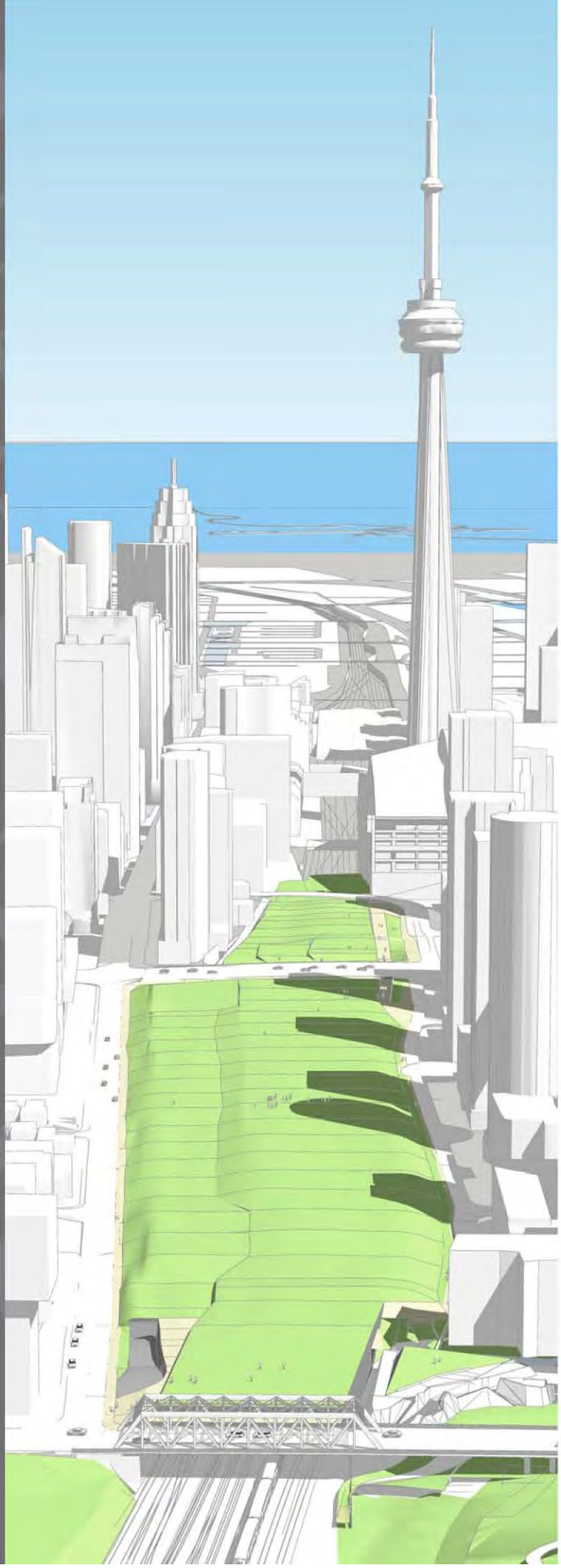


RAIL DECK PARK

Engineering & Costing Study

Executive Summary

NOVEMBER 21, 2017

TORONTO

BUILD TORONTO

WSP

McMILLAN ASSOCIATES ARCHITECTS

EXECUTIVE SUMMARY

Background

The proposal for Rail Deck Park (RDP) comprises the construction of a decking structure over the rail corridor in downtown Toronto between Blue Jays Way and Bathurst Street to facilitate the development of approximately 20 acres of new parkland with associated pedestrian / cycle connections as shown in **Figure 1**. (Potential inclusion of the Metrolinx-owned property at the southwest corner of Spadina Avenue and Front Street increases the size to 21 acres.)

In 2017, an Engineering and Costing Study for Rail Deck Park was undertaken by Build Toronto and consultants WSP and McMillan Associates Architects, in consultation with the City of Toronto. This document provides a high-level summary of the findings from that study.

Figure 1 - Rail Deck Park Study Area

The purpose of the study was to produce a comprehensive reference design concept for RDP with a specific focus on the technical aspects of the site and surrounding areas including:

- Topography, landforms and physical features;
- Rail corridor and yard operations, initiatives and constraints;
- Geotechnical and hydrogeological conditions;
- Structural solutions;
- Archaeological considerations;
- Construction methodologies;

- Vibration and sound attenuation;
- Utilities;
- Traffic and transportation; and
- Permits and approvals.

The study did not involve specific design or programming for the park itself. Instead it incorporated assumptions concerning potential future park design elements to inform the requirements for the decking structure.

