

## **Appendix A. Advances on Alignment at Connors Road**

## Subsequent Planning Advances for LRT Alignment along Connors Road

Development of an EISA for a project as large in scale as the Valley Line-Stage 1 is a lengthy process and requires that the design be “frozen” at the beginning of the assessment. The main body of this EISA, drafted in April and early May 2013, therefore reflects design achieved as of early April 2013 and as documented in detailed design reports prepared by the consulting engineers. Importantly, since that time, concurrent with the draft EISA preparation and review, design work continued on the track corridor alignment where it parallels Connors Road (on Connors Hill) and three alignment options were evaluated. Although it was not feasible to integrate that concurrent work into the main body of the EISA, resource and assessment information was available to the engineering design process and their options evaluation did incorporate environmental information and considered potential impacts. The additional Connors Road design work culminated in a final alignment recommendation that was submitted to LRT D and C in April 2013. The memo (Connected Transit Partnership 2013) concluded the following:

“...Option 3 (full encroachment to the south slope) has the highest negative ratings in terms of south slope environmental impacts, south slope structural requirements, roadworks, constructability/road closures, visual impacts and costs. Therefore, Option 3 has been eliminated from any further evaluation.

Options 1 and 2 are both feasible alternatives, with Option 1 having the greatest impacts on the Ski Hill, Folk Festival gatherings, and Option 2 providing a more balanced impact including the community to the south and somewhat reduced impacts to the north.

In May 2012, City Council approved a P3 delivery methodology for the Valley Line Stage 1 (Mill Woods to Centre West). P3 delivery constitutes design, build, finance, operate and maintain for a 30 year term. One advantage of a P3 delivery is the potential for consortia to bring innovative and optimized, design and construction solutions to the project.

The North Saskatchewan River Valley is a highly visible and sensitive area with numerous geotechnical, environmental and topographical challenges. To facilitate and encourage P3 consortia to bring forward innovative, aesthetic and cost effective solutions, the procurement process will include a number of technical submissions that will be evaluated either as “pass-fail” gates or perhaps as part of a qualitative scoring in addition to bottom line cost.

Option 1 will be included in the Reference Design and presented at Stage 5 Public Open Houses with a caveat stating that flexibility will be included in the contract documents to permit the P3 consortia to propose alternatives that do not encroach any further south than Option 2. This flexibility will allow the P3 consortia to be innovative in optimizing the current 30% design as the detailed designs are developed. “

This recommendation was formally adopted by LRT D and C in June 2013 and will be carried forward as part of the Reference Design into the P3 Procurement phase. The recommendation is now public. It was presented in discussions with select affected stakeholders, at an LRT public open house held on 19 June 2013 and is now available on the City’s website.

This EISA was finalized in early July 2013. Finalization includes provision of this appendix to acknowledge the above advances and decisions made around the Connor Road alignment since the draft preparation. Specifically, this appendix includes the following components:

- This update statement, prepared by Spencer Environmental.
- The full CTP 2013 Connors Road Report from which the above excerpt was taken.
- A copy of the display board presented at 19 June 2013 public open house.

Option 3, the southernmost alignment, was the primary option analysed in the draft EISA, and in the main body of this final EISA document. With the above-described recent developments, Option 3 has been removed from consideration in favour of a more northern alignment. This decision agrees with a recommendation in the EISA to consider a more northerly LRT alignment along Connors Road. As a result of this decision, and with appropriate mitigation and construction techniques, many of the impacts identified in the main body of this EISA for lands in the vicinity of Connors Road will now be reduced. This is particularly true with respect to visual impacts, permanent loss of wildlife habitat, permanent loss of vegetation, barriers to wildlife movement and encroachment on a recognized Natural Area. Conversely, there may be a greater need for a reforestation patch directly north of the corridor to provide for habitat connectivity. In addition, some socio-economic impacts may be increased in association with the increased encroachment on Gallagher Park. A more northerly alignment may also reduce impacts on rare plants, depending on the final alignment in relation to the precise locations of rare plants populations.

Report Cited:

Connected Transit Partnership. 2013. City of Edmonton, Preliminary Engineering-Southeast to West LRT (Valley Line-Stage1) Connors Road Report. Edmonton, Alberta.



City of Edmonton

# **Preliminary Engineering – Southeast to West LRT (Valley Line, Stage 1) Connors Road Report**

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60222337

**Date:**

April, 2013



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# AECOM



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## Executive Summary

The Southeast LRT Concept Plan, Downtown to Mill Woods was approved by City Council on January 19, 2011. The Concept Plan proposed LRT on the north side of the existing Connors Road. This alignment requires the placement of fill material and retaining structures and impacts the existing Gallagher Park and ski hill operated by the Edmonton Ski Club. Initial geotechnical reviews identified concerns regarding the fills and retaining structures on the north side and their impact on slope stability.

A thorough investigation of the Connors Road alignment options has been ongoing throughout Preliminary Design of the Valley Line Stage 1. The Concept Plan, initial geotechnical reviews, and value engineering workshops all suggested investigating the realignment of Connors Road to the south in an effort to minimize fills on the north side of Connors Road and to minimize impacts on the ski hill and Gallagher Park. All materials presented to date through the public engagement process have illustrated Option 3, realigning Connors Road to the south (full encroachment into the south slope). Presentation of this alignment option has spurred several additional meetings with affected stakeholders.

