# EXECUTIVE SUMMARY

The objective of The Arlington Street Bridge Over the CPR Yards Rehabilitation Feasibility and Preliminary Design is to develop a technically compliant and cost-effective rehabilitation strategy for the Arlington Street Bridge to extend the service life and utility of the structure by a minimum of 25 years.

The project involved three phases:

- Phase 1: Data Collection and Analysis of the Condition;
- Phase 2: Develop Various Options for Rehabilitation; and
- Phase 3: Preliminary Design of the Recommended Rehabilitation Concept.

Upon completion of Phase 1, the project direction deviated from the RFP. In November 2023, the Arlington Street Bridge was closed indefinitely and deemed beyond the point of repair. Phase 2 then investigated replacement concepts reusing existing substructure units. Phase 3 concluded this assignment with a Preliminary Design of a replacement bridge including associated utility, road, rail and landscaping works.

## PHASE 1 SUMMARY

Tetra Tech Canada, (Tetra Tech) along with Dillon Consulting Ltd., (Dillon) completed a detailed visual inspection of the Arlington Street Bridge. The inspection was limited to a Safety Inspection for the approach ramps, (Spans 1-13, 22-37) and secondary members not intended to be reused in the rehabilitation plan.

### Steel Corrosion

The level of corrosion observed within the primary bridge elements is of concern, primarily concentrated on members below the deck due to water runoff, de-icing salts and years of exposure to exhaust and steam from locomotives. Localized flange buckling and perforations were observed in several locations. The out of plane bending of primary members could be due to thinning of the section and thermal loads. These defects are warning signs that the member is locally or entirely overstressed.

The steel decking has severe corrosion, and in areas where the decking is completely gone, only the asphalt wearing surface, is supporting vehicle traffic.

### Span 19 Bottom Chord

Noted during the inspection and previous inspections, is that the west bottom chord (opposite to the impact) has been permanently deformed. The top section of the west bottom chord has shifted outward, resulting in the web plates no longer being vertical. Other deformations have been observed on Span 19 that could be linked to the train collision. The stability of the west bottom chord is in question. The full extent of the damage, and performance of the bottom chord under loading and thermal changes are not known. The observed deformation means that the steel has exceeded the elastic range and is now in the plastic or strain hardening range.

### Out of Plane Bending

Out of plane bending was noticed on the bottom chord of Span 15 and 17. Based on our load rating, thermal loads due to seized bearings will reverse the stress on the bottom chord of the Pratt Trusses. The bottom chord is a double angle and has no compression resistance. During extreme heatwaves, the bottom chord can buckle resulting in a lateral collapse of the span. In two locations of two Pratt Trusses, there is evidence of buckling, not severe enough to cause span failure.

Several stringers, cross bracing members, and a floor beam are noted to have bent out of plane. The lateral displacement has reduced the member's structural capacity to resist intended loads. Furthermore, the displacement could increase in the future, further reducing the structural capacity.

### Load Rating

The load rating analysis confirmed most of the deformations observed during the inspection. Several members were determined to be overstressed for various reasons further discussed in the Phase 1 Report.

The seized bearings are of great concern and significantly alter the stresses within the bottom chord of all three truss types. The stresses within the bottom chord due to fixed bearings exceed the structural capacity. Out of plane bending within the bottom chord was observed on two Pratt Trusses, which was further confirmed by the load rating analysis. Later during monitoring of the bearing movements and expansion joints, it was determined that Spans 19-21 bearings are partially functioning

### Phase 1 Recommendations

Based on the bridge inspection and load rating analysis, as part of Phase 1 report, the following recommendations were made:

- Immediate closure of the Arlington Street Bridge to vehicular traffic and pedestrians.
- Install temporary shoring near the midpoint of Span 19 and temporary strengthening of the west bottom chord.
- Install straps to support cross-bracing in Span 20, Bays 1, 2 and 3.
- Do not allow accumulation of snow on bridge or sidewalks.
- Release expansion bearings prior to June 2024.

### Urgent Responses

In response to the Phase 1 Recommendations, the City of Winnipeg took the following actions.

- On November 21, 2023, the City of Winnipeg closed the Arlington Street Bridge indefinitely in response to the above noted recommendations.
- In April 2024, urgent repairs were completed to Span 19 to provide temporary strengthening to the train impact damage.
- In May 2024, urgent repairs were completed to Span 20 to provide support to cross bracing members.
- Scheduled for July-September 2024, the bearings of Spans 14-18 are to be replaced to alleviate the thermal stresses in the bottom chords that has caused localized buckling.
- Bearing replacement and jacking designs have been prepared for Spans 19-21 in the event permanent deformations are observed in the bottom chord due to seized bearings and thermal stresses.

### Rehabilitation of Arlington Bridge

- The condition and strength of the trusses did not allow for the necessary lifting and construction loads necessary remove and replace members ultimately making it unfeasible to repair them.

## PHASE 2 SUMMARY

Phase 2 looked at vertical profile options, bridge replacement concepts, required railway works, constructability and estimated construction costs for the various concepts.

### Vertical Profiles

Four vertical profiles were developed from Logan Avenue to Dufferin Avenue. The vertical profile was developed with a 5.2% grade on the south approach and 6% on the north approach. Only one of the four options met the maximum requirement of Dufferin Avenue intersection grade raise of 1.5m. Option 2 proposes a 1.06m intersection grade raise at Dufferin Street (lowest of the options). Revised Option 2 provides the lowest impact on the Dufferin Avenue and Arlington Street intersection, reconstruction requirements on Arlington Street north of Dufferin Avenue and the properties on Arlington Street north and Dufferin Avenue. Transit can be accommodated at both approaches.

Option 2 profile was recommended for further development in Phase 3 Preliminary Design.

## Intersection Evaluation

The alternative intersection options for Logan Avenue and Dufferin Avenue presented above require determination of the City's project priorities prior to determining a recommended option at each location.

Each option has different characteristics which may align with certain priorities of the City:

**Logan Avenue:**

- Intersection Option 1 improves through traffic movements by eliminating all left-turns and is the base cost option included in the Class 5 cost estimate.
- Intersection Option 2 is the same as Option 1, but with a northbound left-turn lane to westbound Logan Avenue and costs an additional $4,414,650 ($3,960,000 property, $454,650 roadwork) over the base cost option.

**Dufferin Avenue:**

- Intersection Option 1 maintains the existing intersection configuration with the addition of a southbound left-turn lane at Dufferin Avenue and is the base costs option included in the Class 5 cost estimate.
- Intersection Option 2 focuses on improved pedestrian / cyclist safety, introduced bulb-outs in two quadrants, and is less expensive that Option 1 by $227,850. If Option 2 is preferred over Option 1, then the Class 5 cost estimate should be reduced by the noted amount.
- Intersection Option 3 modified Dufferin Avenue's cross-section by introducing a protected left turn lane and reduced pedestrian / cyclist crossing distances and is less expensive than Option 1 by $177,625. If Option 3 is preferred over Option 1, then the Class 5 cost estimate should be reduced by the noted amount.

## Bridge Concepts

Since we have concluded that the existing truss superstructure spans cannot be repaired, we have developed five Bridge Concepts with new superstructures and a combination of salvaged and new piers. Assuming the L-Lead line can be removed, the south approach could extend to Span 16 (Pier 3), therefore eliminating Spans 14 and 15 and concrete Piers 1 and 2.

For the developed Bridge Concepts 1-5, a new Warren truss is proposed for Span 21. Concept 6 includes a pier on track NC09 and two girder spans in place of a truss for Span 21. Other proposed considerations are Warren Trusses for the long spans, steel girders for the medium span lengths, concrete girders for the medium to short spans, and MSE walls for the approach embankments.

Our initial plan was to salvage the piers, however due to limitations with the existing pile capacity, pier replacement in lieu of underpinning was considered and proposed for a few of the Concepts and is discussed below. For all Concepts, Piers 1 and 2 are to be demolished. Reuse of Pier 3 has been considered; however, this will need to be converted to an abutment for Concepts 3, 4, and 5.

Concepts 2 and 6 had a secondary option due to the potential relocation of the Back Lead. Shifting the Back Lead south, allowed the north approach to commence 6 metres sooner, resulting in a reduction in elevation at Dufferin by 400-500mm. Concepts 2A and 6A included relocation of the Back Lead.

From our Phase 2 works, Bridge Concepts 2, 2A, 6, and 6A were recommended for further development in Phase 3 Preliminary Design.

## Railway

**L-Lead Removal**

These new bridge configurations include additional piers in the yard and assumes that the L-Lead will be abandoned as a means of shortening the overall length of bridge and reducing overall bridge replacement costs. The existing L-Lead is an 8,000 foot long, partially abandoned, spur track connecting the south side of CPKC's Winnipeg Yard to their La Riviere Subdivision mainline. Approximately 5,400 feet of track remains in service between the Winnipeg Yard and Industry Spur Track.

The existing L-Lead provides rail service from the Winnipeg Yard to the Lumber Yard, Viterra Grain Terminal, as well as customers along the 7,700-foot-long Industry Spur Track. Currently, there is no access to provide rail service to these customers from CPKC's La Riviere Subdivision. Overall, there are nine (9) at-grade crossings along the L-Lead, five (5) of which are still in service. Three (3) of these five (5) crossings have active protection systems.