Reference Design Concept

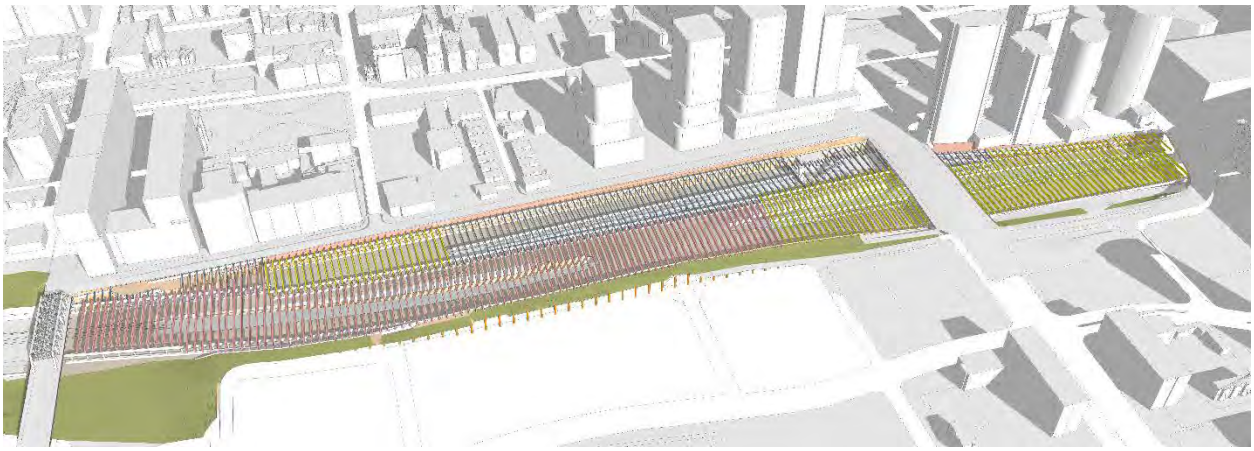
The reference design concept for RDP was developed from the "bottom up" utilizing data that was collected from various sources. The design concept was informed by a tabletop review of existing conditions that was undertaken at the onset of the study. The design concept addresses edge conditions of the new park development and consider connectivity, grade separations, pedestrian movements, and emerging potential park programming elements.

The design concept considers structural solutions that will be permissive of a range of park and ancillary uses.

The concept design is intended to be non-prescriptive in nature in order to allow for the maximum range of programmatic elements and future design activities. Consideration has been given to a range of possible solutions for all systems including foundations, structures, mechanical, and electrical systems. Conceptual layout plans including track level plans, street level framing plans, and street level grading plans have been prepared to illustrate the project conditions. The concept design includes track-level structures and the deck supporting frame as shown in **Figure 2**.

Cross sections and 3-dimensional models have been developed through this study. A sample of these cross sections and models is provided in the Appendix to this document.

Figure 2 - Track Level Structure



Integration of Rail Deck Park with Rail Corridor and Yard System Planning

The emerging capital plans and initiatives in the rail corridor were explored along with some of the technical considerations applicable to undertaking design and construction in and around the rail system. As planning for Rail Deck Park progresses, ongoing coordination with Metrolinx will be essential.

The existing rail infrastructure in the study area was assessed. The rail corridor is comprised of active rail lines along the entire corridor, and an adjacent storage yard between Bathurst Street and Spadina Avenue. There are four major rail lines from the west that access the Union Station Rail Corridor (USRC) including nine approach tracks plus seven yard tracks between Bathurst Overhead and Spadina Avenue that may be affected by RDP construction.

Rail Deck Park will be located above the USRC and will need to be coordinated with capital works phased or underway in the rail corridor. Current rail planning considerations include future track works, signal systems upgrades, switch machine replacement, and electrical enabling works.

The design concept for RDP complies with Metrolinx's recently published Performance Specifications for Structures Passing Over Electrified Corridors. (Vertical clearance can be obtained using different design options such as alternative track tie profiles and/or by raising the overhead structures.)

The design concept incorporates minimal new structural elements within the rail corridor due to limited space. Further study into the effect of electromagnetic fields will be required as planning for RDP progresses.

A new GO station at Front Street West and Spadina Avenue is planned as a part of service expansion under the GO Regional Express Rail initiative. Preliminary designs for station circulation and track-level platform are incorporated into the design concept.

Rail corridor access and permits are critical considerations for the future construction of RDP. Construction access routes, track and work blocks (including potential delay and cancellation of these blocks by Metrolinx), track protection and flagging, and construction safety are some of the key elements that will influence the development and the overall cost of the project.

Geotechnical and Hydrogeological Assessment

For the purposes of planning, and based on a tabletop review of existing conditions, key assumptions considered the composition and thickness of the soil and groundwater levels. Two foundations options were considered in the design concept, including driven steel H-piles and augured caissons.

It was determined that groundwater conditions will not affect the design of the deep foundation units and dewatering is not expected to impact the installation of driven piles.

Groundwater may however impact the installation of caissons and will require further investigation.

Structural Design

The proposed structural system considered in the design concept is long span girders spanning north-south, with secondary framing or cast-in-place concrete beams and columns in the east-west direction. Lateral stability will be provided by cast-in-place shear walls and by rigid frames and buttressing.

Maximum span lengths are approximately 60 metres. Preliminary girder systems considered in the design concept are structural steel trusses, steel box girders, precast concrete girders, and precast concrete segmental girders. The structural girder depths range from 1.5 metres to 4.5 metres depending on span and type.

Civil and Mechanical Systems

The approach to servicing focuses on identifying options where services can be located rather than where they should be located, since the programming of the park has not been established.

Servicing analysis included storm drainage, watermains, sanitary sewers, Toronto Hydro, and telecommunications.

The depth of the secondary structural system will allow for major civic and mechanical systems to be incorporated within the decking structure.

This analysis does not demonstrate any major constraints for future design and integration of civil and mechanical systems once requirements, related to both above and below deck functions, are articulated.

Noise and Vibration

The design concept provides mitigation of train-related noise and vibration as the deck essentially provides a large and absorbent barrier.

Careful consideration of materials and design will be required to avoid amplification of train-related noise at the openings. This can be mitigated through the use of sound absorptive materials below the deck without adversely impacting uses above the deck.