In the early stages of Preliminary Engineering, several solutions were developed and assessed based on the impacts to the Edmonton Ski Club and Gallagher Park, slope stability, geotechnical and environmental risks, and noise. Optimization of design and consideration of stakeholder and public input led to three Connors Road alignment options that were analysed to a high geotechnical level to mitigate concerns relating slope stability. From a geotechnical perspective, all three Options are deemed feasible provided that adequate slope reinforcement measures are implemented to improve the stability of the existing slopes and minimize the risk of future slope movements. As a result of geotechnical feasibility, other factors such as environmental, roadworks, drainage, structures, ski hill/folk festival and community impacts, constructability, visual impact in the river valley, and costs are all critical items to consider.

Based on the Connors Road Alignment Options – Comparison Matrix provided in this report, it is clear that Option 3 (full encroachment to the upper south slope) has the highest negative rating on several criteria. CTP therefore recommends that Option 3 be eliminated from any further evaluation.

Options 1 and 2 are both feasible alternatives, with Option 1 having the greatest impacts on the Ski Hill and Folk Festival gatherings, and Option 2 providing a more balanced impact including the community to the south and somewhat reduced impacts to the north.

In May 2012, City Council approved a Public Private Partnership (P3) delivery methodology for the Valley Line Stage 1 (southeast Stage). P3 delivery constitutes design, build, finance, operate, and maintain for a 30 year term. One advantage of a P3 delivery is the potential for consortia to bring innovative and optimized design and construction solutions to the project.

The North Saskatchewan River Valley is a highly visible and sensitive area with numerous geotechnical, environmental, and topographical challenges. To facilitate and encourage P3 consortia to bring forward innovative, aesthetic, and cost effective solutions, the procurement process will include a number of technical submissions that will be evaluated either as “pass-fail” gates or perhaps as part of a qualitative scoring in addition to bottom line cost. In terms of moving forward, CTP recommends that Option 1 be included in the Reference Design and presented at Stage 5 Public Open Houses with a caveat stating that flexibility will be included in the contract documents to permit the P3 consortia to propose alternatives that do not encroach any further south than Option 2.

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# 1. Concept Plan

The City of Edmonton’s strategic transportation vision “The Way We Move” provides the framework for how the City will accommodate future transportation challenges. Expansion of the City’s light rail transit (LRT) system was identified as a key component in creating a livable, sustainable city. Following the approval of “The Way We Move”, the LRT Network Plan was developed. This plan recommended low floor vehicle technology for new LRT lines that do not interline with the existing high floor vehicle technology currently in operation in Edmonton. Features of this new, urban style LRT include smaller scale stops that are spaced closer together, serving multiple activity centres with greater emphasis on integration into adjacent communities.

During the Valley Line Stage 1 Corridor Selection, two corridors, Connors Road and Dawson Bridge, were advanced to a second screening analysis. The Connors Road alignment was selected as the preferred corridor for the following reasons:

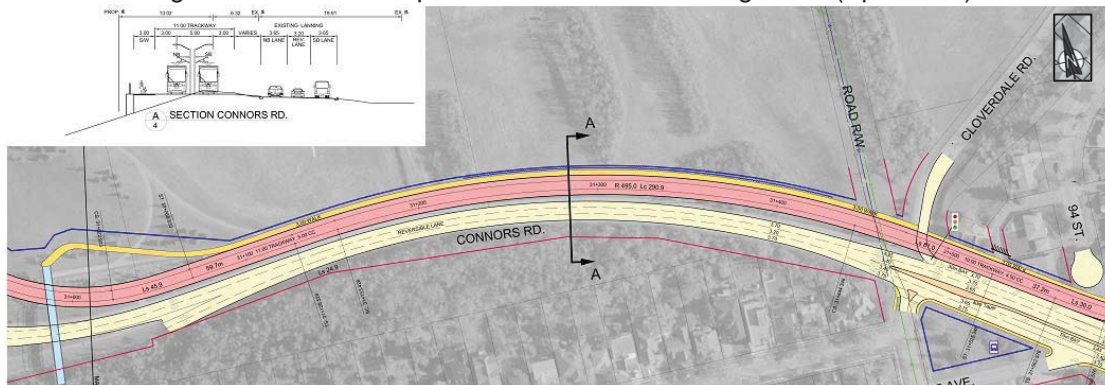
- better aligns with the goal of promoting a compact urban form,
- most direct corridor resulting in faster travel times,
- results in strong potential ridership,
- reinforces current major transit patterns from Downtown to Mill Woods,
- results in slightly fewer impacts to programmed parks areas, and
- shows an advantage in serving redevelopment areas.

The Valley Line Stage 1, Downtown to Mill Woods, Recommended Corridor was approved by City Council in December 2009. At the same meeting, City Council also approved initiation of Concept Planning to evaluate a preferred alignment within the corridor, traffic impacts, costs and other issues.

The Southeast LRT Concept Plan, Downtown to Mill Woods, was approved by City Council on January 19, 2011. The Concept Plan proposed LRT on the north side of the existing Connors Road as illustrated in Figure 1. Concept Plan – Connors Road Alignment. The Concept Plan alignment requires fill material and retaining structures to support the LRT and impacts the existing Gallagher Park and ski hill operated by the Edmonton Ski Club. This alignment does not impact the existing topography and vegetation on the south side of Connors Road.