Several track reconfiguration options were developed to maintain service to the above noted customers. The options were presented to CPKC for review. CPKC did not officially provide acceptance or preference to any option, however, did acknowledge that CPKC is reviewing abandoning the L-Lead.

**Span 19 – New Pier**

Bridge Concepts 2, 2A, 6 and 6A include a new pier beneath Span 19. With these concepts, the existing Span 19 truss span is proposed to be replaced with two steel girder spans, requiring a new pier. The proposed new pier is proposed to be located between tracks FG02 and FG03. Further review on track realignments were completed in Phase 3.

**Span 20 – New Pier**

Bridge Concepts 2, 2A, 6 and 6A include a new pier beneath Span 20. With these concepts, the existing Span 20 truss span is proposed to be replaced with two steel girder spans, requiring a new pier. CPKC indicated that tracks FA12 and FA13 are scheduled to be removed from service soon and that FA14 will be maintained as a service track. This new pier is proposed to be located between tracks FA12 and FA13. Skewing of the pier alignment will not be required, nor will there be a need to realign any existing tracks.

**Span 21 – New Pier**

Bridge Concept 6 and 6A include a new pier beneath Span 21. With this concept, the existing Span 21 truss span is proposed to be replaced with two steel girder spans, requiring a new pier. To accommodate a new pier, existing track NC09 will need to be removed from service. The tracks in this NC group are all at minimum spacing of 13 feet 6 inches. Due to this tight spacing, the proposed new pier will need to be skewed and set in an alignment parallel to the existing tracks (NC08 and NC10) to avoid the need to realign these adjacent tracks. To accommodate the loss of track NC09, additional track improvements are required within the NC Yard which were further developed in Phase 3.

**Back Lead Relocation**

Relocation of the North Back Lead track, to the south, would provide room for two (2) new piers on each side of the relocated track, allowing for a lowering of the road profile across Jarvis Avenue, thus reducing the impact to the raising of Dufferin Avenue/Arlington Street intersection. In addition, this track realignment would require relocation of the existing drainage ditch along the south side of the existing alignment to the north side. This would position the ditch between the North Back Lead and Jarvis Avenue, improving drainage within the CPKC rail yard.

Back Lead relocation was applied to the bridge concepts and resulted in modifying Concepts 2 and 6 to 2A and 6A.

### Phase 2 Recommendations

Upon completion of Phase 2, Tetra Tech recommended proceeding forward with the options below and considerations for further development in Phase 3 – Preliminary Design:

- Revised Option 2 vertical profile.
- Proposed roadway cross-section.
- Bridge Concepts 2 and 6.
- Abandonment of L-Lead.
- Realignment of Back Lead.
- Logan Avenue and Arlington Street intersection Option 1.
- Dufferin Avenue and Arlington Street intersection Option 1.
- Revisiting the 2018 Bridge Decommissioning.
- Further evaluating 5.5% grade on North approach.
- Refining the south approach grade to 5% from 5.3% currently.
- City of Winnipeg obtain market values for all properties noted within Section 6.0.
- Proceed forward with pile capacity testing of existing piles at Pier 3.

The purpose of bringing the above noted options, concepts, and ideas to a Preliminary Design level in Phase 3 is to refine the project cost to a Class 3 level for funding purposes. Also, further developed plans are required for CPKC construction applications and general acceptance of construction methodologies. Properties identified as required herein this report are based on a functional level of engineering. Further development of the reference design will nail down the extent of the properties required, full or partial takes.

Utilities, services, and drainage designs have not been evaluated for the recommended concepts and options as noted above. Numerous uncertainties with options, variations, and CPKC acceptance, prevented the completion of this scope of work. Environmental evaluation of soil contamination has been completed for the recommended concept. Costs from the previous study were carried over for utilities and environmental and considered conservative since the project has been scaled down. Upon selection of a preferred concept and further refinement, utilities, services, drainage and environmental assessments and design will be completed.

## URGENT REPAIRS

### Span 19

To help provide bottom chord redundancy/capacity, post tensioning of both the east and west bottom chords took place. Dywidag Bars were installed on each side of both bottom chords between Bays 1 and 5. Intermediate structural steel batten plates were also installed between the jacking and anchor brackets to reduce the unsupported length of each bay prior to post tensioning. The Dywidag Bars were then post tensioned simultaneously, to a maximum load of 200kN.

### Span 20

Severe corrosion/section loss of the cross-bracing to bottom chord gusset plate connections were observed in Bays 1 to 3 of Span 20. The severe gusset plates section loss posed a risk to the connecting members, ultimately failing and falling onto CPKC track/personnel below. The cross-bracing was secured to the existing structure. Steel cables were wrapped around the cross-bracing members in Bays 1 to 3 and were secured to the steel deck channels located above.

### Bearings

The expansion bearings located on Piers 2, 4, and 6 (south) no longer function to allow for the required thermal expansion and contraction of the Pratt Truss'. Several isolated bent flanges were observed and recorded as Permanent Deformations. To reinstate the thermal expansion and contraction of the Pratt Truss', Tetra Tech completed the design to jack Spans 14-18 and replace the deficient bearings on Piers 2, 4, and 6 (south). This work is scheduled to take place the end of July 2024 and to be complete by early September 2024.

Camelback Truss expansion bearings located on Pier 6 (north) and Pier 8 (south) are also not performing as designed. However, movement has been observed at these locations and they are not completely seized. Designs have been completed to replace the Camelback Truss bearings; in the event this work is required.

## GEOTECHNICAL ASSESSMENT

Tetra Tech and our geotechnical subconsultant, Trek Geotechnical, reviewed the previous geotechnical investigations completed within the CPR Yards Crossing Study Functional Design (2016) and Preliminary Design of the Arlington Street Bridge (2018) completed by Stantec and utilized this information for this preliminary design.

### Pile Load Test Program

The objective of the pile load test program was to confirm the geotechnical capacity of the existing timber piles, to estimate pile length (if possible) using the Pile Integrity Test (PIT), to evaluate the condition of the piles (by others) and to confirm the accuracy of the pile layout drawings. The test pile has an approximate butt diameter of 300 mm, however the installed pile length is unknown but anticipated to be 12 m long based on the expected local subsurface conditions. Testing took place on June 10-12, 2024.

The static load test was performed using an Enerpac hydraulic hand pump jack and an RCH1003 hollow plunger hydraulic load cell with a capacity of 917 kN (103.1 tons) and a 75 mm (3-inch) stroke. The pile load test was performed in general accordance with ASTM D1143 (Quick Test Method), except that the test was terminated upon reaching the maximum stroke (75 mm minus a seating displacement) of the hollow plunger hydraulic load cell. Load increments of approximately 40 kN were used for the test. Most load increments were sustained for a period of 15 minutes, however several increments near the end of the test were extended to between 20 to 30 minutes, as directed by TREK personnel.

The load test was terminated at a maximum load of 460 kN and a pile head deflection of 47.5 mm. Up to a load of approximately 300 kN, the pile behaved nearly linear with no noted creeping under sustained load. At a load of 440 kN, the pile head deflection exceeded 25 mm. Existing timber piles at this site with a factored ULS resistance of 200 kN (0.5 x 400 kN) are anticipated to exhibit 25 mm or less of settlement under service loads (assuming the unfactored service loads at SLS are less than the factored loads at ULS). We expect that based on these findings, underpinning and/or replacement of some piers will be required, since the recommended capacities do not satisfy historical loads, let alone increased loads associated with the rehabilitation works.

### Existing Pile Capacity Results

- The existing piers do not have sufficient foundation capacity for new longer bridge spans, making them unfeasible for reuse in a replacement bridge concept.

## ENVIRONMENTAL REVIEW

During Tetra Tech's assessment of the historical data, we used the CCME Tier II approach for guideline selection whereby we eliminated the exposure pathways that are not applicable to the specific site conditions, mainly we did not consider ingestion of groundwater pathway to be applicable at the CPR railyard, nor anywhere else in Winnipeg. This approach is accepted by Manitoba Environment and Climate Change (MECC). While this approach did result in the reduction of soil samples exceeding guidelines, there remains soil that does exceed applicable guidelines and would still require the disposal

of soil at a facility that is licensed to accept soil with the contaminants present in the soil when they are removed. A summary of the soil containing contaminants is included below.

### Petroleum Hydrocarbon Contaminated Soil

Vicinity of Pier 8 - One soil sample from BH17-01 was submitted for analysis of BTEX, PHC F1-F4, metals, PAH and VOC from a depth of 1.5-2.25 mbg. This soil sample did not exceed the CCME Tier II guidelines.

Vicinity of Pier 7 - Two soil samples from BH17-02 (0.5-1.0 mbg and 1.5-2.25 mbg) were submitted for analysis of BTEX, PHC F1-F4, metals, PAH and VOC. The soil sample BH17-02 at 0.5-1.0 mbg contained concentrations of benzene, copper (metals), and Naphthalene and Phenanthrene (PAHs) that exceed the CCME Tier II guidelines. The soil sample BH17-02 at 1.5-2.25 mbg contained concentration of Naphthalene that exceeds the CCME Tier II guidelines.

Three soil samples from BH17-03 (1.0-1.5 mbg, 1.5-2.25 mbg and 2.25-3.0 mbg) were submitted for analysis of BTEX, PHC F1-F4, metals, PAH and VOC. The soil sample BH17-03 at 1.0-1.5 mbg contained concentrations of copper and naphthalene that exceed the CCME Tier II guidelines. The other soil samples did not contain any contaminants exceeding the CCME Tier II guidelines.

