stakeholders from January 2024 to current:

Meeting Date	Stakeholder
January 03, 2024	County (1st Meeting)
January 24, 2024	County (2nd Meeting)
January 25, 2024	FDOT D4
January 26th 2024	FECR
February 13, 2024	Brightline

Table 1: Key Stakeholder Meeting Dates

OTHER FACTORS: STAKEHOLDER ENAGEMENT

Subsequently, in response to the feedback, the BDO Team began a detailed review of each area of feedback.

- The proposed tunnel design intersected with the piles supporting the existing Bascule Bridge over New River. The revised Project Alignment section on page 13 addresses this concern now.
- The proposed alignment for proposes Brightline's maximum grade of 3%. The proposed alignment considers a 4% grade between SW 7th Street and SW 6th Street over approximately 600 feet on the South side of the tunnel corridor. This is proposed to avoid any road closure or crossing on the SW 7th or SW 6th Street. Based on last meeting with Brightline team, its operations team confirmed acceptance of 4% grade over a short distance.
- Resiliency, particularly the challenges specific to South Florida were requested to be addressed. In discussions, the high risk of flooding in the proposed tunnel area was noted, a risk underscored by a significant flooding event in 2023. It was recommended that comprehensive cost details, including design, construction, commissioning, operation, and maintenance, for flood gates like those used in the POMT and other similar projects should be obtained. This report addresses costs for installing flood gates in Section Other Factors: Resiliency on page 51 of this report.
- Expected challenges, such as de-watering, treating contaminated materials, and managing traffic disruptions from over 10,000 dump truck movements near the tunnel portals, need to be addressed. As this is an initial project alignment design capturing only 1%-3% of the design, such details are not possible at this stage. However, cost allowances were made for dewatering, contaminated materials, traffic impact, etc. which should be addressed in detail in future.
- It was requested to either include the commuter rail station costs in the tunnel estimates or exclude these costs from past and future bridge cost estimates (in previous studies), ensuring a comparable cost.
- Both FECR and Brightline have identified business continuity without interruptions as their primary concern. Both require that construction should not impact any reduction in their operational capacity or speed. Construction-related delays or speed reductions could lead to considerable costs, which either project should avoid or take into account. Plan for implementation of tunnel construction without impacting the existing operations is provided in Appendix F.
- Existing Brightline Station has pilings supporting the station and piles under the side walls of the platform to support a derailed freight train and to act as a barrier to avoid any crashes. This has been addressed in the proposal station location in section starting on Station Design of this report. Other than FECR, each of the stakeholder mentioned in this section has been presented the alternate tunnel alignment. FECR did show inclination to engage in review of the tunnel design. In addition, other stakeholders include marine industry, local developers, Coast

OTHER FACTORS: STAKEHOLDER ENGAGEMENT

Guard, local community, etc. should be engaged. It is recommended that engagement with the stakeholders should continue alongside as part of a sustained dialogue and collaboration.

SECTION 6

PROJECT COST

PROJECT COSTS

Current project costs based on TBM Design including station – Level 4 Cost Estimates

Project Costs

As a base case with a single commuter rail train station, the Level 4 construction cost estimate is $888Mn (2023 dollars), using "apples-to-apples" comparison with previous alternatives. Additional cost estimates are also presented accounting Brightline's needs for an extended platform, access from Brightline station to the underground station platform and an additional access to bus terminal. The O&M costs are estimated at $1.6Mn per annum and Lifecycle costs at $0.8Mn per annum, including contingency.

Understanding the Level 4 Cost Estimate[7]

There are five estimate classes as per the AACE International, TCM Framework: 7.3 – Cost Estimating and Budgeting. Only the level of project definition determines the estimate class. The other four characteristics are secondary characteristics that are generally correlated with the level of project definition, as discussed in the generic standard. The characteristics are typical for the process industries but may vary from application to application. Details regarding the Level 4 estimate and how it can be applied are as follows:

Particulars		Primary	Secondary		
Estimate Class	LEVEL OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Level 4/Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4

Table 2: Level 4 Cost Estimate Details

Notes: [a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

[b] If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools

[7] 18R-97: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries (costengineering.eu)

PROJECT COSTS

Level 4 Estimate or Class 4 Estimate[8]

- Description: Level 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete, and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams for main process systems, and preliminary engineered process and utility equipment lists.
- Level of Project Definition Required: 1% to 15% of full project definition.
- End Usage: Level 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage.
- Estimating Methods Used: Level 4 estimates virtually always use stochastic estimating methods such as equipment factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, the Miller method, gross unit costs/ratios, and other parametric and modeling techniques.
- Expected Accuracy Range: Typical accuracy ranges for Level 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

ANSI Standard Reference Z94.2-1989 Name: Budget estimate (typically -15% to + 30%).

Alternate Estimate Names, Terms, Expressions, Synonyms: Screening, top-down, feasibility, authorization, factored, pre-design, pre-study.

Level 4 Estimate - Assumptions

For consistency, Level 4 and Class 4 estimates can be used interchangeably for this report as all presentations to the City have used Level 4 estimates, whereas AACE International uses Class 4.

[8] 18R-97: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries (costengineering.eu)

PROJECT COSTS – CAPITAL COSTS

Capital Costs

- The current level four cost estimate is $888Mn including the commuter rail station and underground platform.
- Cost estimate was prepared in accordance with FTA Work Elements
- Cost estimate includes Contractor Overhead and Profit.
- ROW Costs include lease of property during construction and underground easements. It is assumed that the underground easements on the properties owned by the City of Fort Lauderdale will not incur any additional cost.
- Professional services include project development costs (2%), engineering (6%), Insurance (2%), permits (1%), PM (3%), CM (3%)
- Contingency is assumed at 33% of construction cost.

FTA Work Elements *(Amount as stated)*	**Level 4 Cost Estimates**
10.00 Guideway and Track Elements (Tunnel)	$ 247,208,757
20.00 Stations, Stops & Terminals	$ 304,624,744
40.00 Site Work & Special Conditions	$ 13,191,496
50.00 Railroad System – Underground Segment	$ 14,509,688
60.00 ROW	$ 1,300,000
80.00 Professional Services	$ 115,906,937
90.00 Contingency	$ 191,246,446
Total Capital Cost (2023 Dollars)	**$ 887,988,068**

Table 3: Project Capital Costs

PROJECT COSTS – CAPITAL COST COMPARISON

Cost Comparison

- Cost comparison is presented for tunnel alternatives presented previously. It is pertinent to note that this comparison is only for presentation purpose as the scope, length and alignments of each tunnel alternative are not comparable.
- The HDR Report's estimate is based on the tunnel alternative consisting of the construction of a commuter rail line within twin, 23-ft diameter TBM bored tunnels crossing under the New River and Tarpon River, with a cut-and-cover station and open approach portals spanning a total alignment length of approximately 1.8 miles.
- The original 2021 HDR cost estimate ($1,822M) was escalated by 5% to bring it to 2023 dollars. This updated total is ~$1,949M.
- The Whitehouse Report included Jacobs Engineering cost estimate of a tunnel length of 1.8 miles.
- BDO proposed project alignment has a total length of 1.146 miles.
- All costs are presented in 2023 Dollars for ease of comparison.