The Concept Plan stated that during future phases of design development, consideration should be given to the evaluation of realigning Connors Road to the south to reduce the amount of retaining structure and to reduce the overall impact on the Edmonton Ski Club hill and Gallagher Park. The idea to further consider realigning Connors Road to the south was noted on several occasions throughout the Concept Plan.

Figure 1. Concept Plan – Connors Road Alignment (April 2011)



During Concept Planning, an initial desktop geotechnical review was conducted by Thurber Engineering Ltd. The geotechnical review stated the following:

*“Placement of fill on the lower slope below the existing roadway has the potential to reduce the local stability of the existing slope and will need to be evaluated during future phases of the design.*

*There is insufficient existing geotechnical information on the soil and groundwater conditions to quantitatively assess the potential impact of the SELRT grade construction on the slope stability. However, based on the preliminary assessment it is considered that widening of the right of way with appropriate retaining structures is technically feasible from a geotechnical aspect. It is expected that the retaining walls may require support by piles and possibly also tie backs or other support methods, depending on the wall height, in order to maintain adequate slope factor of safety.*

*Consideration may also be given to partial relocation of the existing Connors Road southwards towards the upper slope section near the crest of the valley to reduce the potential amount of fill over the down slope side of the roadway. This may potentially reduce the overall impact on the valley slope stability and should be evaluated during subsequent phases of the study to optimize the slope works. Any cuts into the existing slopes would have to be retained by appropriate retaining walls designed to maintain the existing level of slope support.”*

## 2. Value Engineering

During an initial Value Engineering workshop conducted in November of 2011, a list of concerns was generated for the Valley Line Stage 1. The suggestions were evaluated at a high level and higher risk items were shortlisted for further evaluation. Due to the geotechnical history in this area, environmental impacts in the North Saskatchewan River Valley and impacts on the Edmonton Ski Club and Gallagher Park, the alignment of the LRT through the Connors Road corridor was identified as a high risk area. It should be noted that the following concerns were also raised by stakeholders during the Concept Planning phase: negative impact on the Edmonton Ski Club due to reduction in length and slope of ski hill; and Edmonton Folk Festival concerns regarding noise pollution and encroachment into Gallagher Park.

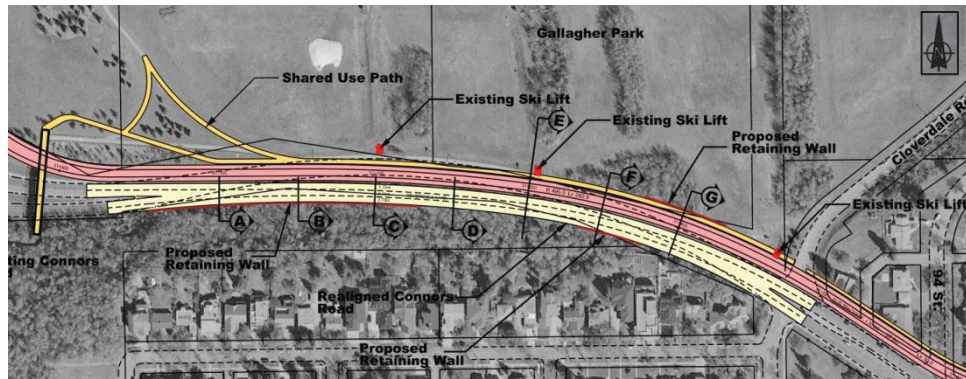
Mitigation strategies developed at the Value Engineering workshop to address high risk concerns related to the Connors Road corridor included the following:

- remove traffic lane from Connors Road,
- move Connors Road to the south,
- align tracks closer to Connors Road,
- terrace trackway and roadway, and
- cut and cover.

Following the Value Engineering workshop, the option of eliminating a lane of traffic from Connors Road was reviewed. Connors Road operates as a 3 lane arterial and is one of a limited number of commuter corridors from southeast Edmonton that provides access to a North Saskatchewan River Crossing and Downtown Edmonton. Connors Road currently carries 24,000 vehicles/day and as the City grows, estimated volumes on Connors Road will escalate to 36,000/day in 2041. Eliminating the existing reversible lane would force existing and future traffic volumes to divert onto the surrounding roadway network, specifically 99 Street and 75 Street. The reassignment of traffic from Connors Road will add significantly to the congestion levels on both 99 Street and 75 Street. Reducing the number of lanes from three to two lanes would reduce the encroachment onto the hill by approximately 4m, which would not be sufficient to eliminate the need for retaining fills and structures. Removal of traffic lanes on Connors Road was not identified in the City Council Approved Concept Plan, does not eliminate the need for retaining fill on the north side of Connors, and will result in significant added congestion on the adjacent roadway network. Therefore, the option of removing a traffic lane from Connors Road was eliminated from any future evaluation.

Further consideration of the mitigation strategies developed at the Value Engineering workshop resulted in a technical evaluation of realigning Connors Road to the south (approximately 15m) in conjunction with reducing the separation between the LRT and Connors Road (see Figure 2. Preliminary Engineering – Connors Road Realignment (February 2012)). This realignment results in the loss of approximately 0.7 acres of existing City-owned woodland on the south side of Connors Road, and aligns a majority of the proposed LRT alignment along the existing Connors Road.