Vicinity of Pier 5 - One soil sample from BH17-04 (0-0.5 mbg) was submitted for analysis of BTEX, PHC F1-F4, metals, PAH and VOC. This soil sample contained concentrations of benzene, copper, naphthalene and phenanthrene that exceed the CCME Tier II guidelines.

One soil sample from BH17-05 (0.5-1.0 mbg) was submitted for analysis of BTEX, PHC F1-F4, metals, PAH and VOC. This soil sample contained concentrations of benzene, PHC F2, naphthalene, and phenanthrene that exceed the CCME Tier II guidelines.

No VOC's were detected in any of the soil samples submitted for laboratory analysis at concentrations that exceed the CCME Tier II guidelines.

Any soil that is disturbed and requires disposal in these areas up to at least a depth of 3.0 mbg, would need to be disposed of at a facility that is permitted to receive soils contaminated with BTEX, PHC F1-F4, metals, PAH and potentially VOC. Additional soil sampling near other Piers where soil will be disturbed and/or to depth greater than 3.0 mbg may also need to disposed accordingly however additional investigation would be required to determine this.

## TRANSPORTATION

Five vertical road profiles were developed.

Only one of the four options met the maximum requirement of Dufferin Avenue intersection grade raise of 1.5m. Revised Option 2 proposes a 1.06m (1.084m final calculated value) intersection grade raise at Dufferin Street (lowest of the options). Revised Option 2 provides the lowest impact on the Dufferin Avenue and Arlington Street intersection, reconstruction requirements on Arlington Street north of Dufferin Avenue and the properties on Arlington Street north and Dufferin Avenue. Transit can be accommodated at both approaches.

With the improved approach grades and the proposed removal of the southbound traffic signal on the bridge with stop condition provided at Logan Avenue, this option is the preferred option. This option will improve safety performance on approach to the bridge and the south and north intersections resulting in minimized impacts to surrounding properties and is able to accommodate the vertical and horizontal clearance requirements from CPKC.

Further to the preferred profile, The City of Winnipeg considered the additional impacts that a less steep bridge approach ramp would have on the adjacent properties and ultimately decided that it is preferred to meet the universal access requirement of 5% maximum gradient.

The resulting profile meets the new bridge superstructure, sight lines, and universal accessibility guidelines, however the minimum gradient of 0.5% is not met over the bridge. Minor improvements are required at Logan Avenue to tie into the proposed profile while at Dufferin Avenue a raise of over 2 mis required impacting Dufferin ~90 m west and 100 m east, this will require extensive reconstruction and property acquisition. The 20 m long 3% gradient can be incorporated just north of Logan, therefore eliminating the need for southbound traffic signals on the bridge. However, to minimize fills at Dufferin Avenue a 20 m long 3% gradient was not incorporated, thus eliminating the possibility of removing the northbound traffic signals on the bridge.

At Logan Avenue a 5% ramp will result in the westbound lanes needing to be reconstructed to adjust the cross fall within the intersection vicinity. North of the intersection a 20 m long 3% tangent enables the removal of the southbound traffic signals at the top of the bridge.

### Roadway Cross Section

To accommodate Transit, lane widths need to be a minimum of 3.5 metres, face to face of barriers/adjacent lanes. The proposed cross-section includes two, undivided lanes at 3.5m, with two 2.5m wide sidewalks. A barrier is proposed between the sidewalk area and traffic lane for safety. Shoulders are currently proposed at 350-400mm. A pedestrian safety fence is included within the cross-section to meet CPKC requirements. Overall deck width is 14.6m.

### Intersection Geometry

Two alternative options were developed at the Arlington Street / Logan Avenue signalized intersection – one favoured through traffic movements on both roadways while the second also included a left turn lane.

Three alternative options were developed at the Arlington Street / Dufferin Avenue signalized intersection – one maintains existing conditions with an added left-turn lane, the second prioritizes reduced pedestrian / cyclist crossing distances, and the third prioritizes additional lanes along Dufferin Avenue.

The City of Winnipeg considered the pros and cons of the two Logan Avenue intersection concepts and the three Dufferin Avenue intersection concepts. The following priorities were identified by the City of Winnipeg:

- Accommodating Transit on the bridge with stops near each intersection.
- Improving the safety of pedestrians and cyclists.
- Minimizing the acquisition of businesses and residences.
- Keeping roadway reconstruction costs to a minimum

With each priority in mind the City expressed interest in Logan Intersection Option 1 and Dufferin Intersection Option 2.

The City of Winnipeg indicated that there is a desire to further refine Logan Intersection Option 1 and develop a new Dufferin Intersection option. At Logan, the City of Winnipeg stated that there is a desire to accommodate Transit south of the intersection outside of traffic and plan for future active transportation facilities that would eliminate the need for acquiring businesses. At Dufferin, the City of Winnipeg confirmed that it is desirable to maintain a maximum 5% gradient on Arlington, but indicated the consequential property acquisition from the Dufferin Avenue raise was less desirable and wanted Tetra Tech to examine an option that would disconnect Dufferin from Arlington and thus reducing the acquisition of several properties that would otherwise be required. The preferred Intersection options are Option 1A at Logan and 2A at Dufferin (which severs Dufferin Avenue at Arlington Street)

**Logan Avenue Intersection Option 1A**

The preferred option. The following refinements were undertaken when compared to Option 1 developed:

- Multi-use pathway alignments connecting to the north side of the intersection have been flared to encourage cyclist speed reduction after descending the 5% grade. It also allows for cyclists and pedestrians crossing the north leg of Arlington to stage outside north/south AT traffic. Additional property is required.

- Termination of the full-height barrier that separates the pathway from vehicular traffic was refined. Due to the low posted speed of 50 km/h a transition from full height barrier to safety curb to barrier curb has been proposed just north of the northerly approach crosswalk.
- Due to a conflict with the southwest smart channel, the eastbound far side transit stop has been relocated to the near side along the northerly edge of the southwest smart channel island.
- The pavement reconstruction limits have been established including:
  - The southwest and southeast smart channels.
  - The westbound gutter and median lanes within the vicinity of the intersection to properly transition the new 5% ramp gradient.
- Drainage swales have been established along the MSE walls.

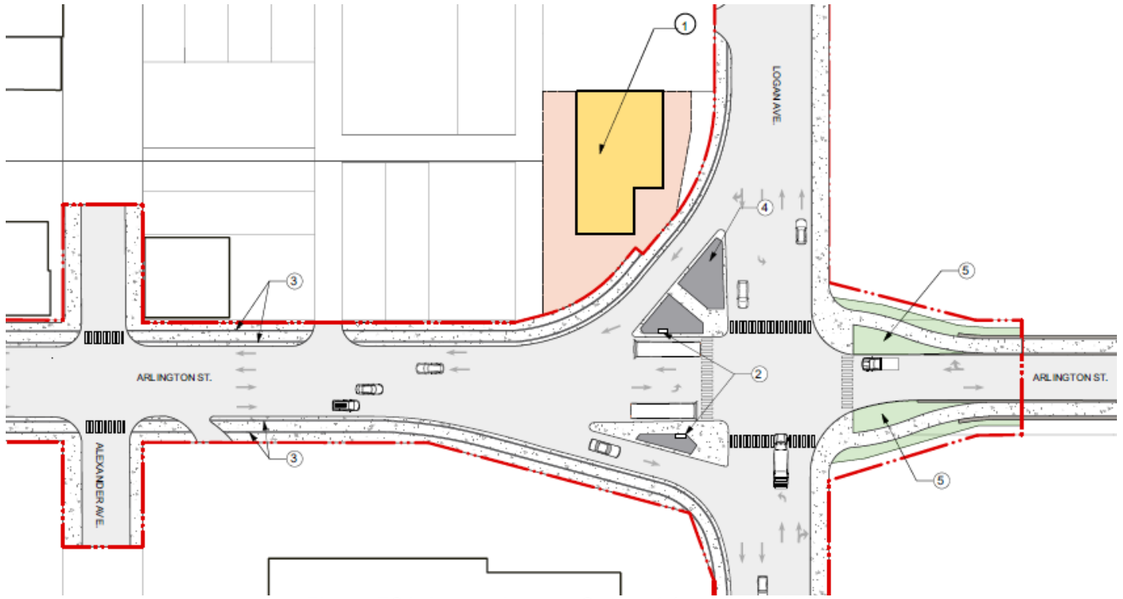



**Figure ES1: Logan Avenue Option 1** (recommended)

**Dufferin Avenue Intersection Option 2A**

Dufferin Avenue disconnected from Arlington Street is the currently preferred and to be considered during an upcoming consultation process. The following refinements were undertaken when compared to the Option 2 previously developed:

- Multi-use pathway alignments connecting at the back lane between Dufferin and Stella have been flared to encourage cyclist speed reduction after descending the 5% grade. It also allows for cyclists and pedestrians crossing Arlington at the pedestrian corridor to stage outside north/south AT traffic.
- The switchback pathways have been shifted further away from Arlington to allow for landscaping opportunities.
- Entrance and exit ramps have been established to connect Dufferin to the east side pathway and west side cul-de-sac.

- Arlington between the back lane and Stella Avenue has been narrowed to provide for drainage requirements of the adjacent residential properties. Catchbasins have been established within the City of Winnipeg right-of-way to maintain positive drainage from the residential buildings.