Below-Deck Safety Systems

The design concept gives consideration to general requirements for below-deck safety systems related to RDP include:

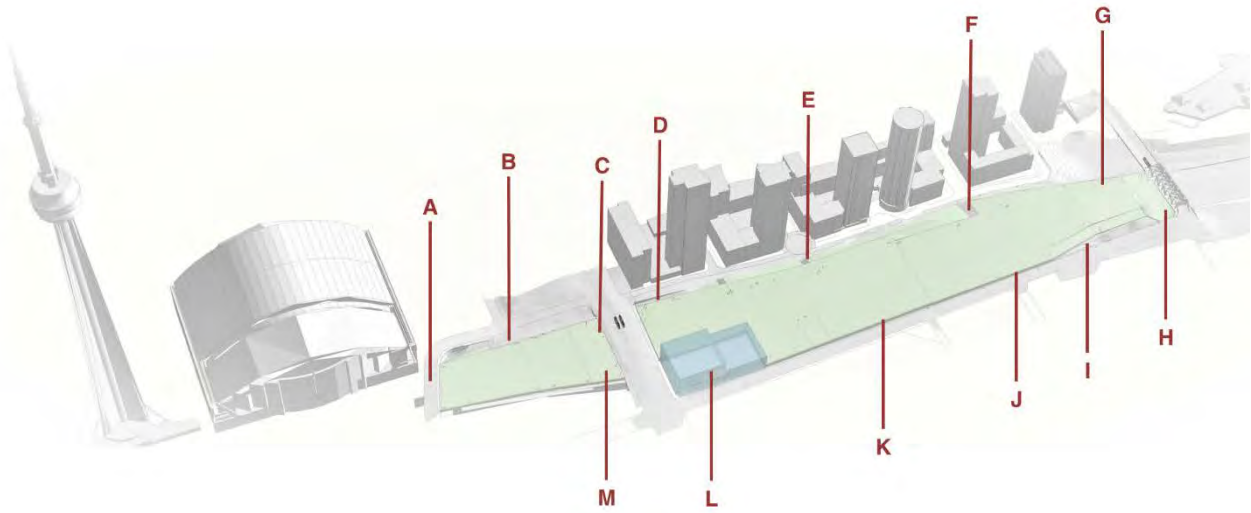
- Lighting system that is vandal-resistant;

- Emergency lighting to illuminate exits, corridor, principal routes and any typical congregation areas, with uninterruptable and back-up power supplies;
- Air quality / ventilation system that provides permanent and temporary (during construction) ventilation, and one that does not negatively impact the above-grade uses on or around RDP;
- Emergency evacuation of train passengers including an emergency procedure plan;
- Emergency egress and signage including warning and hazard signs;
- Emergency generator designed to meet clearance requirements; and
- Fire protection including automatic fire detection, standpipe and hose systems, and portable fire extinguishers.

Topographic Integration

The topographic conditions along the perimeters of RDP were evaluated and took into consideration the grading of the decking structure relative to existing elements shown in **Figure 3**. The lowest vertical separation occurs in the area of the Spadina Pedestrian Underpass (D) and Capreol Court (E) while the greatest vertical separation occurs in the area of the Northern Linear Park (B).

Figure 3 - Rail Deck Park Perimeter Conditions



A. Blue Jays Way
B. Northern Linear Park
C. Spadina Avenue
D. Spadina Pedestrian Underpass
E. Capreol Court
F. Dan Leckie Way
G. Mouth of the Creek Park
H. West Toronto Rail Path
I. Metrolinx Ramp to/from the Rail Corridor
J. Portland Street
K. Front Street
L. Spadina RER Station and Mx Property
M. Spadina South of Front

Authorities Having Jurisdiction and Approvals

Rail Deck Park is subject to City of Toronto by-laws and/or requirements. Permits, licenses and approvals will be required from various agencies at the provincial and federal levels, including routine requirements and those related to construction in the rail corridor. Metrolinx, for example, as the transit authority, will undertake a technical review of the design and have responsibility for approval of a construction access agreement.

EA Requirements

Initial evaluation suggests that an Environmental Assessment (EA) should be undertaken and can be delivered through a streamlined process (e.g., the Schedule C Municipal Class EA process).

Construction Methodology

The Engineering and Costing Study considers the logical sequencing of construction steps as follows:

- **Early Works:** Work required across most or all of the RDP site to relocate utilities, construct temporary facilities, establish access points, and staging areas and to erect barriers;
- **Foundations:** major below-ground structures in and around the Rail Yard, including hoarding, shoring, removal of fill, excavation, installation of caissons and other structures, and primary grade beams;
- **Primary Structures:** walls and columns parallel to tracks (in the east-west direction);
- **Secondary Structures:** long-span girders over the tracks (in the north-south direction);
- **Systems:** fit-up of major mechanical, electrical, irrigation, and drainage systems;
- **Decking:** dressing above the trusses plus securing the underside; and
- **Park:** installation of hard and soft landscaping, park program, and facilities.

Approach to Phasing

Construction “phasing” refers to the order in which the RDP development and construction could be sequenced. It must be logically conceived while also viewed in the context of an overall vision for the project.

The proposed approach to phasing for RDP, shown as **Figure 4**, shows a preferred Phase 1 option which starts west of Spadina Avenue and extends to the current location of the "Puente de Luez" pedestrian bridge.

Although the figure shows one option for the sequence of future phases of RDP, this should be reviewed based on programming and design considerations for the park, as well as alignment with related capital works in the rail corridor.

