THE CITY OF EDMONTON

DESIGN-BUILD AGREEMENT
CAPITAL LINE SOUTH LRT EXTENSION

Schedule 4
Design and Construction Protocols

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SCHEDULE 4

DESIGN AND CONSTRUCTION PROTOCOLS

1. CITY NOT RESPONSIBLE FOR DESIGN OR CONSTRUCTION

The City's rights of review, consent, acceptance, approval or confirmation of compliance with respect to any aspect of the Design or the Construction, including pursuant to Schedule 2 *[Submittal Review Procedure]*, must be for the City's benefit only and no review, consent, acceptance, approval or confirmation of compliance by the City's Representative or any other representative of the City shall, in any way, relieve Design-Builder of its obligation or responsibility for all aspects of the Design and Construction of the Infrastructure, except as may be expressly set out in this Agreement.

2. INTEGRATED PROJECT MANAGEMENT TEAM

2.1 General

(a) Within 120 days after the Effective Date, or at an alternate date Accepted by the City in the Submittal Schedule and Register, Design-Builder must prepare and submit an integrated Project management plan, which must be administered by Design-Builder Project Director, (the "**Integrated Project Management Plan**"). The Integrated Project Management Plan must describe:

(i) the methodology for implementing integrated project management for the Project;

(ii) how Design-Builder will be organized at the company level and personnel level to optimize empowerment and effectiveness of Key Individuals and all other key participants;

(iii) integrated controls and processes to ensure Integration between disciplines in both the Design and Construction and prevent any single discipline (Design or Construction) from working in isolation from any other discipline;

(iv) how the management plans required in this Agreement, including the Design Management Plan, Construction Management Plan, Quality Management Plans, Annual Design and Construction Communications Plans and Testing and Commissioning Plan, are integrated to ensure cohesive delivery of the Design and Construction in compliance with the Project Requirements;

(v) how Design-Builder intends to maintain relationships with, and optimize contributions of, its Subcontractors;

(vi) outline approach to maintaining proactive and effective communication with the City and how ongoing communications with the City will be managed, including how issue resolution protocols are aligned to organization of the City's teams;

(vii) how communications with Stakeholders will be managed and aligned with Schedule 12 *[Communications and Engagement]*;

(viii) how Project risks will be managed, including identification of specific Project risks that may materially affect Design-Builder's ability to comply with the Project Requirements and Design-Builder's strategy for mitigation of such risks; and

(ix) how Design-Builder will manage its work to minimize impacts to operations of Capital Line LRT.

(b) Design-Builder must segment the Design and Construction into discrete, logically organized work packages (each a "**Work Package**"). Subject to Section 6.6(c) *[Design Submissions]*, of this Schedule each Work Package must:

(i) match the structure identified in the "Work Breakdown Structure" to Level 2 as shown in Appendix 4A *[Work Breakdown Structure]* or as otherwise agreed by the City, provided however, that Design-Builder may submit proposed modifications to the Work Breakdown Structure to the City within 60 days of the Effective Date for the City's review. Such modifications must be minor in nature and result in substantially equivalent breakdown of the work acceptable to City. Failure to achieve an Accepted endorsement within 90 days of the Effective Date will result in the Work Breakdown Structure located in Appendix 4A *[Work Breakdown Structure]* being the Accepted Work Breakdown Structure;

(ii) provide sufficient context to permit the City to understand and review the applicable Design scope in accordance with Schedule 2 *[Submittal Review Procedure]*;

(iii) be traceable to the applicable Project Requirements in accordance with the Requirements Management process, and verifiable by cross-referencing the approved Handover Indices and ITPs pursuant to Schedule 9 [Quality Management], which will be used to confirm completeness of the records for each respective Work Package;

(iv) be comprised of a sufficient scope of work, to the satisfaction of the City acting reasonably, to permit logical and efficient management, administration, reporting and review; and

(v) preserve its scope of work as delivery of the Work Package progresses throughout Design and Construction.