**Figure ES2: Disconnected Arlington Street and Dufferin Avenue (recommended)**

## BRIDGE

Since the conclusion of Phase 1 was that the existing truss superstructure spans cannot be repaired/rehabilitated, eight Bridge Concepts with new superstructures and a combination of salvaged and new piers were developed in Phase 2. Through the evaluation and Workshop 1, it was recommended and agreed to carry Options 2 and 6 forward into Phase 3, with a subset to each noted as 2A and 6A. The difference between the original and the “A” version of the option was only the proposed relocation of the back lead to the south to improve drainage within the CPKC yard, reduce span lengths overall and allow for the reduction of grade of the approach toward Dufferin Avenue.

Through discussion at Workshop 3, the preferred option, by all parties in attendance, was Concept 6A as it addressed the north ramp grade universal access requirements, did not utilize a truss (which is very difficult to place requiring extensive ground preparations to a very large portion of the CPKC yard), utilized girder spans which could be made continuous and allows for the potential of launching which should provide reduced impacts to CPKC during construction.

Concept 6A consists of 12 bridge spans. This Concept is similar to Concept 6, the south end of the bridge is the same, with improvements made to the north end span configuration as a result of Back Lead relocation, and replacement of the truss

span in Concept 2A with girder spans and new skewed piers at approximately midspan. Using continuous steel girders, precast concrete deck panels, 2-girder spans instead of a Warren truss for Span 21 and a 9m prestressed precast concrete plank girder span over the back lead, this concept satisfies the proposed vertical profile and CPKC clearance requirements. At the north end the concept makes use of precast box girders as well as precast solid slab girders or plank girders, to achieve the vertical clearances and roadway profile. All other spans are steel girders.

Steel girder range in depth from 1100 – 2400mm. The proposed deck for the steel girder spans are full width and full depth precast concrete. The deck is proposed to be 225mm thick with a 50mm thick HPC overlay. The cast in place concrete distribution decks on Prestressed Precast Concrete Box as well as the Prestressed Precast Concrete Plank Girder have been estimated to be 150mm thick, with a 50mm HPC overlay.

### Existing Foundations

As the ULS design value obtained from the testing is only 200kN, as compared to the unfactored loads which range from 176kN to beyond 400kN, the existing piles and thus piers are not suitable for use in the new bridge configuration without extensive underpinning or replacement.

### New Piers

Foundation types considered for new piers are caissons, driven piles and micropiles. At this time, caisson foundations are the recommended foundation. Through discussions at Workshop 2, the use of micropiles may be a good alternative to the caissons, however, additional information is required to establish a micropile design, such as the existing timber pile locations at each pier, existing geometric extents of each pier, and geotechnical design parameters and information. Through the same discussions, it was agreed that the micropiles should be constructable within a similar timeframe and at a similar cost (or potentially less). The caisson design is further established at this time, and making a change to micropiles later at the detailed design level is not expected to negatively impact the project's preliminary construction schedule and costs. Therefore, the caissons are the recommended foundation. The use of a driven pile array is not recommended due to the number of piles required and the excavation for removal of the existing piers. The overall work area required within the CPKC yard for this option is anticipated to be larger than required for the caissons. Aside from the pile installation, additional construction time is anticipated for pile cap, pier shaft, and pier cap construction which will be less seamless when compared to the caisson construction.

When the additional investigations and information becomes available at the onset of the detailed design phase, it is recommended to review this information with the foundation industry and geotechnical personnel again and confirm the viability of both the caissons and micropiles. If both foundation systems are viable, consideration should be given to completing and tendering a design for both. This will allow for maximum flexibility for the Contractors to complete the construction of a foundation system that they deem to be their most preferred means and methods while addressing risks and thus provide the City with the optimal pricing. This work is a significant part of the bridge construction work and cost and possess the most significant impact on CPKC. Allowing for as much flexibility for the Contractors to be comfortable to complete the foundation scope of work within the constrained requirements of working within the CPKC yard will also work to reduce the risks to the overall project.

### Abutments

The abutment type recommended by the Preliminary Design is a semi-integral abutment, with a free-standing pier-type abutment and MSE wall retaining the embankment backfill. This system separates the abutment into two components: a bridge support structure and an earth-retaining structure, with minimal interaction between the two. The abutments will be supported by a single row of 1220mm (4ft) diameter caissons with a permanent 13mm thick steel casing, similar to the proposed piers. This will create consistency among the substructure units and avoid the Contractor from being restricted to either the abutment or piers for launching. This option can be revised once the loads from launching are evaluated during the Detailed Design. The use of caissons will also allow the superstructure construction to continue prior to the placement of the approach fills, as the abutment foundations would not require the lateral or confinement support of the fill material to withstand construction loads.

## RAIL

Proposed new bridge span and pier configurations will need to satisfy CPKC requirements for horizontal and vertical clearances, as well as accommodate existing service roads required to manage rail yard operations. The existing Arlington Street Bridge does not meet the 7.01m vertical clearance requirement for several tracks, and therefore, the underside of the replacement superstructure will need to be raised.

For the preferred bridge concept, Concept 6A, within Span 19, the proposed pier impacts current inspection roadways. Tracks FG02, FG03, and FG04 will require realignment. Proposed track spacing and alignments have been developed.

A pier is also required within Span 21. To accommodate a new pier, existing track NC09 will need to be removed from service. The tracks in this NC group are all at minimum spacing of 4.12 meters (13 feet 6 inches). Due to this tight spacing, the proposed new pier will need to be skewed and set in an alignment parallel to the existing tracks (NC08 and NC10) to avoid the need to realign these adjacent tracks. To compensate for the reduction in terminal capacity, due to construction of new Pier 8a below Truss Span 21 involving the removal of track NC09, a reconfiguration of some of the North Yard tracks has been proposed, along with the addition of a new track between Tracks NW01 and NW02.

Concept 6A requires the North Back Lead track to be realigned to accommodate the vertical road profile, as well as improving drainage within the CPKC yard and moving this track and it's related rail envelope to be fully within CPKC property. Relocation of the North Back Lead track, to the south, would provide room for two (2) new piers on each side of the relocated track and relocation of the existing drainage ditch along the south side of the existing alignment to the north side. This would position the ditch between the North Back Lead and Jarvis Avenue.

All bridge concepts considered require the L-Lead to be removed. The removal of this line is currently being negotiated by the City and CPKC. CPKC have indicated that it is their intent to pursue terminating these existing services and abandonment of the Lead. Further negotiations regarding cost sharing and development of an agreement between CPKC and the City will be required.

## UTILITIES AND SERVICES

### Logan Avenue Intersection

At the southwest corner of the intersection, a proposed catch basin and manhole will be required to accommodate the revised alignment of the smart channel to Arlington Street and will connect to the 375mm diameter storm relief sewer on Arlington Street instead of the combined sewer on Logan Avenue.

At the southeast corner of the intersection, a proposed catch basin and manhole will be required that will connect to the existing 375mm diameter storm relief sewer along Arlington Street while the existing catch basin will be relocated to accommodate the proposed smart channel to Logan Avenue.

South of Logan Avenue on Arlington Street, there is a section of cast iron watermain that was installed in 1902. The upgrade of this watermain is recommended with the road work given the age of the pipe. The City may wish to extend the upgrade further south to the portion of watermain that is PVC installed in 1985. The hydrant on the southeast side of the intersection will require relocation per the alignment of the proposed smart channel.

A Manitoba Hydro duct and 50mm diameter gas line run along the west side of Arlington Street south of Logan Avenue, both of which should not require relocation. This will be confirmed with Manitoba Hydro as the project progresses into detailed design. The communications conduit the east side of the street should not require relocation but will be confirmed further into the project.

North of the Logan Avenue intersection there is an existing 300mm/375mm diameter combined sewer on the west side of Arlington Street that will sit between the proposed MSE wall and an existing building with little clearance. It is proposed that this section of combined sewer installed in 1912 be removed along with associated catch basins (may require service

connections to adjacent property to be re-routed to Logan Avenue). Stormwater from the west side of the ramp can be handled by installing catch basins and a manhole just beyond the termination of the MSE wall at the intersection and connecting to the existing 375mm diameter storm relief sewer south along Arlington Street and the 750mm diameter combined sewer on Logan Avenue. Stormwater from the east side of the ramp can be handled in the same manner. Also, there is a 375mm diameter combined sewer that crosses the existing bridge ramp which is proposed to be realigned beyond the proposed south bridge abutment. Pipe slopes may be low through the proposed section given the increased length of combined sewer.

Manitoba Hydro has overhead lines along Jarvis Avenue that will have to be moved underground at the bridge location. A 50mm diameter gas line runs along the east side of the current bridge ramp and will require relocation away from the proposed MSE wall. A communications duct runs in close proximity to the proposed north bridge abutment and is to be relocated.

### Dufferin Avenue Intersection

North of the Dufferin Avenue intersection, the existing 300mm diameter clay combined sewer that runs down Arlington Street north of Dufferin Avenue will be removed. A section of combined sewer will still be required in the area up to Stella Avenue as the homes will remain and will require sewer servicing. It is recommended that the 300mm diameter clay sewer installed in 1905 be upgraded.

The 450mm diameter combined sewer that runs along Dufferin Avenue will have to be removed under the highly elevated area at the intersection with Arlington Street. Combined sewer will be installed around the elevated area connecting to the existing 450mm diameter combined sewer on Dufferin Avenue to the west and to the east of Arlington Street.