FTA Work Elements *(All figures are rounded in Mn)*	FDOT (HDR)	Whitehouse (Jacobs)	BDO Level 4 Cost Estimates
10.00 Guideway and Track Elements (Tunnel)	839	705	247
20.00 Stations, Stops & Terminals	88	202	305
40.00 Site Work	86	274	13
50.00 Railroad System	190	86	15
80.00 Professional Services	350	452	1
90.00 Contingencies	391	783	116
Total (2023 Dollars)	**1,949**	**2,606**	**888**

Table 4: Capital Cost Comparison Across Studies

CAPITAL COST - YEAR OF EXPENDITURE

YoE

- YoE assessment is based on the inflation forecast provided in the FDOT Work Program Highway Construction Cost Inflation Factors published in September 2023 for the Work Program FY24/25 – FY28/29.
- An indicative forecast of expenditure has been developed which is in line with projects of similar nature. A more realistic spend forecast can only be developed once the design levels have advanced significantly.
- Total Capital Cost based on the year of expenditure will be $1,040Mn.

FTA Work Elements	Cost in 2023 Dollar	2024	2025	2026	2027	2028	2029	Total
Amount in Mn		1.029	1.06	1.093	1.128	1.165	1.203	
10.00 Guideway and Track Elements (Tunnel)	$ 247.21				$ 83.66	$ 115.20	$ 89.22	**$ 288.07**
20.00 Stations, Stops & Terminals	$ 304.62					$ 177.44	$ 183.23	**$ 360.68**
40.00 Site Work	$ 13.19			$ 14.42	$ 0.00	$ 0.00	$ 0.00	**$ 14.42**
50.00 Railroad System	$ 14.51				$ 4.91	$ 6.76	$ 5.24	**$ 16.91**
60.00 ROW	$ 1.30		$ 0.28	$ 0.28	$ 0.29	$ 0.30	$ 0.31	**$ 1.47**
80.00 Professional Services	$ 115.91		$ 30.72	$ 44.34	$ 26.15	$ 13.50	$ 13.94	**$ 128.65**
90.00 Contingencies	$ 191.25						$ 230.07	**$ 230.07**
Total	**$ 887.99**		**$ 30.99**	**$ 59.04**	**$ 115.01**	**$ 313.21**	**$ 522.01**	**$1,040.26**

Table 5: YoE Details (2024-2029)

CAPITAL COSTS: ADDITIONAL CONSIDERATIONS

Additional Considerations: Brightline and Separate Entrance

- Project Costs are prepared to provide comparable number with previous studies.
- Based on the stakeholder engagement, it was acknowledged that Brightline will be using the new infrastructure for the intercity rail and an additional access to the platform for BCR should be provided from eastside of tracks.
- Brightline trains require a longer platform length. The commuter rail requires a platform length of 500 ft whereas accommodating Brightline trains in the tunnel requires the platform length to be increased to 850 ft. In addition, Brightline commuters also require an access to their existing train station. It is envisaged that such an entrance will be developed from the mezzanine floor directly to the existing above the ground Brightline platform.
- Additional BCR entrance on the eastside of the tracks would be next to the Broward County Transit (Central Terminal) and commuters can access BCR from both sides of the tracks which is common for passenger transit options. It is assumed that the above ground or underground easements for the Bus Terminal will not incur any additional cost.
- Cost estimates for additional tunnel considerations are not included in the base case cost estimate. These considerations are in 2023 dollars and include:
  - Additional platform length (for Brightline): $68,706,125
  - Additional station entrance (for Brightline): $13,235,623
  - Additional BCR entrance (from eastside of tracks): $27,551,925
  - The above costs for addition considerations include contingency, professional services and other soft costs.

OPERATIONS & MAINTENANCE PERIOD COSTS

O&M Costs

- The O&M costs are based on labor, supplies, power, and maintenance of tunnel systems.
- The labor cost includes the staff related to upkeep and maintenance of the tunnel and underground systems. It is our understanding that all customer-facing staff including the Station Master, Ticketing Agents and other support staff related to passenger traffic management will be part of the overall BCR program.
- Labor is limited to technical staff addressing electrical, mechanical and plumbing support. These include Master Electrician and Master Plumber each with a support staff member - an Electrician support and a Mechanical support. Further, two laborers will handle a variety of tasks, from maintenance to assisting in operational duties as needed.
- Major electrical systems include the tunnel ventilation system costing approximately $4Mn to replace with a life span of almost 20 years. However, the cost for such items is expected to be accounted for on a yearly basis or at actual occurrence/end of their life. It is recommended that a yearly accommodation in the form of a reserve be created from the start of the Operational Period.
- The O&M Costs is around ~$1.45Mn per annum including misc. items. In addition, we recommend a contingency of 30%, which will increase the annual O&M Cost to ~$1.9Mn.
- Like previous studies, the costs only include expenses related to the tunnel. No costs related to maintenance of the Station, operations and maintenance of the transit vehicles and the facility to store the vehicles or other station related O&M was considered as part of the cost.
- Details of O&M costs are provided in Appendix B.

Category *(Amount as stated)*	**Per Annum Cost**
Labor	$ 900,000
Utility Expenses (Power Supply)	$ 240,000
Replacement Cost (Lifecycle)	$ 250,800
Miscellaneous	$ 60,000
Contingency	$ 435,240
O&M Cost	**$ 1,886,040**

Table 6: O&M Costs (Annual)

OPERATIONS & MAINTENANCE PERIOD COSTS

Cost Over Life of the Asset

- Tunnel design accounts for the tunnel to have a life span of 125 years. For calculating the total/ cumulative O&M over the life of the asset, a long-term inflation indication published by Federal Reserve is assumed, which is 2.0%.
- In addition to actual cost based on year of spend, a Present Value analysis was performed to calculate the cumulative cost of O&M in today's dollar value. These costs are also provided on 50-Year and 75-Year basis to provide comparison with the bridge alternatives. The life of a bascule bridge is dependent on the design of the bridge but it is in the range of 50 to 75 years, upon which an additional capital expenditure is needed, therefore both present values of the life cycle cost of the tunnel of 50-Year and 75-Year are provided.
- It is important to note that useful life of an asset means that the asset is designed to last at least the defined number of years with regular O&M spend. A typical approach is to account for a replacement cost of the asset at the end of expected useful life of the asset.
- Based on the analysis, the Present Value of the O&M Cost of the tunnel is around $100Mn, $148Mn and $240Mn for 50, 75 and 125 years, respectively

Forecast Period	Cumulative O&M Cost	Present Value (Today's Dollar Value)
50 Year Forecast	$195,740,776	**$99,735,368**
75 Year Forecast	$395,260,708	**$147,800,235**
125 Year Forecast	$1,259,619,767	**$240,468,584**

Table 7: Cost Over Life of Asset (Discounted to PV)

SECTION 7

FUNDING OPTIONS

FUNDING OPTIONS

Introduction

Funding from the IIJA is being distributed nationwide, becoming a prominent subject in numerous State of the State speeches by Governors as they initiate the new year. The infrastructure legislation, enacted in November 2021, allocates a total of $1.2 trillion, with around $550 billion dedicated to new spending initiatives and investments. Announcements regarding expenditures and the commencement of projects have emerged from various regions, predominantly concentrating on the IIJA's key areas of interest, including roads and bridges, power infrastructure, broadband, as well as passenger and freight rail.

Programs that include heavy rail, commuter rail, light rail, streetcars, and bus rapid transit can benefit by applying for FTA grants. This would include the Capital Investment Grant. Other Federal Non-FTA grants can also be utilized for funding such as those available under USDOT and FRA. Finally, local funding entails funds available via state DOTs and local taxes.

In developing project funding solutions, federal grants related to tunnel projects have been considered due to the project's strong emphasis on community connectivity, justice components, and the importance of north-south connectivity, making this project a strong candidate for funding.

The funding options in this report are based on the options presented in Whitehouse Report, which provided funding contribution required from local sources. It is our understanding that the local funding from the County will be allocated from the transportation surtax approved for a period of 30-year, 1% sales surtax in November 2018. Each of the three options presented federal and state contributions complement the local funding for the New River Crossing Project.