Figure 4* | *Rail Deck Park Phasing

Scope and Costs

The cost estimate was developed as a **Class 4 Estimate,** in accordance with guidelines provided by the Association for Advancement of Cost Engineering.

The total budget for complete development of Rail Deck Park is estimated to be in the range of $1.665 billion as shown below in **Figure 5.**

The estimate is based on an analysis of the reference design concept, which is advanced to between 1% and 5% design development.

The cost estimate reflects the scope of the design concept which has been quantified and estimated. The design concept will be substantially refined and elaborated through subsequent stages of design.

<u>Cost Categories</u>

The cost summary was developed for early works (Phase 0) and each of the four construction phases (Phases 1-4) for the decking structure and park development.

Hard costs generally include all elements related to early-works, foundations, primary and secondary structures, systems, decking and park development described above.

Cost associated with the early works should be considered provisional until further information concerning related capital works in the rail corridor are known. There is a higher degree of certainty associated with deck and park construction which are more applicable to quantity and unit price analysis.

Exclusions from the cost estimate include soft costs related to services that could reasonably be delivered by the City (e.g., legal costs), taxes and fees administered by the City, and escalation. Allowances and contingencies have been documented.

General Requirements

General requirements for track related work are cited as much higher than customary. It is assumed that these allowances will remain applicable to work related to the rail corridor, rail yard, and any work which is to be performed adjacent to or above the rail lines.

Work Restrictions

Approximately $304 million is allocated to work restrictions related to premiums for construction activities in, around or above the rail corridor and yard. These values are subject to refinement through advancement of the concept and development of constructability methodologies with Metrolinx, and are considered to be highly variable at this stage.

Contingencies

Approximately $327 million is allocated to design and pricing, construction and other contingencies. Design contingencies are lower for deck and park construction, where the scope is clearer and the methodological uncertainty related to track work is reduced.

Potential for further certainty of scope and/or reduction of contingencies can be realized during subsequent design work and through engagement with Metrolinx. This will involve work to refine the assumptions of this study, determine design scope for early works with more certainty, and through coordination of track-level works associated with Rail Deck Park, North Bathurst Yard reconfiguration, and Spadina-Front GO Station construction.

Figure 5 - Rail Deck Park Cost Summary by Phase

	Phase 0 & 1	Phase 2	Phase 3	Phase 4	TOTAL
Area (square metres)	37,972	10,600	17,199	15,738	81,509
Early Works Packages	155,000,000	7,000,000	9,000,000	9,000,000	180,000,000
Deck Construction	255,000,000	73,000,000	99,000,000	103,000,000	530,000,000
Park Construction (On Top of Deck)	39,000,000	13,000,000	16,000,000	14,000,000	82,000,000
sub-total	**294,000,000**	**86,000,000**	**115,000,000**	**117,000,000**	**612,000,000**
General Requirements	42,000,000	12,000,000	16,000,000	17,000,000	87,000,000
Construction Management Fee	29,000,000	8,000,000	11,000,000	12,000,000	60,000,000
Work Restrictions	146,000,000	42,000,000	57,000,000	59,000,000	304,000,000
sub-total	**511,000,000**	**148,000,000**	**199,000,000**	**205,000,000**	**1,063,000,000**
Design and Pricing Contingency Construction (C/O) Contingency Other Allowances	156,000,000	44,000,000	63,000,000	64,000,000	327,000,000
HST- Excluded	0	0	0	0	0
Total Construction Costs (excluding early works)	**667,000,000**	**192,000,000**	**262,000,000**	**269,000,000**	**1,390,000,000**
Total Construction Costs (including early works)	**822,000,000**	**199,000,000**	**271,000,000**	**278,000,000**	**1,570,000,000**
Total Design Fees (including contingency)	**50,000,000**	**12,000,000**	**16,000,000**	**17,000,000**	**95,000,000**
Total Construction Costs and Design Fees	**872,000,000**	**211,000,000**	**287,000,000**	**295,000,000**	**1,665,000,000**
Cumulative Total (excluding escalation)	**872,000,000**	**1,083,000,000**	**1,370,000,000**	**1,665,000,000**	