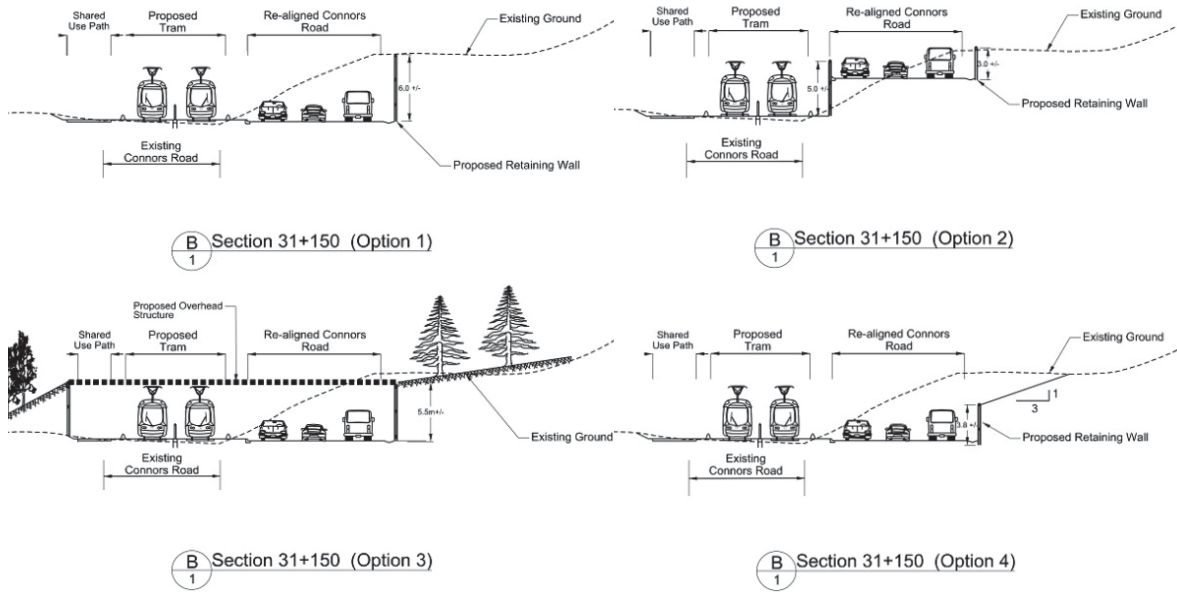
Figure 2. Preliminary Engineering - Connors Road Realignment (February 2012)



Four alternative design solutions that had been previously discussed at the Value Engineering workshop were prepared for Cross Section B and are illustrated in Figure 3. Preliminary Engineering - Connors Road Realignment Options (February 2012). The following outlines the high level details of these four design solutions:

- Option 1: full height retaining wall
  - Approximately 6.0m height of retaining wall
  - Option carried forward for further evaluation
- Option 2: terraced trackway and roadway
  - Two retaining walls varying between 3m to 5m in height
  - Option eliminated due to structural costs
- Option 3: cut and cover
  - Approximate cut of 5.5m with an extension of park space as cover
  - Option eliminated due to structural costs
- Option 4: increased slope of hillside with reduced retaining wall height
  - Approximately 3.8m height of retaining wall
  - Increased excavation and impact to woodland south of Connors Road
  - Option carried forward for further evaluation

Figure 3. Preliminary Engineering - Connors Road Realignment Options (February 2012)



The conclusion from this initial evaluation was to proceed with further evaluation of realigning Connors Road to the south with consideration of both Option 1 and Option 4 cross sections, and to collate additional geotechnical information on the existing soils and slope stability.

### 3. Preliminary Engineering Geotechnical Site Investigation

An initial geotechnical site investigation throughout the North Saskatchewan River Valley was carried out by Thurber Engineering Ltd between October and November 2011. The site investigation for the LRT alignment was comprised of the following:

- desktop review of air photos, available geologic/geotechnical data, topographic information and archived records of historic activities in the area,
- site visits,
- test hole drilling and instrument monitoring, and
- laboratory testing.

Following the completion of the borehole drilling and testing, a geotechnical report was prepared summarizing the overall appraisal of the geotechnical conditions along the alignment, the potential challenges related to geotechnical issues, and impacts of the geologic/geotechnical conditions on the proposed LRT facilities.

In regard to Connors Road, the geotechnical report stated:

*“The stratigraphic profile in the area consists of man-made fills associated with the grading and landscaping activities in the seventies and eighties, colluviums materials derived from sloughing and slumping of the valley slope, native lacustrine and glacial deposits overlying bedrock. Because of the steeply sloping terrain at the Edmonton Ski Club, fill heights could be up to 5m in places. Depending on its lateral extent and height the placement of additional fill may trigger slope instabilities. Two failure modes are possible: shallow slumping of the existing fill and colluvium material and deep seated sliding along the bentonite zones or weak horizons in the bedrock.*

*Existing fills at the test holes were up to 4.6m thick in some places and appeared to be the thickest near the top of Connors Road. Test hole results indicated that the fill comprised clayey soils with pockets of organic material and was firm to stiff in consistency. It is possible that existing fills associated with the grading of the ski hill were placed in a somewhat uncontrolled manner. Slope instabilities associated with loading of these fills and any underlying disturbed colluviums are of concern. In addition, the variability and lower quality of the fill material and the inclination of the hill slopes could have adverse impacts on the capacity of pile foundations subjected to lateral loads.*