FUNDING OPTIONS: WHITEHOUSE REPORT

Whitehouse Report presented three key funding options, shown below:

Amts in Mn	MID-LEVEL BASCULE BRIDGE		
Capital Cost	$ 572*		
	Option 1 - Non-Federal	Option 2 - Federal FTA**	Option 3 - Federal Non-FTA
% Allocation			
State/FDOT	50%	25%	25%
Local Funding/Broward County	50%	25%	25%
Federal Grants		50%	50%
Capital Cost Distribution Under Options			
State/FDOT	$286.00	$143.00	$143.00
Local Funding/Broward County	$286.00	$143.00	$ 143.00
Federal Grants		$286.00	$286.00

Table 8: Funding Options as per Whitehouse Report

**Capital Cost assumed is based on previously proposed mid-level bascule bridge (Currently under redesign by the County)*

***Eligibility for FTA Funding is primarily based on ridership*

Option 1 Non-Federal

In this approach, the state DOT would collaborate with the County to finance the project. Funding for local infrastructure typically originates from various sources, including local general taxes, special funds like dedicated user fees and designated taxes, intergovernmental grants, bond proceeds, or a mix of these options. This option is based on the understanding that surtax dollars will be made available for local funding for the project. In this scenario, both the County and the state DOT would each cover 50% of the funding. Various advantages of this approach include fast decision-making, reduced risks attributed to inflation and no requirement for federal compliance.

FUNDING OPTIONS: WHITEHOUSE REPORT

Option 2 Federal FTA

Federal and state grants represent a major funding source of local infrastructure financing. For this option, the FTA's Capital Investments Grant is considered as a 50% contribution with the remaining 50% split equally between state and local. This option would require FTA rating of Medium or better to be eligible for FTA Capital Investment Grant.

Option 3 Federal Non-FTA

This option entails a range of federal discretionary grants to cover 50% of the cost whereas the rest of 50% is split equally between the state and local.

FUNDING OPTIONS BASED ON LEVEL 4 TUNNEL COST ESTIMATE

The table below presents Funding options based on the Level 4 cost estimates of the tunnel alternative presented in this report.

Amts in Millions	Tunnel Alternative		
Capital Cost (Year of Expenditure)	$ 1,040		
	Option 1	Option 2	Option 3
% Allocation			
State/FDOT	28%	14%	14%
Local Funding/Broward County	28%	14%	14%
Federal Grants	45%	73%	38%
Federal Financing			34%
Capital Cost Distribution Under Options			
State/FDOT	$ 286.00	$ 143.00	$ 143.00
Local Funding/Broward County	$ 286.00	$ 143.00	$ 143.00
Federal Grants	$ 468.00	$ 754.00	$ 400.00
Federal Financing			$ 354.00

Table 9: Funding Options for Tunnel

- Option 1: Assumes 45% contribution from federal grants whereas local contribution will be 28%.
- Option 2: Assumes 73% contribution from federal grants whereas local contribution will be 14%.
- Option 3: Assumes 38% contribution from federal grants with federal financing contributing 34%.
- All options assume that the local contribution is steady state and in line with previous studies. Since most of the federal grants require a local match, federal financing can be considered as a local match.

FUNDING OPTIONS BASED ON LEVEL 4 TUNNEL COST ESTIMATE

- USDOT grants that could be considered for this project are CRISI, FSP – National, RAISE, INFRA, MEGA, and Reconnecting Communities. Federal financing options include RRIF and TIFIA which are low-cost interest loans available to projects such as New River Crossing. RRIF financing is now available for a period of 75 years, and this would mean that an annual financing cost can be as low as $15Mn per annum. Such an expense can be easily covered through a value capture approach and identifying alternative revenue sources to fund the project.
- The options presented are an initial step towards development of the project. The table above identifies various funding sources available, and a final option can be a permutation of one of the many options presented in this report. At this stage, these options provide a framework for projects financial planning. In addition, innovative delivery mechanisms should be considered to not only secure funding of the project but also for maximum risk transfer to private parties for construction of the Project.

SECTION 8

CONCLUSION

CONCLUSION

In conclusion, the analysis presented in this report reflects the planning and strategic considerations required for the tunnel alternative for the New River Crossing project. From the initial selection of the tunnel alignment, influenced by geological, infrastructural, and urban constraints, to the station construction methodology, stakeholder engagement, financial strategies, and next steps, this report provides an outlay for future development.

The technical exploration highlighted the critical role of alignment in tunneling, especially in urban environments where horizontal adjustments are often necessary to navigate existing structures and geological challenges. The adoption of the SEM and the potential use of TBM reflect a deep understanding of the need to minimize impact on the urban core and ensure the structural integrity of the tunnel and its surroundings, whilst providing an experience that will not disrupt business operations and will not impact private properties.

Stakeholder engagement and the assessment of property impacts, and resilience strategies have been identified as pivotal elements, ensuring that the Project not only advances with the support of key entities like FECR and Brightline but also incorporates robust measures against environmental challenges, particularly flooding. The financial analysis, revealing a refined cost estimate and a strategic approach to funding, sets a clear path for the Project's economic viability.

As we look towards the next steps, the commitment to finalizing the report and engaging with City staff for feedback signals a proactive approach to addressing any outstanding concerns and refining the Project plan. This report presents a lower cost tunnel alternative as a fiscally viable option with an innovative approach towards project’s funding.

The estimated cost of the tunnel and design that ensures minimal disruption on existing railroad operations and the marine industry is a consideration. This project has emerged as a strong candidate for federal grants, given its potential community benefits, the need for a North-South connectivity and providing mobility option for residents and commuters in South Florida. Moving forward, the Project will require comprehensive impact studies, construction planning, and further refinement of funding plans. Collaboration and continued discussions with stakeholders, and alignment of interests will be crucial in advancing this Project towards a successful realization.

SECTION 9

NEXT STEPS

NEXT STEPS

The City has started down the path of understanding what the community needs from the New River Crossing, defining what the Project should achieve, and scoping the way forward. Several next steps that the City now must take. All these steps will require a concerted effort from City leadership, the County, FDOT, USDOT and the Fort Lauderdale community at large. Some of these next steps will include the following:

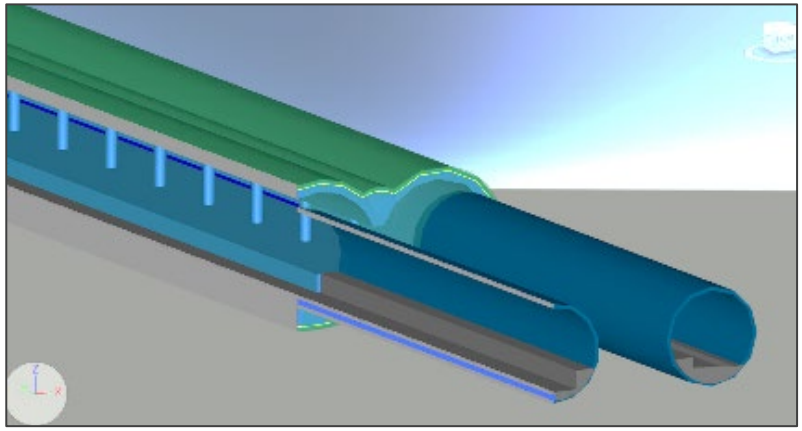
- Continued stakeholder outreach communication and greater understanding, this stakeholder will include, but are not limited to, the County, State, Federal agencies, community groups, homeowners' associations, businesses (both large and small), the marine industry and the railroad operators. For any alternative to be viable, inputs from both Brightline and FECR would be of utmost importance and so will their buy-in.
  - FECR has not seen the tunnel designs but agreed to review it. This would ensure its concerns and limitations are accommodated for the tunnel alternative.
  - Brightline should also be approached to review the revised tunnel alternative and seek their input in relation to underground platform, access to the Brightline Station and other concerns related to their operations.
  - In addition, key stakeholder such as Coast Guard and other agencies should be approached to explore any limitations.
- The Project has significant impact on the City, as such it is recommended that additional impact studies and construction planning to be undertaken. These will need to include but not limited to economic, community, quality of life, property impacts, geotechnical, topographical, and utility surveys.
- Funding for the Project is the most critical element in deciding selection of the alternative. It is recommended that a continued and cohesive approach is adopted to pursue funding opportunities both at the federal level and explore revenue generation alternatives at the local level.