APPENDICES

KEY

- EXISTING STRUCTURE
- PROPOSED WALL STRUCTURE
- EXISTING RAIL TRACKS

TRACK LEVEL PROPOSED PLAN

RAIL DECK PARK

DRAWING NUMBER: ROP-APP-A-01

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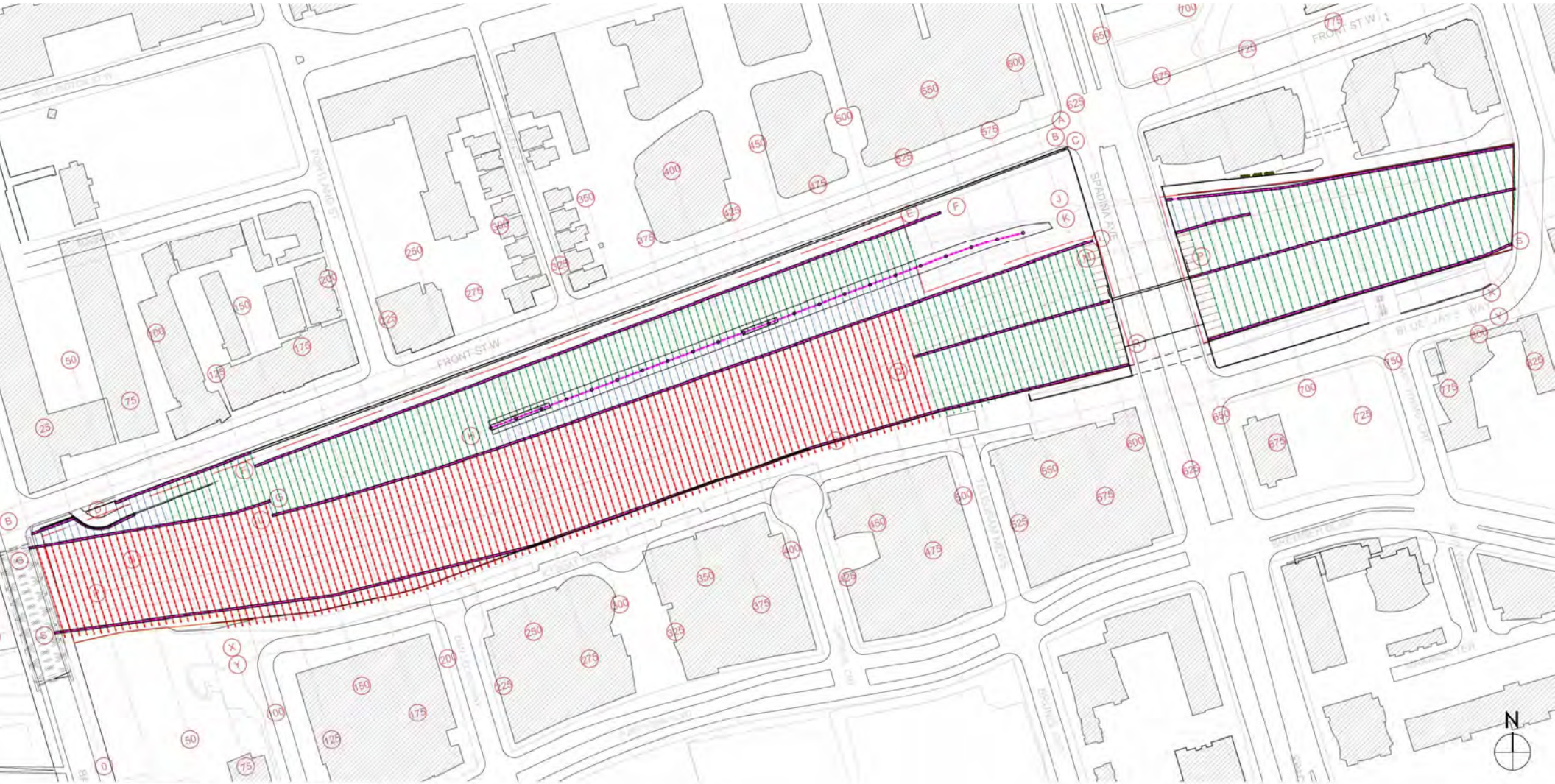

metres 100 200

SITE BOUNDARY
PRIMARY BEAM
SECONDARY BEAM (1 - 20m STRUCTURAL SPAN)
SECONDARY BEAM (20-40m STRUCTURAL SPAN)
SECONDARY BEAM (40-60m STRUCTURAL SPAN)
I BEAM

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STREET LEVEL PROPOSED PLAN

SCALE 1:1000 @ 34"X22" 1:2000 @ 17"x11" 05 JULY 2017

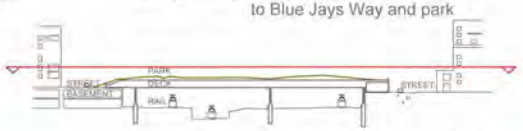
DRAWING NUMBER RDP-APP-A-02

RAIL DECK PARK

metres 100 200

KEY

- STEPPED ACCESS
- RAMPED ACCESS
- LIFT ACCESS
- ENTRANCE TO RAIL DECK PARK
- +89.1 PROPOSED LEVEL
- +89.1 EXISTING LEVEL