*Test holes identified a bentonite seam some 8m below the elevation of the slope toe. It is not anticipated that this bentonite zone will have a substantial impact on stability. Nevertheless, some of the bentonite faces of the clay shale bedrock were characterized by low shear strength. Fill loading may trigger instabilities seated in these weaker horizons of the bedrock. It should be noted however that there is no known history of instability at this site and the presence of a wide river terrace in front of the slope toe protects it from river action.*

*Once the configuration of the LRT structures in this area is developed, slope stability analyses will be performed to assess the two failure modes identified above, and recommendations pertaining to any required slope stabilization measures will be provided. In general, however, design measures aimed at reducing the lateral extent and height of additional fills would be preferred. Such measures may include shifting both Connors Road and the proposed LRT alignment to the south, or supporting the LRT track way on a structural system that requires minimal or no fills.”*

## 4. Stakeholder Involvement

### 4.1 Public Involvement Plan

As defined in City of Edmonton's Public Involvement Policy and Framework, a Public Involvement Plan was developed for the Valley Line (Southeast to West) LRT Preliminary Design stage. The approved Public Involvement Plan recommended five stages of consultation as follows:

- Stage 1 - Pre Consultation (November 2011 – February 2012)
- Stage 2 – Initiation (March – April 2012)
- Stage 3 – Consultation (May – June 2012)
- Stage 4 – Refinement (September 2012 – May 2013)
- Stage 5 – Conclusion (June 2013 – November 2013)

The Valley Line extends from Lewis Farms in west Edmonton to Mill Woods Town centre in southeast Edmonton. The line is 27 km long, and to facilitate the public involvement process, the line was split into the following 6 areas:

- Area 1- Mill Woods Town Centre to Whitemud Drive
- Area 2 - Whitemud Drive to Argyll Road
- Area 3 - Argyll Road to Strathearn
- Area 4 - Strathearn to Centre West
- Area 5 - Centre West to 149 Street and,
- Area 6 - 149 Street to Lewis Farms

### 4.2 Consultation

Connors Road is located within Area 4 - Strathearn to Centre West. All open houses for Area 4 were held at the Northern Alberta Pioneers Cabin (a.k.a. Old Timers Cabin) on Scona Road. Open Houses that have been conducted to date for Area 4 are listed below:

- Stage 2 - April 11, 2012,
- Stage 3 – June 14, 2012, and
- Stage 4 - September 24, 2012.

Throughout all of these open houses, the Connors Road alignment was shown as realigned to the south with retaining walls. In addition to the open houses, meetings specifically relating to Connors Road were also held with the Cloverdale Community League, Edmonton Ski Club, Edmonton Folk Music Festival and 95 Avenue resident groups.

Concerns with the proposed design heard at these meetings include:

- Geotechnical stability
- Construction- and operation-related noise and vibration
- Impacts to wildlife and natural areas
- Aesthetics of bank and realigned road and track rights of way from north and south views
- Potential impacts to private property and components (wall, deck, landscaping) at the top of bank

The analysis that follows has considered the above-listed concerns.



### 4.3 Connors Road Alignment Evaluation

Continued consultation between the City of Edmonton and the aforementioned stakeholders resulted in an agreement to evaluate the following three alignment options for Connors Road and the LRT:

- Option 1 – Concept Plan
  - retain existing Connors Road with trackway encroaching to north into Gallagher Park
- Option 2 - Partial encroachment to the south
  - trackway not to encroach south of the existing Connors Road south curb
- Option 3 – Full encroachment to the south
  - as shown at Stage 2, Stage 3, and Stage 4 open houses

#### 4.3.1 Urban Traffic Noise Policy

When the City plans to build or upgrade a major transportation facility, such as the Southeast to West LRT, adjacent to or through a residential area, it must follow the Urban Traffic Noise Policy (C506A) to determine if and where noise attenuation (noise barriers) should be built. The policy states:

*“The City of Edmonton will seek to achieve a projected attenuated noise level below 65 dBA Leq24 or as low as technically, administratively, and economically practicable, where any urban transportation facility (arterial roadways or light rail transit) is proposed to be built or upgraded through or adjacent to a developed residential area where private backyards will abut the transportation facility.”*

Noise modelling was undertaken and confirmed through the Preliminary Design stage of the project, and has identified that noise levels exceed 65 dBA Leq24 in the areas adjacent to five residential properties on 95 Avenue. Therefore, the properties abutting the LRT right of way are eligible for the construction of a noise attenuation mechanism such as a wall, per Figure 4 below. The location of this wall is common to all three of the design Options that follow.

Figure 4. Noise Attenuation Structure Location



The City of Edmonton will contact eligible property owners later in 2013 to solicit feedback on 1-3 options for the finishing treatment of this noise attenuation wall.

### 4.3.2 Option 1 – Concept Plan

#### 4.3.2.1 Road Alignment

Option 1 maintains the existing Connors Road alignment as illustrated on Figure 5. Option 1 - Concept Plan - Road Alignment. Maintaining the existing Connors Road results in no impact to the existing road structure, road drainage, utilities and also preserves the existing woodland environment to the south of Connors Road. This option does not warrant retaining structures on the south side of Connors Road. From a traffic management and constructability point of view, it will be possible to maintain a minimum of two lanes of traffic flow on Connors Road during construction with only some minor, off-peak lane closures. Roadway rehabilitation (pavement, curb, and gutter) costs have been included in Option 1 estimates.