(c) Without limiting Section 2.1(a) *[General]*, the Integrated Project Management Plan must also:

(i) define the scope and geographic limits of the Design and Construction activities comprising each Work Package and identify each Site on which Construction related to the Work Package will be performed;

(ii) ensure that all aspects of the Design and Construction are assigned to Work Packages;

(iii) establish a Work Package numbering scheme that ensures that each Work Package has a unique and clear identifier;

(iv) describe the sequencing of Work Packages in terms of predecessor and successor relationships between Work Packages; and

(v) establish a process for monitoring the progress of each Work Package.

(d) Design-Builder must issue one or more Design Certificates, Construction Certificates and, where applicable, Commissioning Certificates for each Work Package in the form required by the NBCAE or in the form included in Appendix 4B *[Certificate Forms]*.

2.2 Updates to the Integrated Project Management Plan

Prior to implementation of any amendments or updates to the Integrated Project Management Plan, Design-Builder must submit the proposed amendments or updates to the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

2.3 Compliance with the Integrated Project Management Team

Throughout the Construction Period, Design-Builder must implement and comply, and ensure that all Design-Builder Persons comply, with the Integrated Project Management Plan and any amendments or updates which have been accepted by the City.

3. CONSTRUCTION ADMINISTRATION

3.1 Construction Joint Committee

3.1.1 General

(a) Within 20 Business Days after the Effective Date, the City and Design-Builder must establish a joint liaison committee (the "**Construction Joint Committee**") consisting of the City's Representative, Design-Builder Project Director, Key Individuals as reasonably necessary or as required by the City, and such other members as the Parties may agree from time to time.

(b) The duties and obligations of the Construction Joint Committee must end at the Final Completion Date.

(c) The purpose of the Construction Joint Committee is to provide a formal forum for the Parties to consult and cooperate in all matters relating to the Project. Any member appointed to the Construction Joint Committee will not have any duties or obligations arising out of such appointment independent of such member's duties or obligations to the Party making such appointment.

(d) The Construction Manager, or a member of the Construction Joint Committee as approved by the City, must attend Communications and Engagement Working Group meetings in accordance with the requirements set out in Section 4.2 *[Communications and Engagement Working Group (CEWG)]* of Schedule 12 *[Communications and Engagement]*.

3.1.2 Authority

The Construction Joint Committee:

(a) must only have authority as expressly delegated to it by the City and Design-Builder and both Parties will give reasonable consideration to delegating appropriate authority to permit efficient decision making with respect to the Project;

(b) must adopt the terms of reference provided in Appendix 4C *[Construction Joint Committee Terms of Reference]* and any revisions agreed to by the City**;**

(c) must strike, establish terms of reference for, delegate authority and appoint members having the necessary experience and qualifications to, the following sub-committees:

(i) Safety Sub-committee, which shall

(A) be comprised of:

(1) fire and life safety, as further described as the "Fire-Life Safety Committee (FLSC)" in the 'Handbook for Transit Safety and Security Certification' published by the U.S. Department of Transportation, Federal Transit Administration; and

(2) safety and security, as further described as the "Safety and Security Review Committee (SRC)" in the 'Handbook for Transit Safety and Security Certification' published by the U.S. Department of Transportation, Federal Transit Administration;

(B) oversee Design-Builder's Safety and Security Certification Program;

(C) include the Safety Manager to report status, open items and Hazards, threat and risk management and resolution;

(ii) Testing and Commissioning Sub-committee, as further described in Schedule 6 *[Testing and Commissioning]*;

(iii) Interim Design Review Sub-committee, as further described in Section 6.8 *[Interim Design Reviews]*;

(iv) Integration Sub-committee, as further described in Section 5.6.4 *[Integration Sub-committee]*;

(v) Operational and Maintenance Readiness Sub-committee, as further described in Section 5.11 *[Operational and Maintenance Readiness Sub-committee],* closely aligned with the Integration Sub-committee, but focused upon operations and maintenance preparedness;

(d) may strike, establish terms of reference for, delegate authority and appoint members having the necessary experience and qualifications to, such sub-committees as the Construction Joint Committee may determine are necessary from time to time and all such sub-committees must report to the Construction Joint Committee; and

(e) must have no authority to agree to any amendments or to give any waivers of this Agreement.