A storm relief sewer will be installed around the elevated area connecting to the 375mm diameter land drainage sewer on the east side of Dufferin Avenue, collecting stormwater from Dufferin Avenue and Arlington Street. The west section of the proposed storm relief sewer will drain to the 900mm diameter storm relief sewer on Arlington Street. The east section will also drain to the 900mm diameter storm relief sewer on Arlington Street but will include flows from the bridge ramp area south of Dufferin Avenue.

To accommodate the preferred Dufferin intersection, Option 2A, North of the Dufferin Avenue intersection, an additional section of existing 900mm diameter storm relief sewer will be removed. Additional catch basins at the north end of the bridge ramp will replace those note d above. The proposed storm relief sewers will connect to the existing 900mm diameter storm relief sewer flowing north and connecting to the 1350mm diameter storm relief sewer flowing east on Stella Avenue.

A 50mm diameter gas line runs along the north side of Dufferin Avenue that will require relocation outside the highly elevated area around the intersection with Arlington Street

South of Dufferin Avenue intersection, there is a 300mm diameter combined sewer that runs along Arlington Street on the existing bridge ramp. Given the proposed increased elevation, it is recommended that the sewer be re-routed outside the proposed MSE walls with connections to the 300mm diameter combined sewer on both the west and east sides of the bridge ramp along Jarvis Avenue. A connection back to the 450mm diameter combined sewer is proposed as the existing 300mm diameter sewer on the bridge ramp currently connects to the 450mm diameter combined sewer along Dufferin Avenue. Pipe slopes may be low through the proposed section given the increased length of combined sewer.

A 750mm diameter storm relief sewer currently runs along Arlington Street at the proposed location of the MSE walls for the proposed bridge ramp. The proposed storm relief sewer will start just south of the north bridge abutment and will run north to connect to the 375mm diameter land drainage sewer on Dufferin Avenue and ultimately to the 900mm diameter storm relief sewer on Arlington Street. Catch basins closer to the Dufferin Avenue intersection can be directed to 900mm diameter storm relief sewer.

The weir chamber at Dufferin Avenue and Arlington Street is proposed for removal. However, the weir can be relocated to the east side of Arlington Street in the area of the proposed combined sewer and storm relief sewers if preferred by the City. The weir chamber at Jarvis Avenue and Arlington Street is proposed for removal, given the proposed connection of the upstream and downstream combined sewers along Jarvis Avenue.

Manitoba Hydro has overhead lines along Jarvis Avenue that will have to be moved underground at the bridge location. A 50mm diameter gas line runs along the east side of the current bridge ramp and will require relocation away from the proposed MSE wall. A communications duct runs in close proximity to the proposed north bridge abutment and is to be relocated.

### Land Drainage

The project area is an established and dense mix of commercial, industrial, and residential properties. The overall imperviousness of the area is high, consisting primarily of paved roadways and parking lots, buildings, gravel lots, and some vegetated boulevards and yards

The Arlington Bridge project was mentioned in the Selkirk District study but noted that “The development of the (Arlington) bridge will have minimal impact on the CSO Master Plan”. None of the other district studies planned to use the Arlington Bridge project as an opportunity for CSO mitigation.

Proposed area drainage will follow typical City of Winnipeg design practices and standards, as well as Provincial Environmental Act (License No. 3042), which states that the City “shall not increase the frequency or volume of combined sewer overflows in any sewershed due to new and upgraded land development activities and shall use green technology and innovative practices in the design and operation of all new and upgraded storm and wastewater infrastructure”.

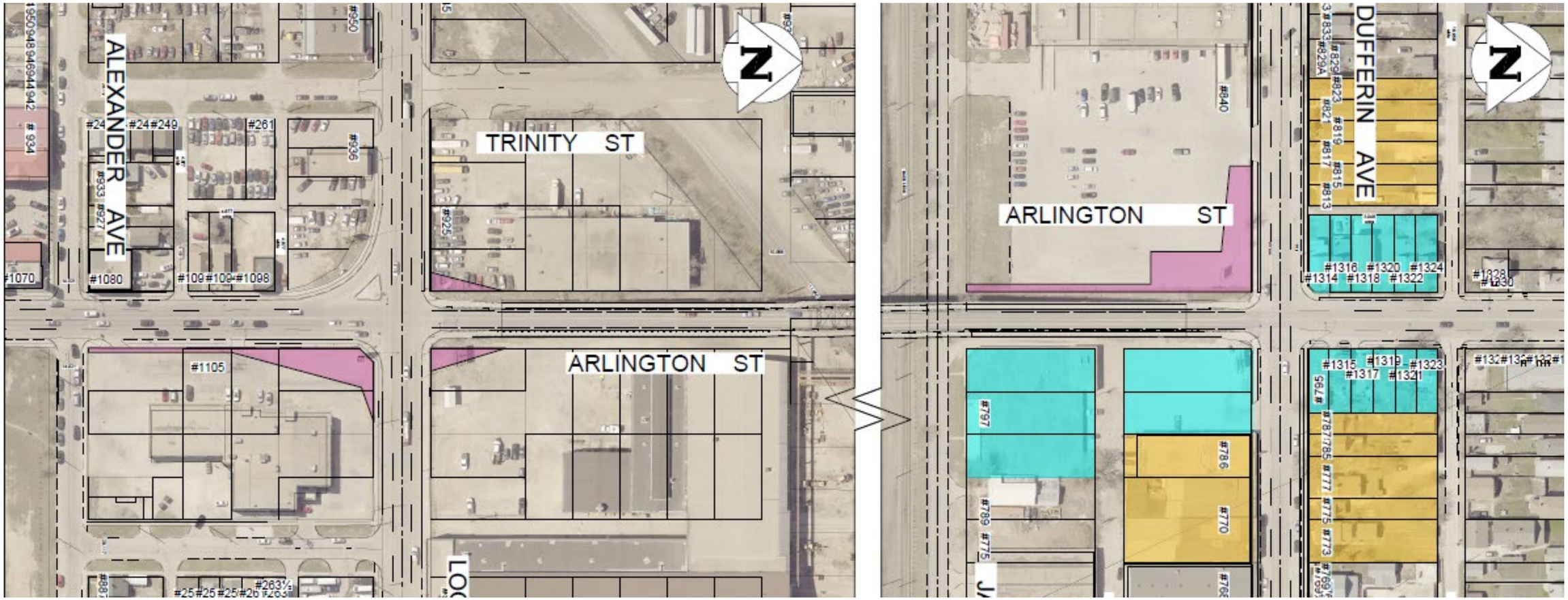
In general, proposed drainage within the project area will include:

- Overland flow will be directed to SRS’s, any existing connections to CS’s will be removed.
- No increase in peak flow to the SRS’s:
  - South side of the bridge may require flow restriction (orifice) or minor stormwater storage (surface or underground). Overall change in imperviousness and therefore runoff on this side of the bridge is expected to be negligible.
  - North side of the bridge is expected to self manage runoff reduction as the overall area imperviousness is expected to drop with the introduction of additional green spaces around the bridge. Some flow control or green infrastructure may be introduced as required.
- Green infrastructure will be introduced where practical:
  - South side of the bridge has limited opportunity due to confined space or proximity to structures. Technologies that could be introduced would be limited to hardscape features such as permeable pavements, or potentially stormwater tree trenches.
  - North side of the bridge has more options with the additional greenspace, and may introduce technologies such as infiltration trenches, vegetative buffers, bioretention / rain gardens, or stormwater tree trenches.
- Bridge deck drainage will continue to discharge vertically downward to the CPKC yard, it is assumed that there will be no opportunity to modify or improve the existing CPKC yard drainage.

For the proposed bridge a 20.0 m deck drain spacing:

- Spacing based on providing roughly half a lane clear of ponded water for minor and major storms.
- Overall inlet capture efficiencies during the minor storm is 34% - 51%, and 29% - 43% during the major storm.
- Final spacing to be modified based on structural requirements (pier locations) during detail design.

## PROPERTY




Thirty properties have been identified as potentially impacted by solutions proposed herein this study. The base or recommended solution impacts 17 properties. Three properties on the south side, 14 properties on the north side. Four properties are partial takes, the remaining are full takes. Partial takes are noted in magenta colour, full takes are cyan and additional properties for Dufferin Avenue connection are in yellow.

### South Side Property Impacts

Logan Avenue intersection, Option 1A was developed with the intent to accommodate Transit outside of traffic while simultaneously plan for future active transportation facilities. Without acquiring property along the west side of Arlington Street. Property is required on the southeast corner of the intersection for a smart channel, as well as corner cuts from 925 and 901 Logan Avenue. Property on the southwest corner is not required, however is currently owned by the City of Winnipeg and identified as a potential site for redevelopment.

One of the partial property takes is on CPKC property, 901 Logan Avenue, which cannot be obtained through expropriation. Only a corner cut is required, however this section of property will need to be negotiated with CPKC.

### North Side Property Impacts

Twenty-seven properties have been identified on the north side to be impacted by solutions proposed herein this report. One property on the north side is a partial take, the other remaining properties identified are full property takes.

The recommended solution, which is disconnecting Dufferin Avenue, only impacts 14 properties (1 partial take, 13 full property takes). Of the 14 properties required, eight properties contain houses and are all full takes.

Thirteen additional properties will be required if the Dufferin Avenue and Arlington Street intersection is raised 2m for connection. The embankment spill impacts additional houses and businesses along Dufferin Avenue.