Figure 5. Option 1 - Concept Plan - Road Alignment



#### 4.3.2.2 Track Alignment

Option 1 track alignment is located immediately north of the existing Connors Road, encroaching into Gallagher Park and the ski hill as illustrated on Figure 6. Option 1 - Concept Plan - Track Alignment. Option 1 track alignment geometry has been optimized to reduce the separation between the existing Connors Road and the track. This track alignment poses the largest impacts to Gallagher Park, north of Connors Road, and will result in the greatest loss of existing vegetation north of Connors. Impacts to the Edmonton Ski Club include the reduction in length of the ski hill and the relocation of three existing ski lift structures. Of the three options reviewed, Option 1 presents the most significant impact to the ski hill. Option 1 requires an additional separate drainage system for the trackway.

Figure 6. Option 1 - Concept Plan - Track Alignment



#### 4.3.2.3 Structures

Given the geotechnical concern about placement of fills on the north side of Connors Road and potential future slope movement, a significant length of the LRT will be supported on piles, which are underground structural supports. This is required to support both the track and the shared use path, and to serve as a slope reinforcement element to protect the stability of the slope (see Figure 7. Option 1 – Concept Plan – Structures). Pile lengths of approximately 25m are required to provide sufficient embedment into bedrock. Option 1 maintains the existing Connors Road alignment, and therefore does not introduce retaining wall requirements along the South side of Connors Road.

Figure 7. Option 1 - Concept Plan - Structures



#### 4.3.2.4 Cost Estimate

Option 1 has an approximate cost of approximately \$12 million (Table 1. Option 1 – Concept Plan – Cost Estimate). This cost includes site clearance removals, road rehabilitation, structures and relocation of three ski lift structures. No costs associated with any potential off-corridor road improvements have been included in this estimate.

**Table 1. Option 1 - Concept Plan - Cost Estimate**

Item	Total
Removals	\$50,000
Roadworks	\$800,000
Structures	\$5,500,000
Impact on Ski Hill	\$750,000
<b>Sub-Total</b>	<b>\$7,100,000</b>
Other (Design, Contingencies, Management, General)	\$4,000,000
<b>Total</b>	<b>\$11,100,000</b>

### 4.3.3 Option 2 – Partial Encroachment to South

#### 4.3.3.1 Road Alignment

Option 2 is a compromise of both Option 1 and Option 3, in which Connors Road is realigned so that it only partially encroaches into the existing slope on the south side (Figure 8. Option 2 - Partial Encroachment to South - Road Alignment). The existing road structure from just east of the existing pedestrian overpass to west of the 95 Street intersection will require total reconstruction along with relocation of existing utilities. Option 2 includes installation of new drainage to accommodate both the realigned Connors Road and tracks, accompanied by a new storm water management facility at the base of Connors Hill. Partial encroachment to the south introduces the need for a retaining structure on the south side of Connors Road, impacting the existing woodland area to the south. To construct the realigned Connors Road and associated retaining walls, total closure of Connors Road will be required for at least one construction season. Timing of the closure will have to be co-ordinated with roadway closures associated with construction on Walterdale Bridge. Traffic detouring and management will have to be determined to confirm routing and potential off-corridor improvements prior to implementation.

Figure 8. Option 2 - Partial Encroachment to South - Road Alignment



#### 4.3.3.2 Track Alignment

Option 2 locates the track alignment immediately north of the realigned Connors Road, such that it does not encroach any further south than the existing south curb of Connors Road (see Figure 9. Option 2 - Partial Encroachment to South - Track Alignment). As with all the presented alignment options, the track alignment impacts the existing vegetation north of Connors Road. This option has less of an impact on the ski hill than Option 1, requiring the relocation of only two ski lift structures. Option 2 requires an additional separate drainage system for trackway.

Figure 9. Option 2 - Partial Encroachment to South - Track Alignment



#### 4.3.3.3 Structures

Given that an increased length of track is accommodated on the existing Connors Road, the length of track on piles is reduced from Option 1 as shown on Figure 10. Option 2 - Partial Encroachment to South - Structures. Encroachment into the south slope of the existing Connors Road necessitates construction of two retaining walls totalling approximately 260m in length. The west wall has a maximum of height of 6m and the east wall a maximum height of 3m. It should be noted that the east wall would be jointly used in conjunction with the required noise wall to provide attenuation to residential properties west of 95 Street. To achieve adequate long term stability for the excavated slopes, two types of pile retaining walls are recommended. For the shallower cuts near the top of Connors Road, a row of discrete cantilever piles with permanent shotcrete lagging is recommended. For the deeper cuts along the central section of the alignment, concrete soldier piles, ground anchors and permanent shotcrete lagging is recommended. Geosynthetic wall drains should be installed behind the shotcrete and connected to a drainage pipe to prevent hydrostatic water pressure from building behind the wall. Site clearance and construction associated with the retaining walls on the south side of Connors Road will be challenging.