SECTION 10

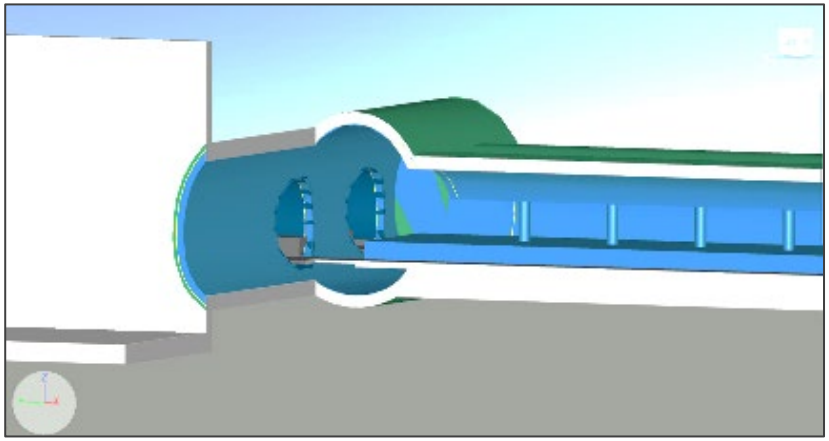
APPENDICES

APPENDIX A – CROSSCUT BIRD'S EYE VIEWS

North end of the Station



South end of the station



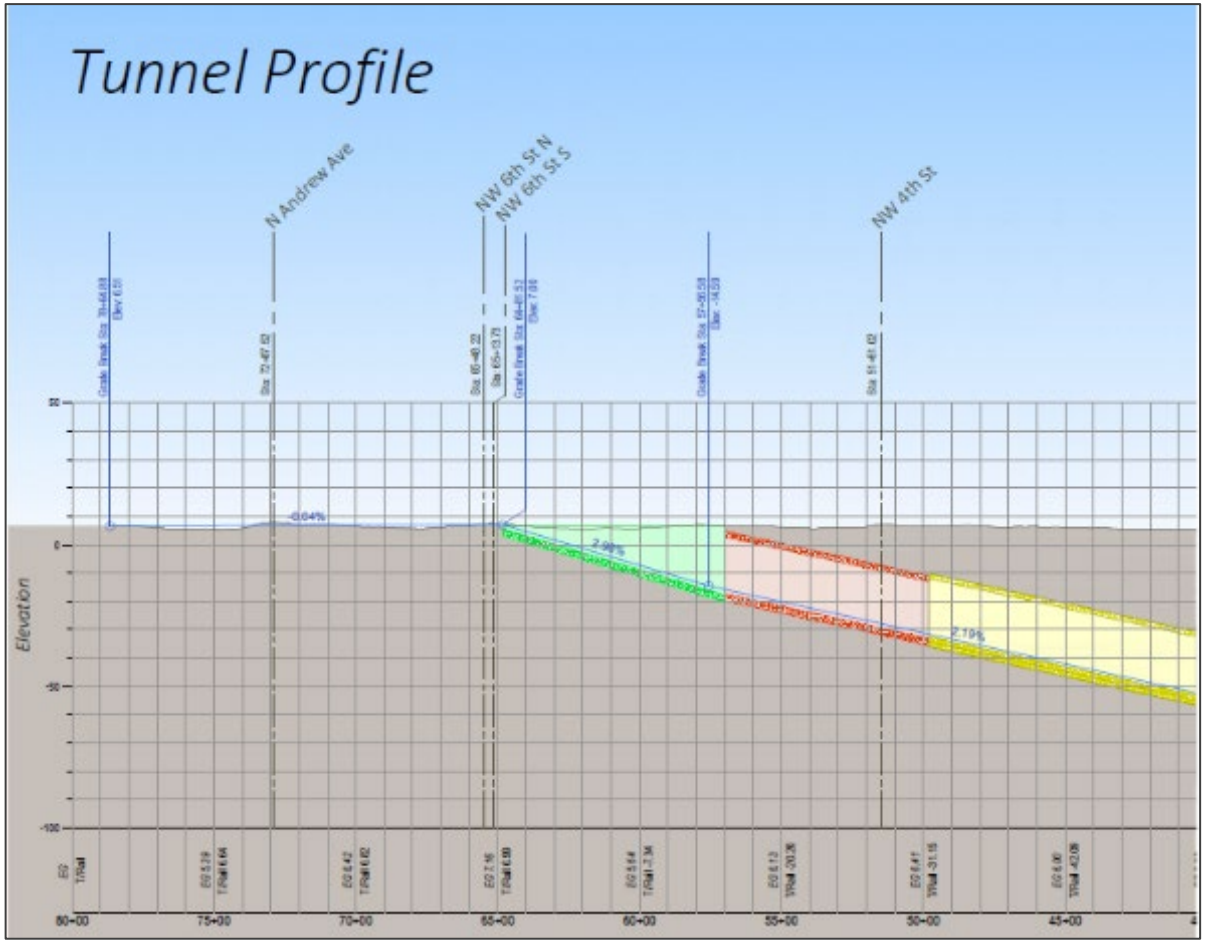
APPENDIX B – O&M COST DETAILS

Category	Description	Quantity / Period	Unit Cost	Total Labor	Burdened cost	Total
Staffing						
	Master Electrician	1	$ 125,000.0	$ 125,000.0	$ 187,500.0	$ 187,500.0
	Master Plumber	1	$ 125,000.0	$ 125,000.0	$ 187,500.0	$ 187,500.0
	Electrician support	1	$ 100,000.0	$ 100,000.0	$ 150,000.0	$ 150,000.0
	Mechanical support	1	$ 100,000.0	$ 100,000.0	$ 150,000.0	$ 150,000.0
	laborer	2	$ 75,000.0	$ 150,000.0	$ 225,000.0	$ 225,000.0
Total Labor						$ 900,000.0
Power Supply	Electrical charge (per month)	12 Months	$ 20,000.0	$ 240,000.0		$ 240,000.0
Replacement costs						
	Tunnel Ventilation System	20 Years	$ 4,400,000.0			$ 220,000.0
	Pumps	15 Years	$ 132,000.0			$ 8,800.0
	Power Substations	20 Years	$ 220,000.0			$ 11,000.0
	Blue Light Stations	20 Years	$ 220,000.0			$ 11,000.0
Miscellaneous	Misc. items per month	12 Months	$ 5,000.0			$ 60,000.0
Total Labor and Materials						$ 1,450,800.0