## LAND USE AND ARCHITECTURE

The proposed redevelopment strategy for the acquired properties for Arlington Street along Dufferin Avenue follows existing development patterns and land uses, but with a landscaped buffer on the east side of the bridge to bring some life to this space and lessen the 'canyon effect' between the MSE wall and any new buildings. The west side of the MSE wall fronts along an open parking lot, so it does not present the same issues related to perceived safety and sightlines. The embankment also reduces the height of the MSE wall to a more human scale and lessens the surface area available for graffiti.

This option for closing Dufferin Avenue at Arlington Street provides not just for an embankment, but also a wider public space east of the bridge. Potential enhancements to the public realm in this area include a multi-use path connection to Jarvis Avenue, pedestrian-scale lighting, community gardens, a gathering circle, shade trees and shrub plantings, and a community-based public art installation on the MSE wall where it crosses the Dufferin right-of-way.

The west side of the MSE wall fronts along an open parking lot, so it does not present the same issues related to perceived safety and sightlines. The embankment also reduces the height of the MSE wall to a more human scale and lessens the surface area available for graffiti. The concept includes typical streetscape improvements where space allows.

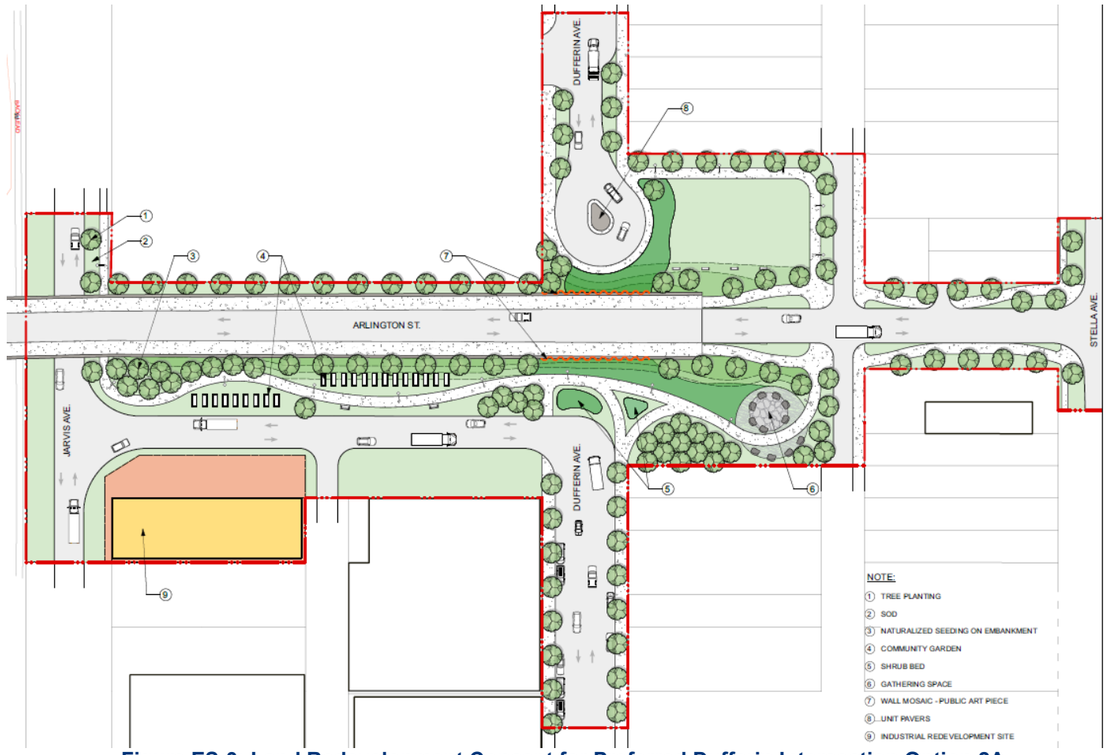



**Figure ES-3: Land Redevelopment Concept for Preferred Dufferin Intersection Option 2A**

On the south side of the CPKC Winnipeg Yard, the only property that is available for development is the existing City of Winnipeg owned at the southwest corner of Arlington Street and Logan Avenue. Other portions of property are required for the intersection footprint with limited opportunity for streetscaping.




**Figure ES-4: Land Redevelopment Concept for Preferred Logan Avenue Intersection Option 1A**

## DECOMMISSIONING

### Approach Spans

The approach spans are Spans 1-13 on the South end and Spans 27-37 on the north end. The locations of these approach spans are not above active railway tracks, and therefore the decommissioning of those spans will not have any impacts on CPKC's yard activities. The proposed plan is that these spans will be removed in place with conventional demolition techniques. The removal of these spans for at least one end of the bridge will need to be scheduled following the removal of the middle spans to maintain access for demolition tasks between the noted ends spans.

### Pratt Trusses

The Pratt Trusses are the smaller size trusses located in Spans 14-18. Spans 14 and 15 are not above active railway tracks, however, Spans 16, 17, and 18 have active tracks below them that are used very often and will therefore require some interruptions to CPKC activities. The preferred method by CPKC for the decommissioning of the Pratt Trusses was to drop them down in place by explosion.

### Camelback Trusses

The drop down by explosion method was discussed with demolition contractors and the procedure was presented to the City of Winnipeg and CPKC, who were in agreement during the Workshop No. 2. During the Workshop No. 2, the Contractors in the meeting expected to complete the whole explosion process for each span with interruptions to CPKC activities for 48 hours. CPKC were very strict about not exceeding the agreed duration of interruption for each span, as any delays would cause major penalties and significant delays in their business in Winnipeg and numerous other cities. CPKC's preferred season to complete this work is during July as it is their least busy time during the year with the lowest volume of rail cars.

The explosion process of demolition, if completed by experienced contractors, could be contained, posing no risk of damage to nearby infrastructure and the tracks below, with the proper protection in place. The installation of the explosives is estimated to take 24 hours and may begin immediately prior to the closure of the tracks below the span, with minimal impact to CPKC. Access is required at this point to remain in place from one end of the bridge to install the explosives from above the bridge. The tracks would require protection below the bridge span for 3 times the span width (below span and 1 span width extra on each side). The preparation work below the bridge can start to take place with guidance from CPKC and their flaggers, while tracks are still being used.

The Contractor is to protect the yard below each span by flooding the railway tracks with ballast rocks and laying timber mats above the ballast rocks. The plan is to layout the material in place along the tracks while the trains are still passing by with their regular schedule.

Immediately following the blast drop down of the trusses, the Contractor will begin to clean up the debris from the explosion as quickly as possible, remove the timber mats, unflood the ballast rocks over the tracks, and return the closed railway tracks for use by CPKC within the specified time limit.

### North Spans

The North Spans referred to in this section are Spans 22-26, which are the girder spans located from north of the last Camelback Truss to Jarvis Avenue. The spans north of that area are the approach spans which will be removed in place with conventional demolition techniques.

## CONSTRUCTION METHODOLOGY

### Substructure Construction Methodology

Construction of the new piers will involve caisson installation. The following main steps are required:

### Mobilization and Excavation

Construction of the piers is expected to require the following equipment:

- Hydraulic Rotary Rig with auger bit / hydraulic hammer (Soilmec SR-70/ Delmag Crane or similar);
- A 70-150-ton service crane;
- A wheel loader;
- Small Excavator (similar to a Caterpillar 318 shown in the Figure ES-5);
- Flat deck railcar carrying steel casings and reinforcing cages, or flatbed truck;
- Shielding system to prevent spray of excavated material (if required);
- Concrete, generator and miscellaneous small tools; and
- Safety fencing and scaffolding.

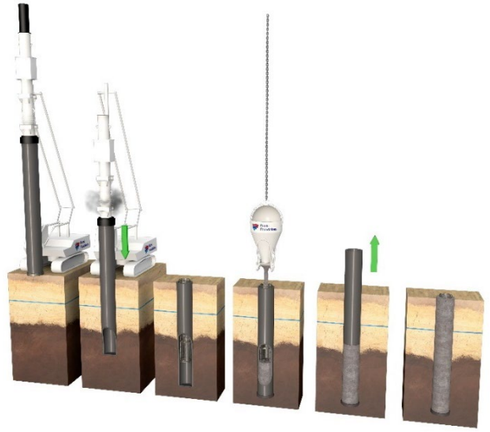


**Figure ES-5: Step-by-Step Caisson Installation**

### Caisson Construction

Once materials and equipment are available on site, the drilling rig will be positioned for the first caisson. A service crane will unload steel casings from a flatbed truck located near the proposed substructure unit. Once the casings are on the ground adjacent to the pier location, the rotary rig will connect a cable to the end of the casing and raise it into a vertical position. The casing will be driven through the overburden until it reaches bedrock. The steel casing pipe will be installed into the drilled shaft to prevent foreign material from entering the caisson.

Material removed from the steel casing will be loaded into a standard dump truck or rail car for transportation offsite or redistribution within CPKC property due to contamination. Drilling will continue into the rock for the socket shaft. The service crane will be used to install the reinforcing cages into the open pile casings. Reinforcing cages will be delivered to the pier location using a flatcar on the adjacent track or flatbed truck. Concrete will be placed to typical tremie methods within the caissons.

### Pier Cap Construction

Steel forms and prefabricated reinforcing cages, delivered to the site using flatbed trucks or the railway, may be used to construct the pier caps to minimize forming and construction schedule.