Figure 10. Option 2 - Partial Encroachment to South - Structures



4.3.3.4 Cost Estimate

Option 2 has an approximate cost of \$21 million (Table 2. Option 2 – Encroachment into South Slope – Cost Estimate). This cost includes site clearance, removals, road reconstruction, structures, relocation of two ski lift structures, and drainage improvements. No costs associated with any potential off-corridor road improvements have been included in this estimate.

Table 2. Option 2 – Partial Encroachment into South Slope – Cost Estimate

Item	Total
Removals	\$200,000
Roadworks	\$1,750,000
Structures	\$11,000,000
Impact on Ski Hill	\$500,000
<b>Sub-Total</b>	<b>\$13,450,000</b>
Other (Design, Contingencies, Management, General)	\$7,500,000
<b>Total</b>	<b>\$20,950,000</b>

4.3.4 Option 3 - Full Encroachment to South

4.3.4.1 Road Alignment

Option 3 consists of the deepest encroachment into the existing south slope. (Figure 11. Option 3 - Full Encroachment to South - Road Alignment). Virtually the entire length of Connors Road from the existing pedestrian overpass to 95 Street will be realigned, requiring the removal of the equivalent length of the existing Connors Road and all associated utilities. As with Option 2, this option requires the installation of new drainage to accommodate both the realigned Connors Road and tracks, accompanied by a new storm water management facility at the base of Connors Hill. Full encroachment into the south side requires longer and higher retaining walls and has the greatest impact on the existing south side vegetation. To construct the realigned Connors Road and associated retaining walls, total closure of Connors Road will be required for at least one construction season. Timing of the closure will have to be co-ordinated with roadway closures associated with construction on Walterdale Bridge. Traffic detouring

and management will have to be determined to confirm routing and potential off corridor improvements prior to implementation.

Figure 11. Option 3 - Full Encroachment to South - Road Alignment



#### 4.3.4.2 Track Alignment

The Option 3 track alignment is located immediately north to the proposed realigned Connors Road as illustrated in Figure 12. Option 3 - Full Encroachment to South - Track Alignment). Option 3 has the least impact on the existing vegetation on the north side of Connors Road. As for the Edmonton Ski Club ski hill, only one ski lift structure at the top of Connors Road has to be relocated. Option 3 requires an additional separate drainage system for the track.

Figure 12. Option 3 - Full Encroachment to South - Track Alignment



#### 4.3.4.3 Structures

A short section, approximately 80m, of track towards the top of Connors Road is supported on piles as illustrated in Figure 13. Option 3 - Full Encroachment to South - Structures). The deepest encroachment into the south slope necessitates the longest and highest retaining walls. Similar to Option 2, two separate walls totalling approximately 355m in length are required. The west wall has a maximum of height of 7m and the east wall a maximum height of 3m. It should be noted that the east wall would be jointly used in conjunction with the required noise wall to provide attenuation to residential properties west of 95 Street. To achieve adequate long term stability for the excavated

slopes, two types of pile retaining walls are recommended. For the shallower cuts near the top of Connors Road, a row of discrete cantilever piles with permanent shotcrete lagging is recommended. For the deeper cuts along the central section of the alignment, concrete soldier piles, ground anchors and permanent shotcrete lagging is recommended. Geosynthetic wall drains should be installed behind the shotcrete and connected to a drainage pipe to prevent hydrostatic water pressure from building behind the wall.

Site clearance and construction associated with the retaining walls on the south side of Connors Road will be challenging.

Figure 13. Option 3 - Full Encroachment to South – Structures



#### 4.3.4.4 Cost Estimate

Option 3 has an approximate cost of \$27 million (Table 3. Option 3 – Full Encroachment into South Slope – Cost Estimate). This cost includes site clearance, removals, road reconstruction, structures and relocation of a single ski lift pole, and drainage improvements. No costs associated with any potential off corridor road improvements have been included in this estimate.

Table 3. Option 3 - Full Encroachment into South Slope - Cost Estimate

Item	Total
Removals	\$200,000
Roadworks	\$2,500,000
Structures	\$13,500,000
Impact on Ski Hill	\$250,000
<b>Sub-Total</b>	<b>\$16,450,000</b>
Other (Design, Contingencies, Management, General)	\$9,000,000
<b>Total</b>	<b>\$25,450,000</b>



## 5. Environmental Assessments

Two environmental assessments have been undertaken to identify impacts of LRT and associated construction as listed below:

- Summary of Findings from Environmental Assessment Investigations at Connors Hill (November 2012), and
- Wildlife Passage Considerations and Assessment.

These assessments included vegetation surveys, rare plant surveys (Figure 14. Existing Plant Communities), breeding bird surveys, wildlife movement analysis, ecological connectivity assessment, qualitative evaluation of the habitat quality and rarity within the river valley.

Figure 14. Existing Plant Communities



In addition, as a result of the Valley Line Stage 1 crossing through the North Saskatchewan River Valley, an Environmental Impact Assessment is required to fulfill the requirements of the City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP) (Bylaw 7188). This assessment is ongoing and is anticipated to be presented to City Council later this year.

## 6. Constructability

In assessing the three options for Connors Road, a series of meetings were held with designers and contractors to collect their input on construction methodologies and scheduling. Presentations and descriptions of all three options were provided along with the geotechnical and environmental reports.