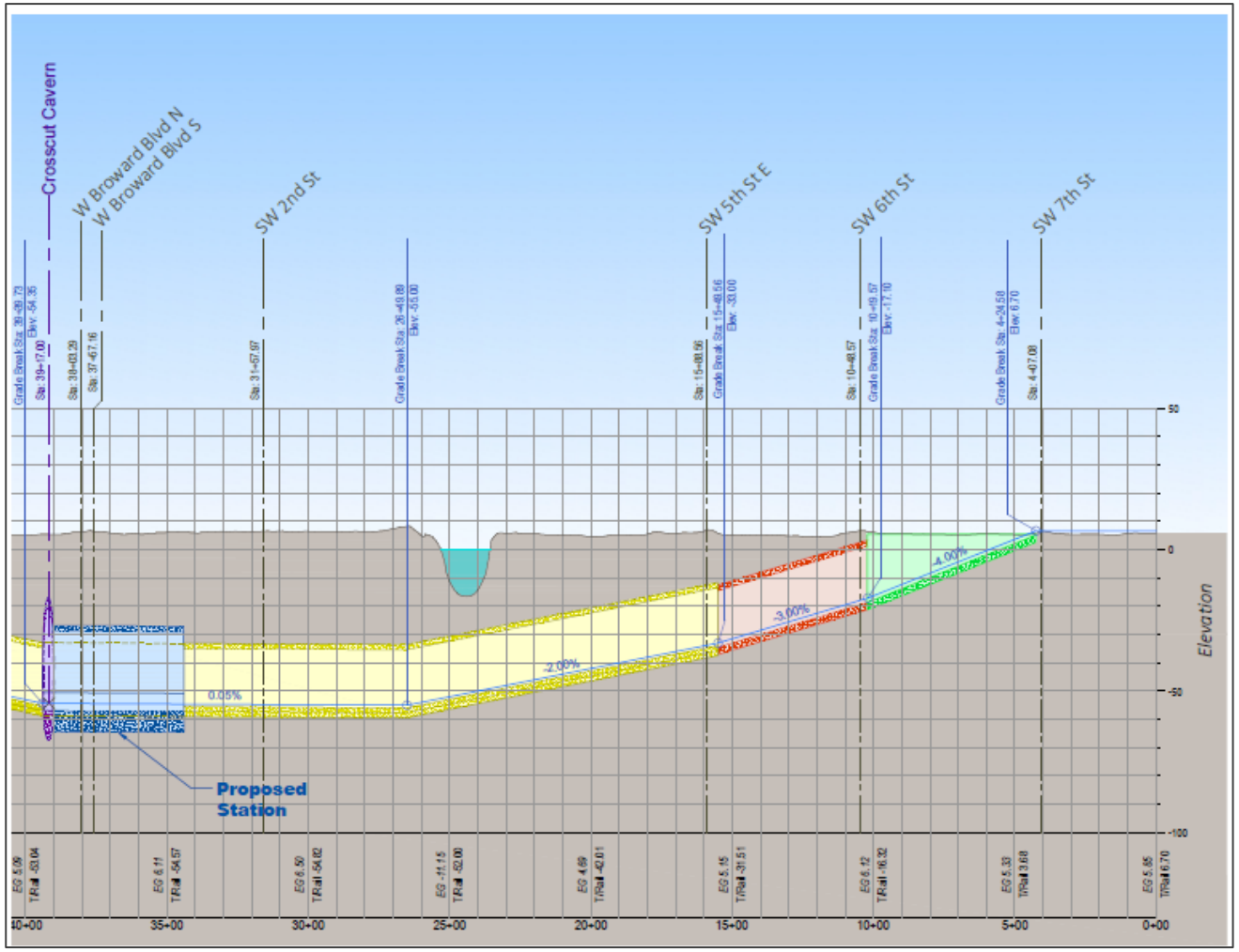
	Contingency	30%				$ 435,240.0
Total O&M Cost						$ 1,886,040.0

Note: This O&M cost does not include the Railroad systems such as signal, communication, operation control, etc. and also the operational costs related to the Station. These are all in line with the previous studies as it has been assumed that such expenses will be for the entire BCR and not limited to the Project.

APPENDIX C - TUNNEL PROFILE NORTH



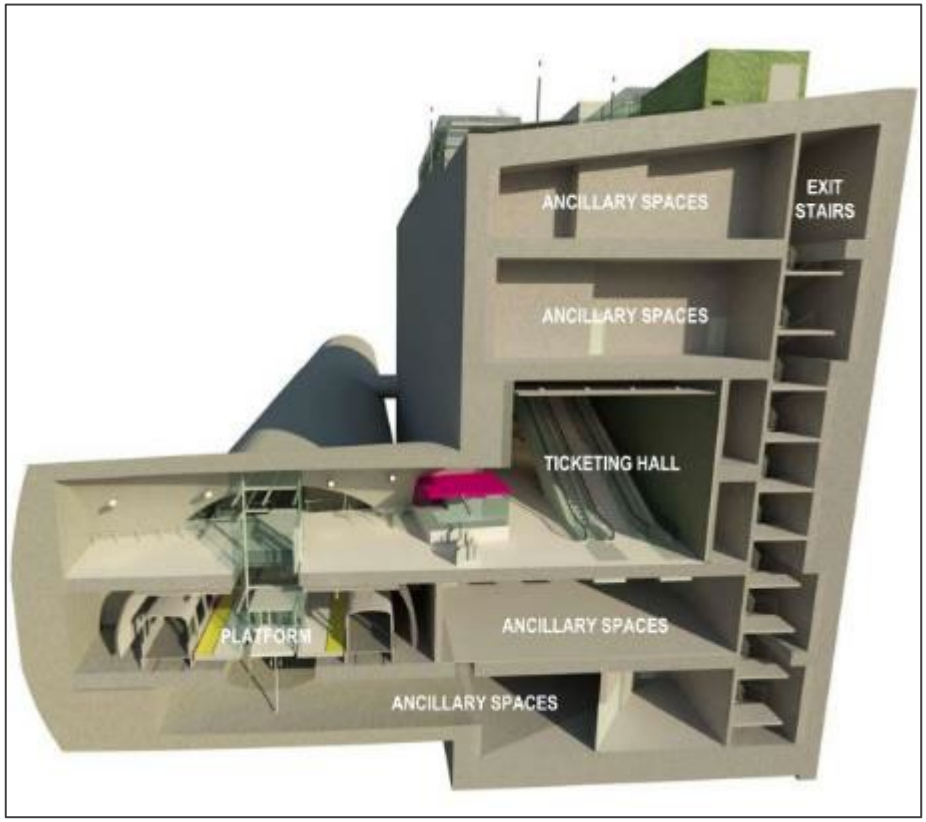
APPENDIX C - TUNNEL PROFILE SOUTH



APPENDIX D - STATION DESIGN EXAMPLE, CHINATOWN SAN FRANCISCO

APPENDIX E - STATION DESIGN EXAMPLE, SPACES

- Cavern Size 55’ wide x 43’ high
- Difficult ground condition
- Large cross-sectional areas
- Pre-excavated TBM Tunnels
- Confined setting with limited construction staging area
- Adjoining historical, sensitive structures, and extensive underground utilities



APPENDIX F – TUNNEL CONSTRUCTION STAGES

The objective of the Project is to construct a tunnel in a way that is both affordable and achievable, with minimal impact on the existing railroads infrastructures and operations. For this project we developed the following construction stages. Please note that the figures shown in the following slides are schematics only and not to scale

It is imperative to address how construction will take place so that the solution proposed is practical and does not hamper any stakeholder's operations These stages will ensure that the tunnel is built with minimal disruption to operations and adjoining properties. Please note that the figures shown in the following slides are schematics only and not to scale :

Stage 0: This is the existing condition of the track configurations on surface. There are three tracks (T1, T2, and T3) north of the station to allow freight trains to bypass the station. Track T3 offers a bypass option for the station, while T1 and T2 pass through the station and proceed southward over the existing bridge.