Steel forms do not require falsework towers that might increase the footprint of the work zone. Instead, brackets attached to the completed pier caissons or abutment columns are used to support the forms. These brackets are removed following the removal of the pier cap formwork; all of which is accomplished using all terrain cranes. Reinforcing cages can be preassembled off site and moved to the pier. Once the rebar cage has been moved to the pier locations, they can be lifted into the forms, as seen in Figure ES-6, and concrete placed via a pump truck set in a designated area.



**Figure ES-6: Steel Forms for Pile Cap**

### Superstructure Installation Methodology

### Incremental Launching

Incremental launching may be used for steel girder installation. Launching is not beneficial for the shorter spans. Launching from the north side is preferred due to the available area to develop the launching work area. Launching of Spans 4 - 9 are proposed. Closure of Jarvis Avenue would occur during the launching process and provide some flexibility to the Contractor regarding the launching pad setup and location at the north end of the project.

During detailed design the potential launch Span 3 as well will be reviewed based on detailed design girder dimensions and profiles. Otherwise Span 3 (and Span 1 and 2) will be installed by traditional crane methods.

Incremental launching involves assembling sections of the superstructure on a launch bed located on the north side of the proposed structure, then pushing, and/or pulling the assembled superstructure into place. The process is repeated until the entire structure is in place. Launching has the principal benefit of removing operations between the piers, not impacting the railway. It is expected that to launch one span, it would take 4-6 hours. Significant set-up time is required to prepare for the next launch process.



Figure ES-7: Launching Nose



Figure ES-8: Incremental Launch of Girders

## Deck Construction

Full width, full depth precast deck panels are proposed. The deck panels are 225mm thick reinforced and prestressed concrete slabs installed on neoprene strips on top of the supporting structural steelwork. Once installed, joints between the panels will be filled with Ultra High Performance Concrete. The proposed deck system is anticipated to minimize impacts to CPKC, as compared to traditional Cast-in-Place concrete decks. The deck panels can be fabricated as the substructure works are completed and brought to site, from a precast facility within plant quality control process, ready to be installed. The panels will be placed by typical construction equipment and as they are placed, the deck panel create a surface to accommodate construction activities, without the installation of forms. This avoids placement of a formwork and falsework over the rail yard.



Figure ES-9: Full Depth Precast Panel Installation

## Roadworks Staging Considerations

The following outlines high level construction staging approaches to street construction associated with the Arlington/Logan intersection and at the Arlington/Dufferin intersection.

## Arlington/Logan Intersection Improvements

Three major components are anticipated for street construction:

1. Build a smart channel right turn in the southeast corner and rebuild boulevard with sidewalk and new curb line.
2. Reconstruct right turn island to a smart channel in southwest corner and rebuild boulevard with sidewalk/path and new curb line.
3. Remove ramp and use north leg of the intersection as a construction access point. Rebuild radii and curb ramps in northeast and northwest corners as part of ramp construction.

Four construction stages are anticipated.

**Stage A Construction (Figure ES-10):**

a. With westbound left turn restricted full time, close southbound Arlington Street adjacent to the right turn island in the southwest corner.

b. Make northbound Arlington Street approach two lanes at Logan Avenue with northbound left in the existing southbound median lane.

c. Close northbound curb lane on Arlington Street to build smart channel, curb, boulevard, and path on east side of Arlington Street.

d. Use temporary setback stop lines and closure areas to maintain pedestrian connectivity on the east side of Arlington Street.

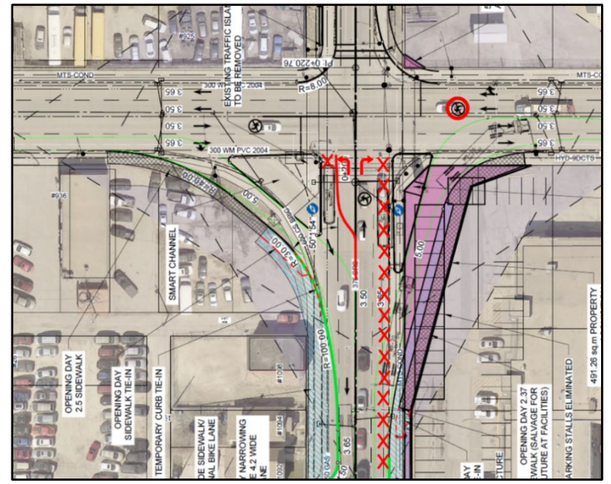



Figure ES-10: Stage A Construction

**Stage B Construction (Figure ES-11):**

a. Close eastbound curb lane on Logan Avenue including the right turn cut-off. Allow eastbound right turn (except trucks) into southbound and northbound median lane space on Arlington Street (for bus off tracking).

b. Complete north end of smart channel in southeast corner and then open smart channel ASAP (See Stage C).

c. Use a portion of the eastbound lane closure on Logan Avenue for pedestrian access. Maintain pedestrian access in southeast corner by moving path of travel around construction activities in the large area available (including the city property).

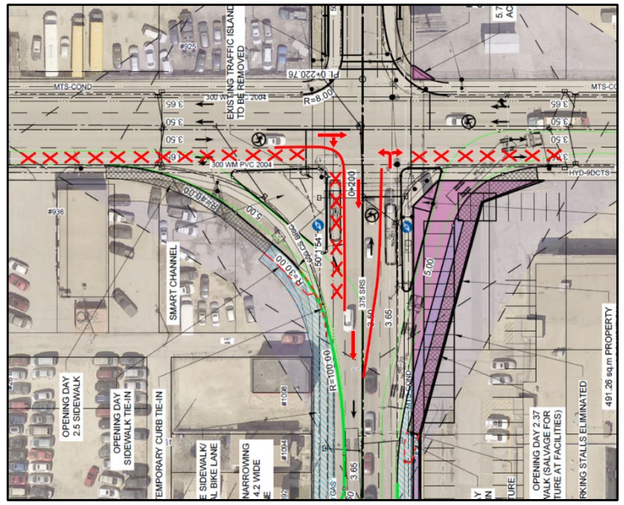



Figure ES-11: Stage B Construction

**Stage C Construction (Figure ES-12):**

a. Open northbound right turn smart channel. Run southbound through lane on Arlington Street to Alexander Avenue in the existing northbound through lane. Allow eastbound right turn (except trucks) into southbound and northbound median lane on Arlington Street.

b. Use large area available in the southwest corner of the intersection to keep pedestrian connections available.

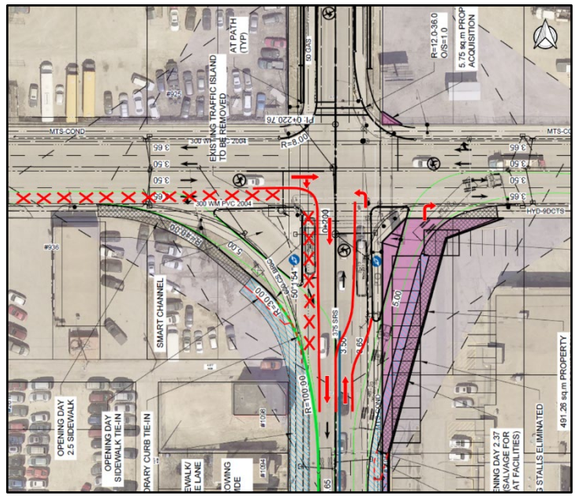



Figure ES-12: Stage C Construction

**Stage D Construction (Figure ES-13):**

a. Close westbound curb lane on Logan Avenue for north side ramp tie in construction and radius improvements.

b. Allow pedestrians to use a portion of the westbound curb lane closure to maintain an east-west connection.

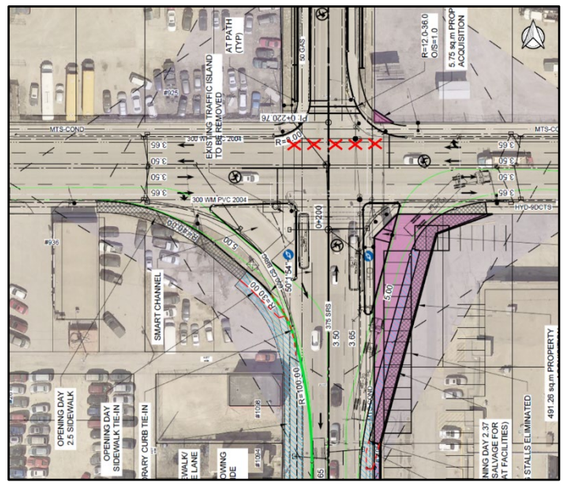



Figure ES-13: Stage D Construction

## Arlington/Dufferin Intersection Improvements

Roadwork is as follows:

- Rebuild entire Arlington/Dufferin intersection and east, west, and north approach legs to raise the grade of the intersection to match higher bridge ramp tie-in grades.
- Build Arlington ramp to a landing point between Dufferin and Stella. Create a cul-de-sac on Dufferin Avenue west of Arlington Street and create a new road connection between Dufferin Avenue and Jarvis Avenue east of Arlington Street.