PARK LEVEL PROPOSED PLAN

SCALE: 1:1000 @ 34"X22" 1:2000 @ 17"X11" 26 JULY 2017

DRAWING NUMBER: RDP-APP-A-03

RAIL DECK PARK

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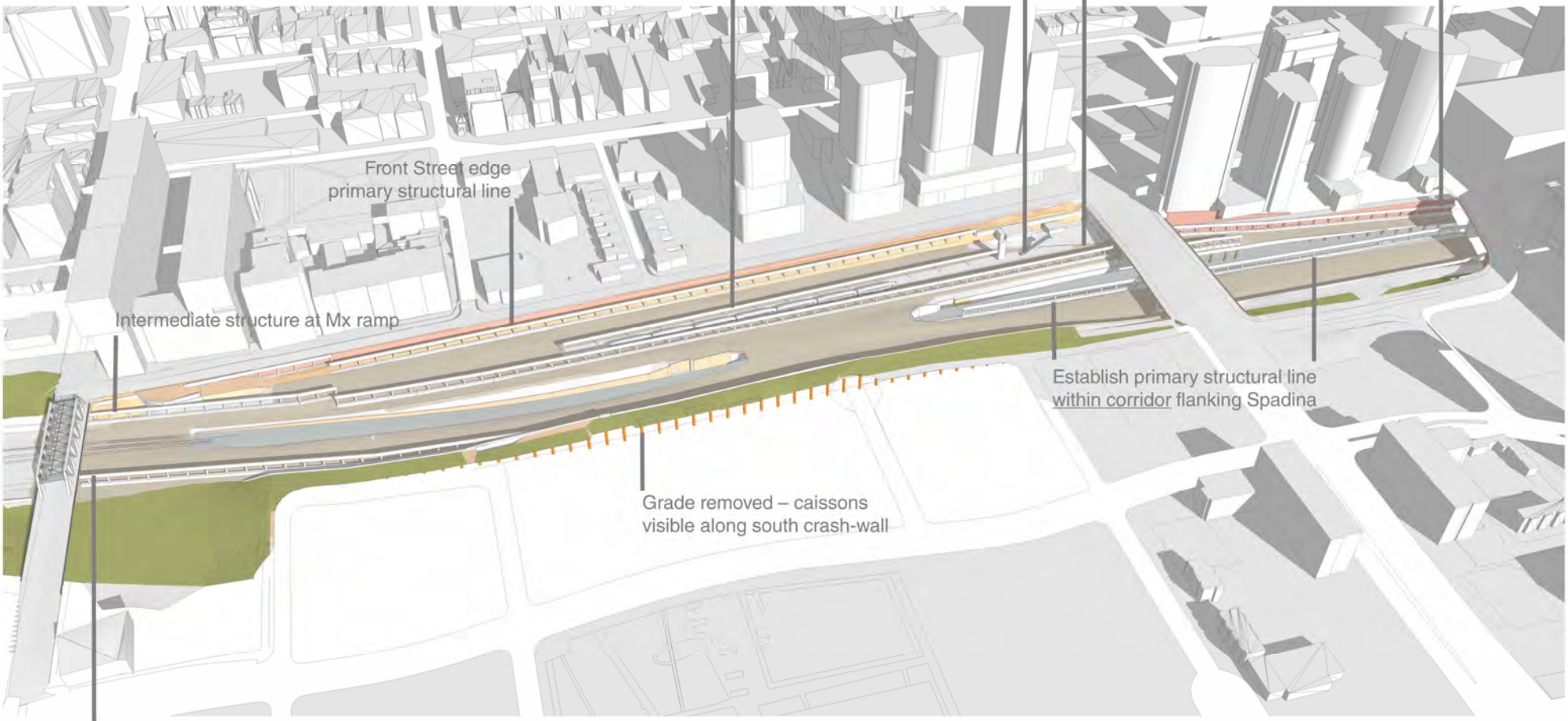
REFERENCE CONCEPT