Stage 1: A new crossover will be installed between Tracks T2 and T3.

Stage 2: With the installation of the crossover, Track 2 can be temporarily taken out of service to construct track slab. The station will remain operational served by tracks 1 and 2 and the freight by-pass remain operational at the station.

Stages 3 and 4: With portion of track 2 taken out of service, a track slab can be constructed and a cross over between track 1 and 2 can be installed. Track 2 will be reinstated and the work in this area will be under the track slab.

Stage 5: In this stage, track 1 north of the station can be taken out of service for the tunnelling operation. The station will remain operational and the by-pass freight track will remain operational.

Stage 6: in this stage the portals on the north and the south will be constructed allowing the launch of the TBM

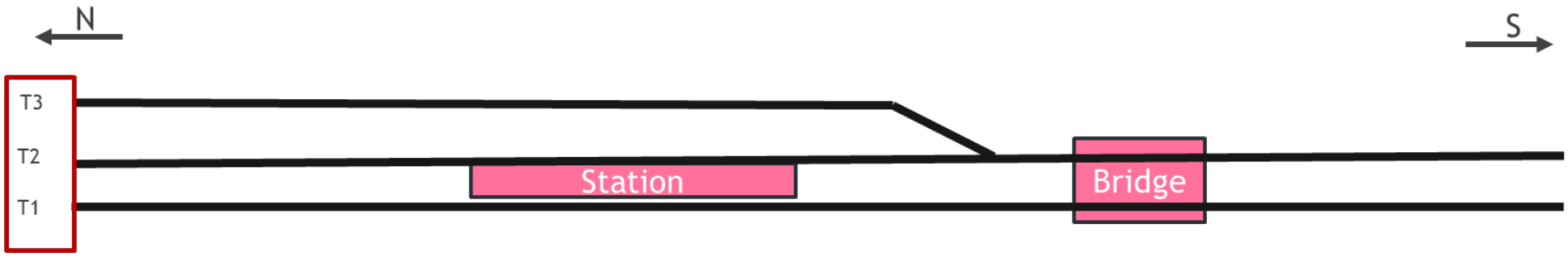
Stage 7: This stage, the TBM will be launched from the north Portal toward the south portal run between the south portals by launching the TBM from the north Launch Portal. All surface operations continue to function without any disruption.

Stage 8: During this stage, upon the completion of the first run of the TBM, It will be transported from the South portal and relaunched from the North portal.

Stage 9: In this stage, the second TBM tunnel will be excavated.

Stage 10: In this stage the approach structures will be completed and the connection to the surface tracks in the north and the south will be completed and the temporary crossovers can be removed.

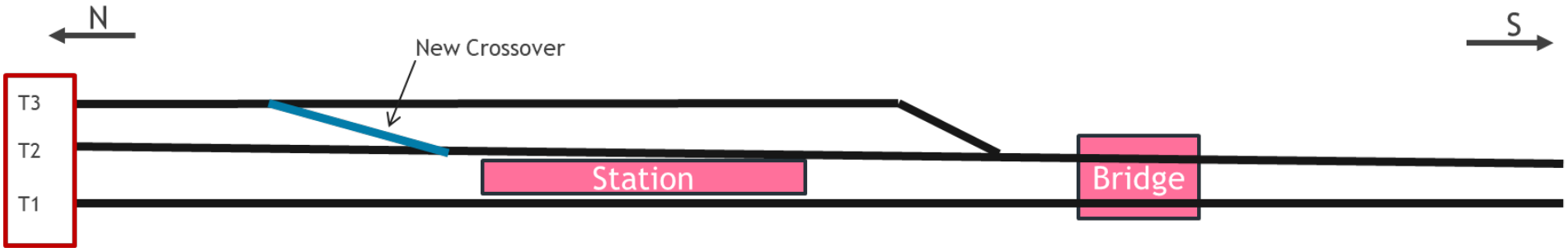
STAGE 0 – EXISTING CONDITION



The diagram above, depicts how the process of maintaining operational tracks involves construction sequencing. When examining the actual tunnel, more data will likely be gathered. The diagram is schematic and not to scale but rather illustrates how the railroad remains functional during this type of work. Essentially, it represents the current state where there is a bridge and a station, with a surface track just before the station that can be used to bypass it.

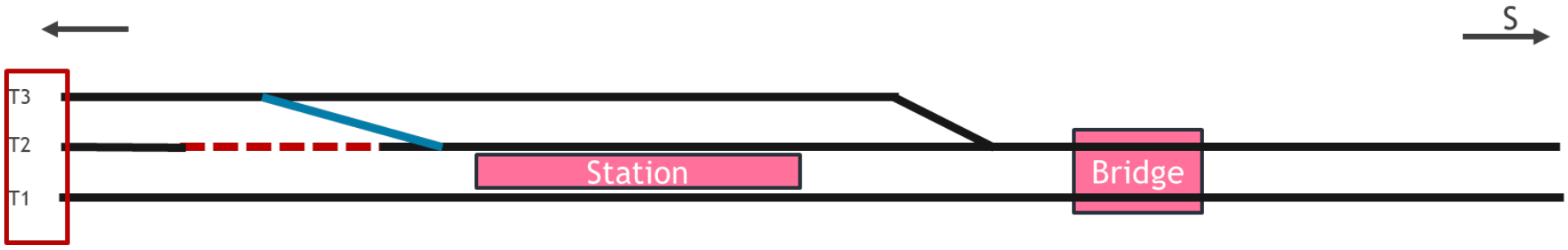
- The Station in this section on the graphic refers to the existing Brightline station
- The Bridge in this section on the graphic refers to the existing bascule bridge

STAGE 1 – INSTALL CROSSOVER T3/T2 TRACKS



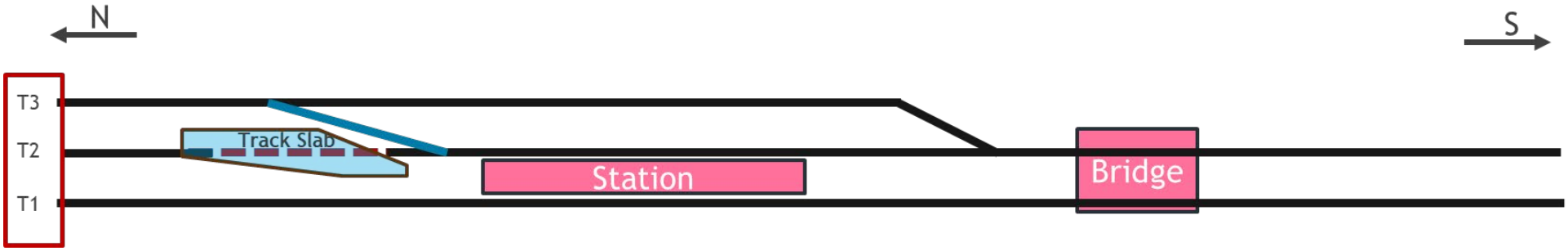
The above diagram depicts the initial step that involves installing a crossover between Track T3 and Track T2. This allows the flexibility of rail operation to connect to the station or to bypass the station as needed.

STAGE 2 – DECOMMISSION T2 TRACK SEGMENT NORTH OF THE NEW CROSSOVER TO INSTALL TRACK SLAB



The above diagram depicts that Track T2 is taken out of service to allow the installation of track slab at this location, while the station and the bypass tracks remains operational due to the presence of Track T1 and Track T3, which can be used to access the crossover and the station.