Proposed detour components are illustrated in Figure ES-14 and described in the following list:

- Reroute Dufferin Avenue truck traffic to Jarvis Avenue via McGregor Street and Sinclair Street. If not possible periodically due to closure of Jarvis Avenue under Arlington Bridge, then use Selkirk Avenue as detour route between McPhillips Street and McGregor Street.
- Reroute Arlington Street truck traffic to McPhillips Street, McGregor Street, and Salter Street via Selkirk Avenue.
- Detour Arlington Street regional traffic to Selkirk Avenue. Close southbound curb lane far side of the Arlington/Selkirk intersection to communicate full closure of Arlington Street at Stella Avenue.
- Property access only on Dufferin Avenue west of Parr Street and east of Sinclair Street.
- Transit reroute likely on Selkirk Avenue between McPhillips Street and Arlington Street. Other available Transit detour route would be on Sinclair Street between Selkirk Avenue; however, this segment of Sinclair Street is only 7.5 m wide (local street section).
- Pedestrian detour via Parr/Stella/Sinclair. Maximize pedestrian access to property and only limit during actual construction affecting sidewalks or when accessibility cannot be maintained.

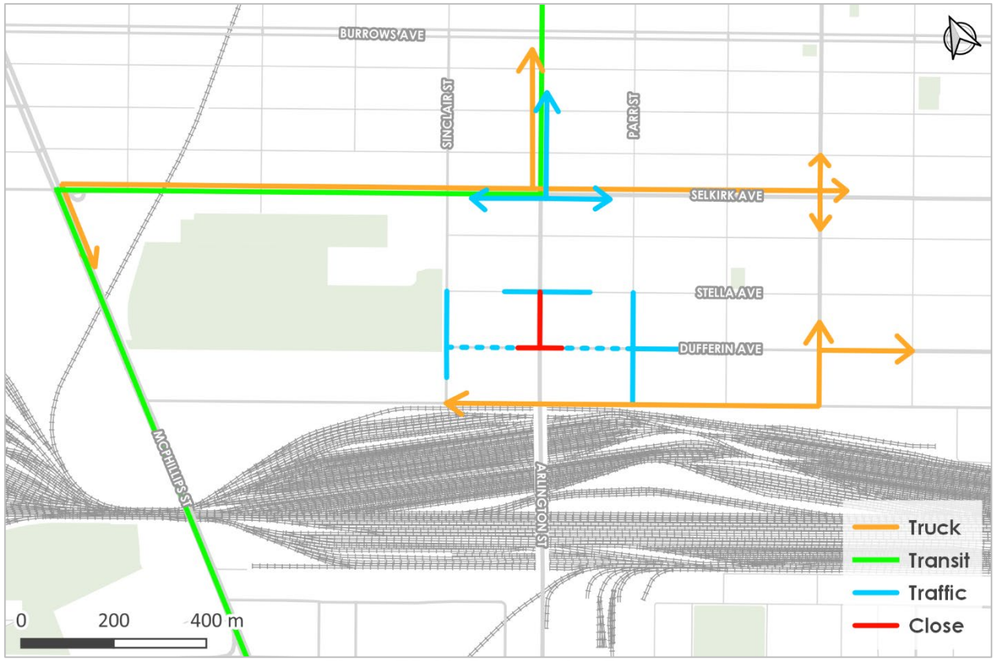



Figure ES-14: Construction Detour

## STAKEHOLDER CONSULTATION

The Stakeholder Consultation scope of work was deferred to the Detailed Design phase for this project. Originally scheduled to commence in Phase 2, the plan to reach out to vested stakeholders was put on hold when the Arlington Street Bridge was suddenly closed on November 21, 2023.

A new draft Consultation Strategy Plan will be developed based on the recommendations of this report. This project requires funding to move forward. Once this project has progressed to the Detailed Design phase, stakeholders will need to be consulted and informed on the proposed plan and how previous goals were incorporated into the revised design.

## RISK

For this assignment, the Risk Register started with risks identified in 2018. The 2018 risks were converted to the City of Winnipeg template and screened for relevance to the current assignment. In Phase 2, the initial Risk Register was populated by our project team and sent to the City for review. The project continued and in Phase 3, the Risk Register was presented within Workshop 2 on May 29, 2024. Each risk was reviewed and evaluated by the project team and representatives from the construction industry. The risk cost impacts are included in the basis of estimate, with the risk register presented in the Appendix of the Phase 3 report.

Risk costs have been determined for each risk. A summary of the risks and costs are provided in the table below.

**Table ES-1: Proposed Project Schedule**

| Risk | Cost | |
|---|---|---|
| Decommissioning | $733,000 | Allowance for additional work required for demo |
| Material, Construction Quantities | $2,415,000 | Allowance for increase in construction quantities |
| Engineering | $664,000 | Allowance for addition design/CA work required |
| Utilities | $338,000 | Allowance for unknown utilities and extra work |
| Land Acquisition | $646,000 | Allowance for increase in property costs |
| Landscaping | $69,000 | Allowance for additional landscaping and art |
| Soil Remediation | $53,000 | Allowance for increase is contaminated soil quantities |
| CPKC Railway | $905,000 | Allowance for additional flagging and CPKC reviews |
| Caisson Construction | $2,000,000 | Allowance for poor rock quality, deeper caissons |
| Delay Costs | $3,000,000 | Allowance for schedule impacts and contractor claims |

## SCHEDULE

The preliminary schedule is provided in the Table below.

**Table ES-2: Proposed Project Schedule**

| Project Tasks | Start | Finish |
|---|---|---|
| Arlington Street Bridge PD Study | August 2023 | July 2024 |
| Decommissioning/ Bridge Funding | July 2024 | November 2024 |
| Decommissioning Detailed Design | December 2024 | October 2025 |
| CPKC Decommission Review | March 2025 | January 2026 |
| Tender Bridge Decommissioning | January 2026 | April 2026 |
| Bridge Decommissioning | May 2026 | September 2026 |
| L-Lead Track Removal | July 2024 | September 2025 |
| Property Acquisition | January 2025 | August 2026 |
| Detailed Design of New Bridge | January 2025 | March 2026 |
| CPKC Construction Plan Review | August 2025 | August 2026 |
| CPKC NC-09 Relocation | September 2026 | October 2026 |
| Back Lead Removal/ Reconstruction | September 2026 | October 2026 |
| Tender/Award Bridge Construction | October 2026 | December 2026 |
| New Bridge Construction | January 2027 | October 2029 |
| Site Redevelopment/ Landscaping | May 2030 | August 2030 |

## CLASS 3 COST ESTIMATE

The cost breakdown sheets are provided in Appendix B. The total estimated cost for the New Bridge and Decommissioning is as follows:

**Table ES-3: Decommissioning Cost Estimate**

| Arlington Street Bridge - Decommissioning Class 3 Cost Estimate | | |
|---|---|---|
| **Description** | **Existing Bridge** | |
| Decommissioning of Existing Bridge | $ | 12,954,000 |
| **SUB TOTAL CONSTRUCTION COSTS** | **$** | **12,954,000** |
| **Engineering Costs** | **$** | **1,346,000** |
| **Insurance** | **$** | **117,000** |
| **Risk** | **$** | **1,480,000** |
| **Overhead/Administration Charges & Interest** | **$** | **1,053,900** |
| ***TOTAL (Rounded)*** | ***$*** | ***16,950,900*** |

**Table ES-4: New Bridge Cost Estimate**

| Arlington Street Bridge Replacement Class 3 Cost Estimate | | |
|---|---|---|
| **Description** | **Bridge 6A/Dufferin 2A (BOE)** | |
| Mob and Demobilization | $ | 5,122,000 |
| Bridge Works | $ | 84,582,000 |
| Road Works | $ | 4,544,000 |
| MSE Wall Works | $ | 7,564,000 |
| Rail Works | $ | 7,175,000 |
| Utility Works | $ | 7,762,000 |
| Soil Remediation | $ | 234,000 |
| Property Acquisition | $ | 4,506,000 |
| Landscaping / Art | $ | 821,000 |
| Sub-Total | $ | 122,310,000 |
| **SUB TOTAL CONSTRUCTION COSTS** | **$** | **122,310,000** |
| **Engineering Costs** | **$** | **13,182,00** |
| **Insurance** | **$** | **1,005,000** |
| **Risk** | **$** | **10,563,000** |
| **Overhead/Administration Charges & Interest** | **$** | **2,305,500** |
| ***TOTAL (Rounded)*** | ***$*** | ***149,365,500*** |

## CONCLUSION AND RECOMMENDATION

Upon completion of Phase 3, Tetra Tech recommends proceeding forward with the options and considerations listed below, for further development in Decommissioning and Replacement Bridge Detailed Design. Our recommendations are as follows:

- Decommissioning of truss spans via blasting.
- Existing bridge North Spans to be removed with cranes.
- Existing bridge approaches to be removed from grade.
- Vertical profile Option 2A (w/ 5% grades).
- Bridge Concept 6A.
- Relocation of the Back Lead.
- Relocation of NC-09 track.
- Removal of L Lead line.
- Logan Avenue Intersection Option 1A.
- Dufferin Avenue disconnection, Option 2A (pending stakeholder input).
- Rock socketed caissons for foundations.
- Full depth precast concrete deck panels.
- Plan for bridge decommissioning in summer 2026.
- Commence decommissioning planning in 2025.
- Develop and implement a Stakeholder Consultation Plan once project future is known.
- Undertake further geotechnical testing at each proposed pier during Detailed Design.
- Acquire identified full and partial property takes for Dufferin Avenue disconnection option.
- Inspect the existing Arlington Street Bridge annually until the bridge is decommissioned.