FOUNDATIONS + STRUCTURE

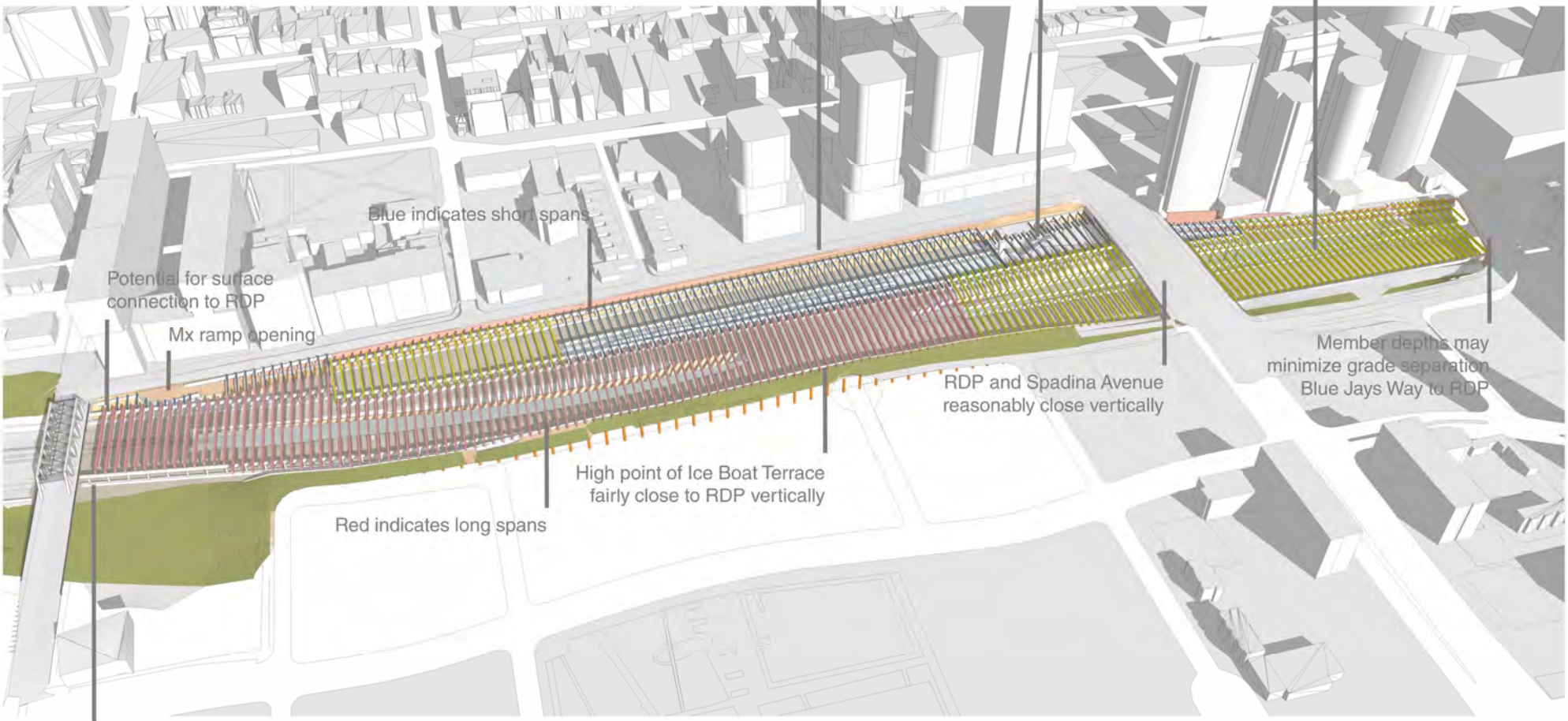


DRAWING NUMBER
RDP-APP-C-02

RAIL DECK PARK

REFERENCE CONCEPT

DECK + PARK



DRAWING NUMBER
RDP-APP-C-03

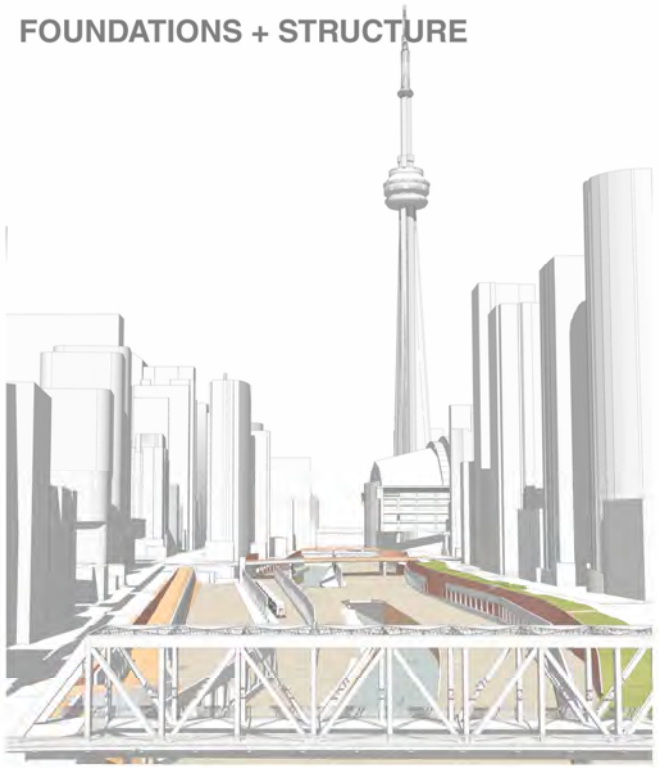
RAIL DECK PARK

CONSTRUCTION SEQUENCE

EARLY WORKS

Utility Relocates
Track Relocates
Demolition
Site Remediation
Temporary Works
- Temporary services or relocates
- Overhead protection for trains and rail personnel
- Creation of Laydown Areas for construction
- Creation of construction access points
- Temporary work for Phasing purposes

FOUNDATIONS + STRUCTURE



Substructure:
- Foundations
- Bulk Excavation
- Special Conditions

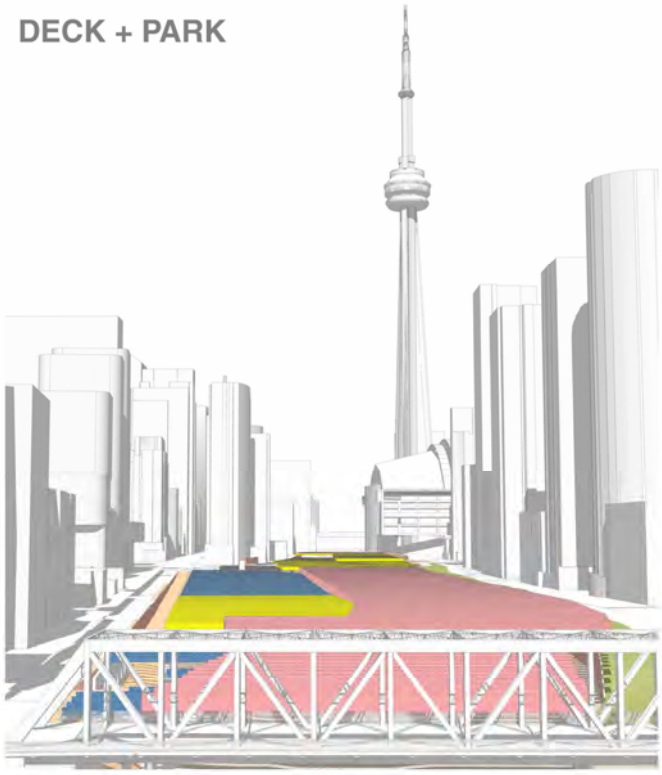
Site Development:
- Mechanical Site Services
- Electrical Site Services

- Ancillary Work

Demolition & Alterations

Sitework:
- Site Development
- Mechanical Site Services
- Electrical Site Services
- Ancillary Work
- Demolition & Alterations

DECK + PARK



Structure:
- Suspended Deck Construction
- Roof Construction

Mechanical:
- Plumbing & Drainage (Track Level and Deck Level)
- Fire Protection (Track Level)
- HVAC (Ventilation of track level)
- Controls

Electrical:
- Service & Distribution
- Lighting Devices & Heating
- Systems & Ancillaries