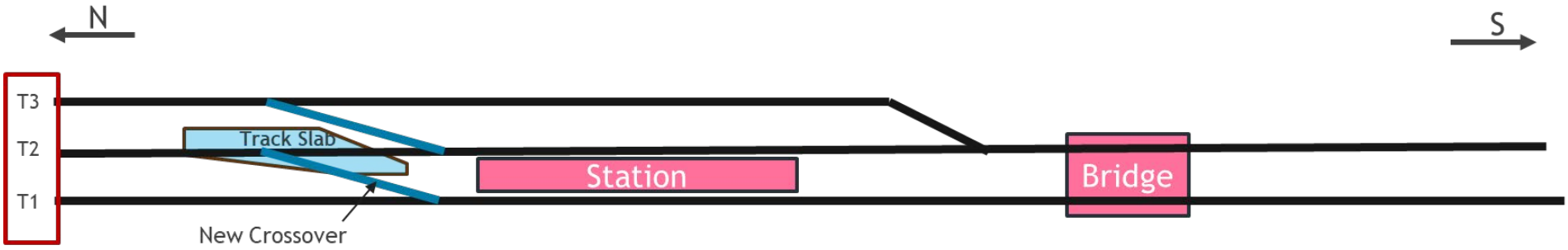
STAGE 3 – INSTALL TRACK SLAB UNDER T2 TRACK



The above diagram depicts the construction of the track slab in this area. The track slab will be a structural slab that will be placed on the ground once the track is removed. Its purpose is two-fold:

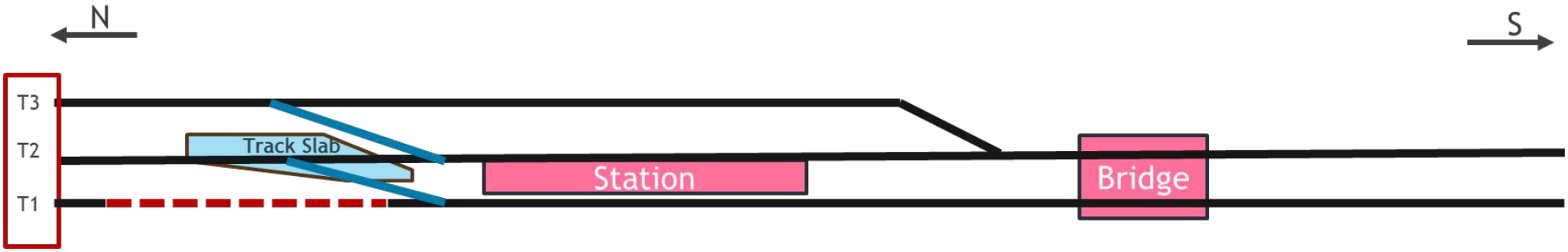
- Serve as a deck;
- Establish a connection between Track T2 and Track T1.

STAGE 4 – REINSTATE T2 TRACK & INSTALL CROSSOVER T2/T1 TRACKS



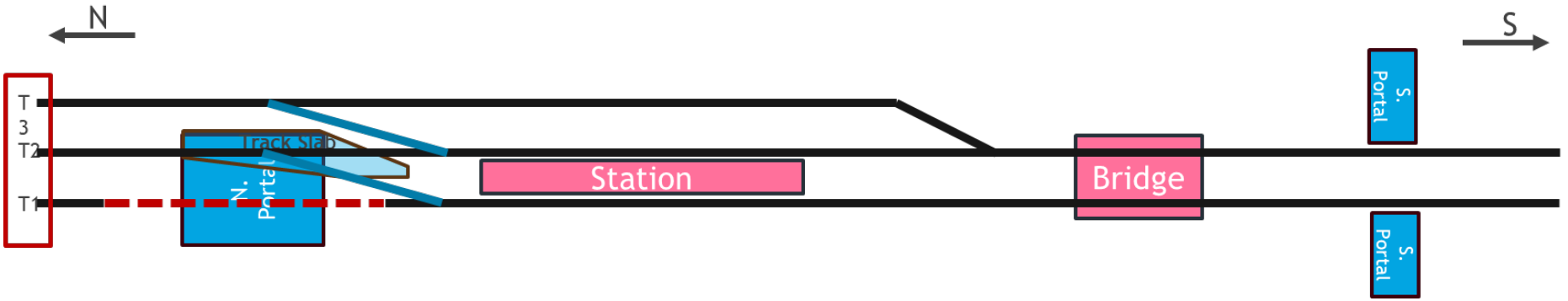
The above diagram depicts the installation of another crossover between Track T2 and Track T1 to allow rail operation flexibility. The track slab acts as a foundation for Track T2 and as roof slab for future cut-and-cover portal.

STAGE 5 – DECOMMISSION T1 TRACK SEGMENT NORTH OF CUT AND COVER SECTION



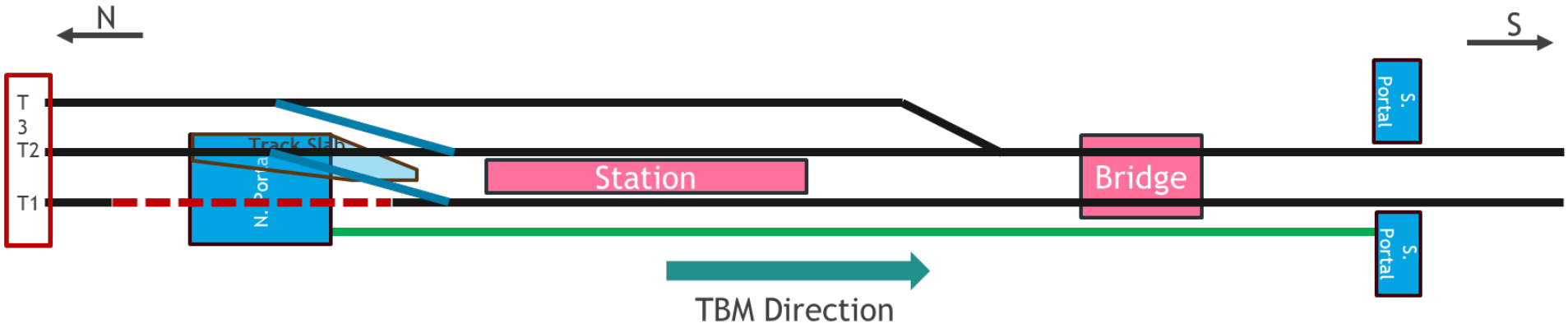
The above diagram depicts that, at this stage, Track T1 north of the track slab can be completely taken out of service it North of the station. Nevertheless, the station will continue to operate as usual, as it remains accessible via Track T2 and Track T3. Also, the bypass track T3 remains operational.

STAGE 6 – PORTAL CONSTRUCTION



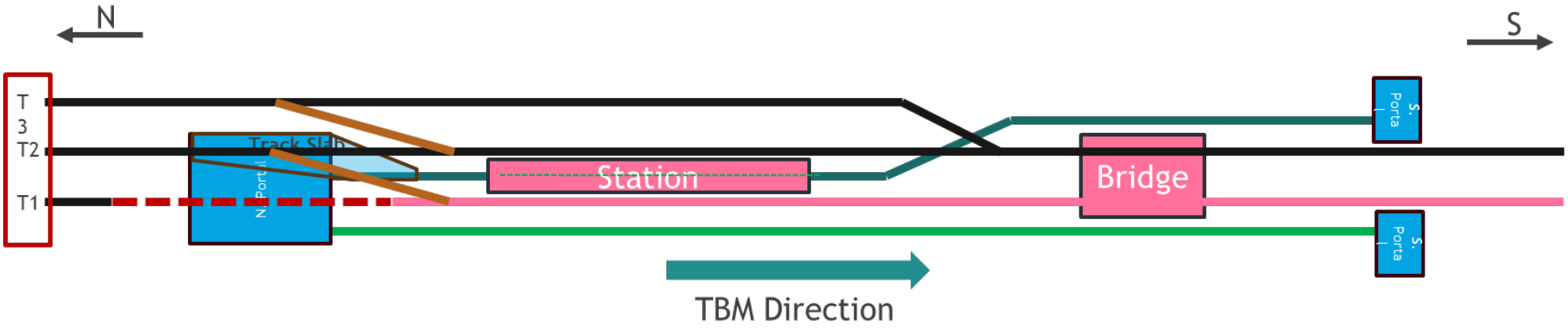
The above diagram depicts that construction will take place from the North at this location. Beneath the existing track slab/decking and the removed track, the North portal will be built, along with the launching shaft for the TBM. Simultaneously, towards the South direction, the two portals required to receive the TBM will also be constructed.