Findings are as follows:

- Accessibility of large construction machinery to the south slope is very challenging and will result in long and intrusive road closures
- Stressed anchors to be installed at approximately 20 degrees to the horizontal for retaining walls on the south side
- Piles to be drilled
- Wall faces to be drained
- To avoid stability issues, construction of retaining walls on the south side will be implemented through small segments at a time. Construction will then “leap-frog” to other sections of the wall, allowing sufficient time for curing before stressing and installation of anchors. This technique requires that specialized construction equipment will continually be moving up and down Connors Road which is inefficient and very time consuming.
- All construction work to be carried out minimizing grading, cuts and fill, and disturbance to existing vegetation.
- Costs and constructability challenges for Option 1 are less than for Options 2 and 3
- Connors Road can remain open during construction of Option 1, but must be closed during construction of both Option 2 and Option 3

## 7. Conclusion and Recommendations

A thorough investigation of the Connors Road alignment options has been ongoing throughout Preliminary Design of the Valley Line Stage 1. The Concept Plan, initial geotechnical reviews, and value engineering workshops all suggested investigating the realignment of Connors Road to the south in an effort to minimize fills on the north side of Connors Road and to minimize impacts on the ski hill and Gallagher Park. All materials presented to date through the public involvement process have illustrated realigning Connors Road to the south (Option 3 - full encroachment). Presentation of this option has spurred several additional meetings with affected stakeholders and has provided an opportunity for the City to learn about concerns of stakeholders in the area.

In the early stages of Preliminary Engineering, several solutions were developed and assessed based on the impacts to the Edmonton Ski Club and Gallagher Park, slope stability, geotechnical and environmental risks, and noise. Optimization of design and consideration of public input led to three Connors Road alignment options that were analysed to a high geotechnical level to mitigate concerns relating to slope stability. From a geotechnical perspective, all three Options are deemed feasible provided that adequate slope reinforcement measures are implemented to improve the stability of the existing slopes and minimize the risk of future slope movements. As a result of geotechnical feasibility, other factors such as environmental, roadworks, drainage, structures, ski hill/folk festival impacts, constructability, visual impact in the river valley, and costs are all critical items to consider, as illustrated below in Table 4. Connors Road Alignment Options – Comparison Matrix.

**Table 4. Connors Road Alignment Options – Comparison Matrix**

Issues associated with Connors Road Alignment	Option 1	Option 2	Option 3
<b>Environmental</b> <i>Impacts to existing vegetation (grasses, shrubs, trees, etc.) and wildlife:</i>			
- Temporary displacement during construction			
- Permanent displacement due to trackway, roadway, etc. infrastructure			
• North	3	2	1
• South	1	2	3
<b>Roadworks/Drainage/Utilities</b> <i>Magnitude of new infrastructure for roadways, drainage, and utilities; extent of upgrades required to existing infrastructure</i>	1	2	3
<b>Structures**</b> <i>Extent of structural infrastructure required for trackway, roadway, geotechnical stability, etc.</i>			
• North	3	2	1
• South	1	2	3
<b>Existing Land Use Impacts</b> <i>Extent of impact to the existing ski hill slopes, existing ski lift infrastructure, and Folk Festival</i>	3	2	1
<b>Constructability</b> <i>Challenges and risks associated with construction of retaining walls, track structure on piles; impacts to traffic during construction; etc.</i>	1	2	3
<b>Visual Impact on the River Valley</b> <i>Level of visual impact on the River Valley assumed directly correlated to the extent of exposed surface of proposed infrastructure</i>	1	2	3
<b>Cost</b> <i>Total cost of existing infrastructure removals, construction of roadway, trackway, SUP, geotechnical structural infrastructure, drainage, etc.</i>	1	2	3
<b>Total</b>	<b>15</b>	<b>18</b>	<b>21</b>

\*Note: 1 = lowest (positive)  
3 = highest (negative)

\*\*All options include measures to improve stability of existing slope and minimize risk of future slope movement

Based on the above matrix, it is clear that Option 3 (full encroachment to the south slope) has the highest negative ratings in terms of south slope environmental impacts, south slope structural requirements, roadworks,

constructability/road closures, visual impacts and costs. Therefore, Option 3 has been eliminated from any further evaluation.

Options 1 and 2 are both feasible alternatives, with Option 1 having the greatest impacts on the Ski Hill, Folk Festival gatherings, and Option 2 providing a more balanced impact including the community to the south and somewhat reduced impacts to the north.

In May 2012, City Council approved a P3 delivery methodology for the Valley Line Stage 1 (Mill Woods to Centre West).

P3 delivery constitutes design, build, finance, operate and maintain for a 30 year term. One advantage of a P3 delivery is the potential for consortia to bring innovative and optimized, design and construction solutions to the project.

The North Saskatchewan River Valley is a highly visible and sensitive area with numerous geotechnical, environmental and topographical challenges. To facilitate and encourage P3 consortia to bring forward innovative, aesthetic and cost effective solutions, the procurement process will include a number of technical submissions that will be evaluated either as “pass-fail” gates or perhaps as part of a qualitative scoring in addition to bottom line cost.

Option 1 will be included in the Reference Design and presented at Stage 5 Public Open Houses with a caveat stating that flexibility will be included in the contract documents to permit the P3 consortia to propose alternatives that do not encroach any further south than Option 2. This flexibility will allow the P3 consortia to be innovative in optimizing the current 30% design as the detailed designs are developed.