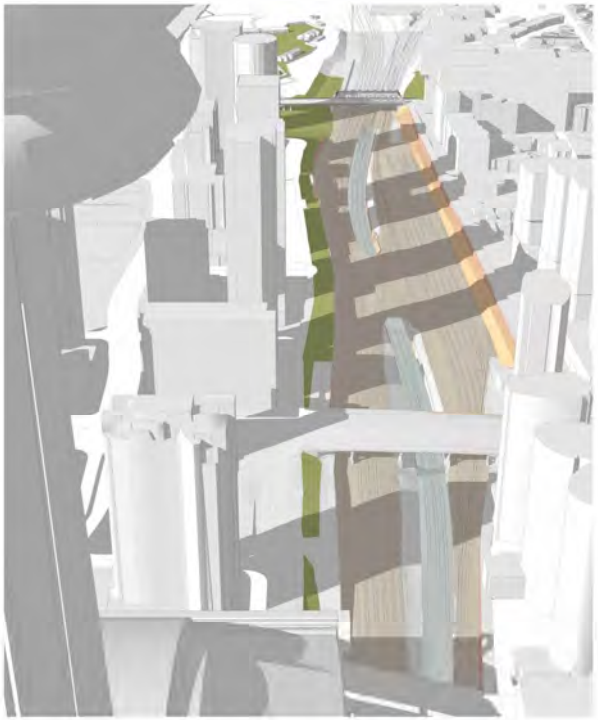
Park Installation (not yet shown)

DRAWING NUMBER
RDP-APP-C-04

RAIL DECK PARK

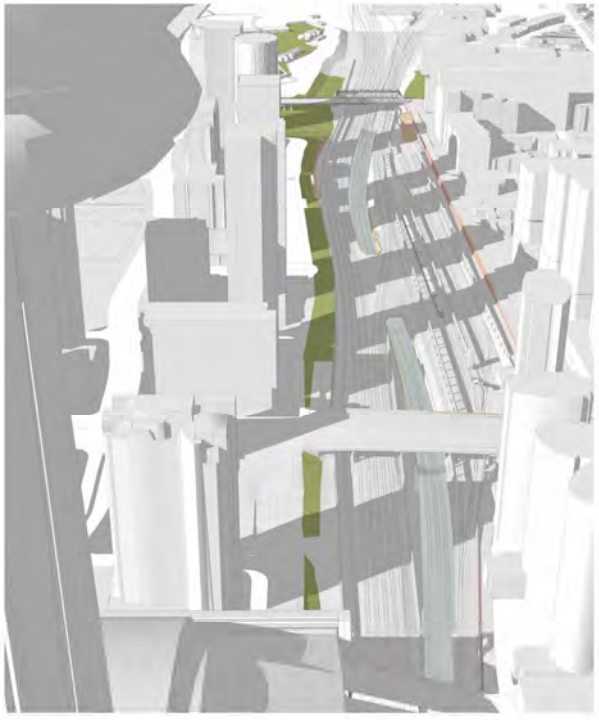
CONSTRUCTION SEQUENCE

EARLY WORKS



Utility Relocates
Track Relocates
Demolition
Site Remediation
Temporary Works
- Temporary services or relocates
- Overhead protection for trains and rail personnel
- Creation of Laydown Areas for construction
- Creation of construction access points
- Temporary work for Phasing purposes

FOUNDATIONS + STRUCTURE



Substructure:
- Foundations
- Bulk Excavation
- Special Conditions

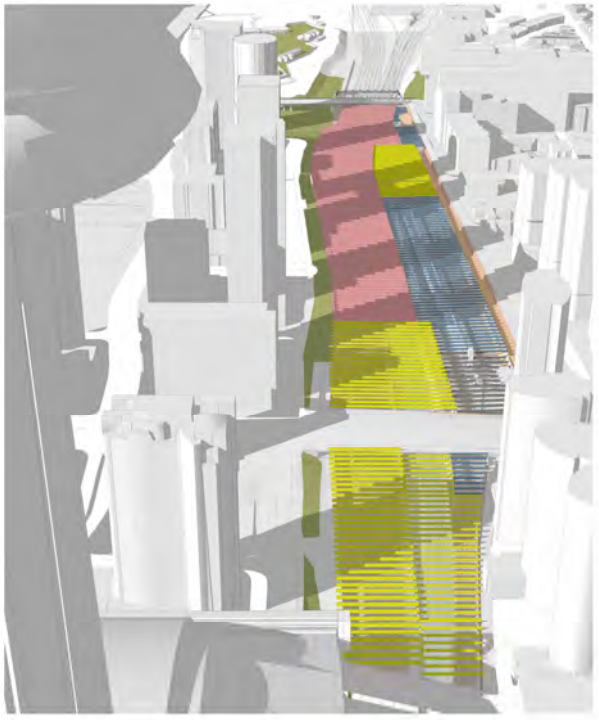
Site Development:
- Mechanical Site Services
- Electrical Site Services

- Ancillary Work

Demolition & Alterations

Sitework:
- Site Development
- Mechanical Site Services
- Electrical Site Services
- Ancillary Work
- Demolition & Alterations

DECK + PARK



Structure:
- Suspended Deck Construction
- Roof Construction

Mechanical:
- Plumbing & Drainage (Track Level and Deck Level)
- Fire Protection (Track Level)
- HVAC (Ventilation of track level)
- Controls

Electrical:
- Service & Distribution
- Lighting Devices & Heating
- Systems & Ancillaries

Park Installation (not yet shown)

DRAWING NUMBER
RDP-APP-C-05

RAIL DECK PARK