STAGE 7 – FIRST TBM TUNNEL DRIVE



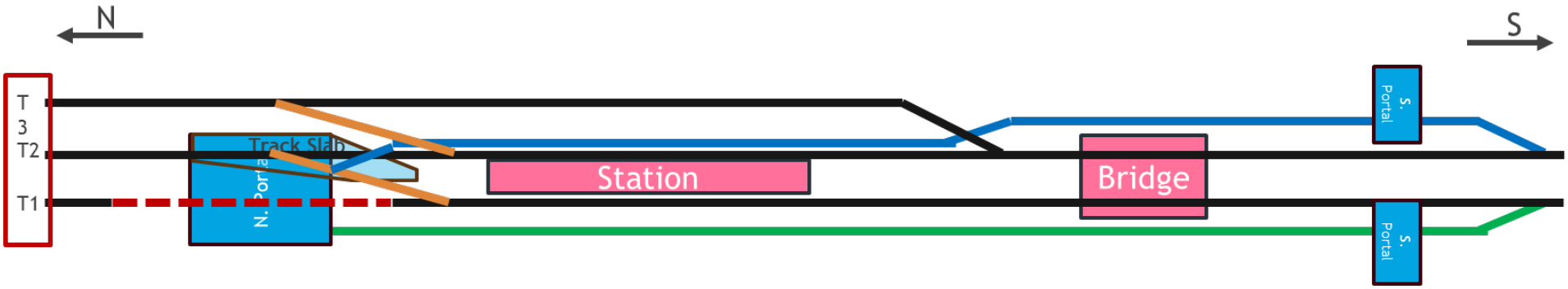
The above diagram depicts that the objective is to have the first run of the TBM between by launching TBM from the North. Note that the green is a tunnel while the black are surface tracks.

STAGE 8 - NORTHBOUND TBM TUNNEL DRIVE



The above diagram depicts the TBM is taken from the south portal and relocated to the same launch shaft area in North portal for subsequent launches from north portal. The green indicates the direction of the TBM, the black indicates the surface tracks, while the blue represents the path towards the South portal where it can be retrieved.

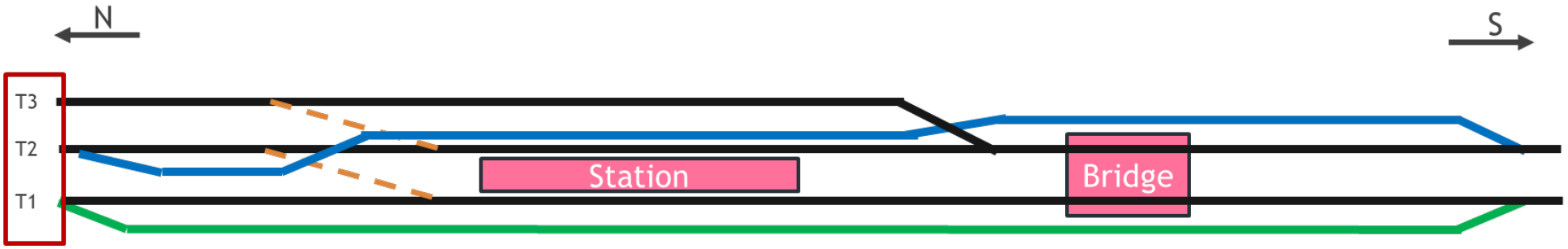
STAGE 9 – SECOND TBM TUNNEL DRIVE



The above diagram depicts a surface connection is established between the traffic cover and T1, as well as a surface connection from the south portal to the existing tracks. The red line represents the tunnel, while the construction above ground is depicted in the surface area. The construction takes place while the surface tracks and station remain operational. The red and green lines between the orange boxes represent the underground tunnel, while the red and green lines outside the orange boxes represent the surface grid. This serves as a connection between the existing track and the switch, and it is only a brief connection point.

- The black represents surface tracks.
- Blue and green represents tunnels.

STAGE 10 – COMPLETE THE APPROACH STRUCTURE AND REINSTATE TRACK T1 AND CONNECT TO SURFACE TRACKS



The above diagram depicts the result of this process will provide the capability to have a straight track at the surface, along with two tracks underground.

- The Tracks T1, T2 and T3 are restored to its original configurations.
- The track work in the tunnels gets completed.
- The crossovers for tracks T3/T2 and T2/T1 can remain in place for operational flexibility if desired.
- The black and brown represent the surface tracks.
- Blue and green represent tunnels.

APPENDIX G - TYPICAL PROJECT PHASES

Currently, there is a significant amount of federal grant money anticipated to be available over the next few years, extending through 2026. One of the most promising avenues for funding for this project is the Inter City Rail Program. With approximately $47 billion still up for allocation and considering the landscape of commuter and infrastructure projects nationwide, the opportunity for funding appears favorable. Allocations have already been made to projects like Amtrak and the Northeast Corridor, leaving other major initiatives in states like California and Florida as primary contenders for the remaining funds. The Brightline project in Florida recently secured $3.5 billion from this same program, adding to a previous allocation of $6 billion. Next steps for the project could look like the following:

PLANNING

Develop project concepts that establish the type and scope of capital project that best meets the goals and objectives identified by the stakeholders.

- Project identification
- Purpose and need
- Project planning
- Conceptual engineering (1%-5%)
- Consideration of alternatives
- Preliminary Project Costs
- Preliminary Funding & Financing Plan
- Cost Benefit Analysis
- Economic Impact Analysis
- Project Development & Environmental Study (5%-15%)

DESIGN DEVELOPMENT

Design Development involves verifying the program requirements and schematic design, further developing and refining the project details to provide a comprehensive description of the project's intent.

- Environmental review (NEPA)
- Preliminary Design and Engineering (15% - 30%)
- Cost estimate
- Budget and schedule
- Project management plan
- Funding plan
- Procurement strategy
- Stakeholder agreement

FINAL DESIGN

Address requirements for new construction, confirm basis of design, develop project plans, establish change management processes and continue to foster communication and stakeholder discussions.

- Final engineering
- Final budget and schedule
- Procurement process
- Project agreements
- Refined project management plan
- Refined financial plan
- ROW acquisition
- Permitting
- Early work and relocations

CONSTRUCTION

Finalize construction documents, conduct procurement process, and oversee construction process. Maintain controls in place to oversee process and ensure adherence to standards, specifications and budget.

- Capital construction
- Env. Re-evaluation
- Commitment compliance
- Equipment acquisition
- Utility construction
- Financing costs
- Construction operations
- Construction oversight
- Testing and commissioning

OPERATIONS

Achieve substantial completion and handover to O&M contractor.

- Punchlist & warranties
- Coordination to ensure monitoring and compliance is in place
- Establish protocols to measure and report benefits
- Project analysis and benefits assessment
- Contingency planning and enforcement of warranties (as applicable)

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