3.2 Monthly Progress Report

(a) No later than ten days after the end of each month during the Construction Period, Design-Builder must submit a Monthly Progress Report in a form acceptable to the City, which must describe the progress of the Design and Construction during the preceding month and planned progress for the forthcoming month.

(b) Each Monthly Progress Report must include:

(i) an executive summary describing all Project Work completed during the applicable month and the status of ongoing work;

(ii) a Project look ahead working level schedule, aligned to the Construction Schedule and the most recent Schedule Update, describing all Project Work Activities started and completed in the month as well as all planned Project Work activities over the next 30, 60 and 90 days, including details of all associated activities required to be completed by the City (if any) clearly noted; and

(iii) dashboard narratives on the following topics, each in separate report sections:

(A) safety statistics and person-hours (broken down by Design-Builder work forces and Subcontractors) for the previous month, as reported pursuant to Section 9 *[Incidents]* of Schedule 11 *[Construction Safety Requirements];*

(B) quality issues for the previous month, including a summary of NCR status and audits performed, as reported pursuant to Section 3.7 *[Monthly Quality Management Reports]* of Schedule 9 *[Quality Management]*;

(C) financial reporting of the previous month's invoicing against contract value, along with a table listing all the previously approved invoices and their respective values plus a similar table for all Change Order Confirmations to date;

(D) environmental inspection reports and issues for the previous month, as reported pursuant to Schedule 10 *[Environmental Performance Requirements]*;

(E) Transportation Accommodation reports and issues for the previous month, as reported pursuant to Section 1-5 *[Transportation Management]* of Schedule 5 *[D&C Performance Requirements]*;

(F) Design and Construction progress

(1) for the previous month, including variances from the Construction Schedule and the Submittal Schedule and Register and any related issues, including identification of problems and issues that have arisen during the current reporting period, and are causing delay or may cause delay to the Design or Construction, outstanding problems and issues and summary of resolved problems and issues; and

(2) planned for the forthcoming month;

(G) interfaces and Integration progress for the previous month;

(H) updates to the Hazard Logs;

(I) public communication and engagement progress and issues for the previous month, including a summary of any events and inquiries;

(J) any other information or data which describes the previous month's progress or issues related to the Design and Construction;

(K) Project risks, including:

(1) descriptions of all Project risks identified during the applicable reporting period that may materially affect Design-Builder's ability to comply with the Project Requirements, together with Design-Builder's strategy for mitigation of each such risk; and

(2) updates with respect to the status of, and any changes in, each previously identified Project risk, updated to the current reporting period;

(L) high quality progress photographs for each Site that support the assessment of progress being claimed in the month as well as communications needs on the Project;

(M) high quality time-lapse videos at all Structures that support the assessment of progress being claimed in the month, as well as communications needs on the Project;

(N) status of Key Dates in comparison to the Construction Schedule together with a narrative explaining any deviations (positive or negative).

(iv) to the extent not included in the foregoing, the reports required pursuant to Section 1.2 *[Subcontracts – Records and Reports]* of this Agreement; and

(v) corrections to the most recent past monthly report where the City has identified errors or lack of clarity in reporting that have not been corrected in that past report. This must include reference to the section and a statement of the corrected information.

3.3 Progress Measurement Parameters

The Percent Completion for the Monthly Construction Payment is to be assessed using the Work Breakdown Structure in Appendix 4A [*Work Breakdown Structure*] of this Schedule and subject to the following parameters:

(a) Progress is to be assessed as a percent complete (up to 100%) for each Level 3 package, as indicated in the "Level" column of the Work Breakdown Structure, based on the City's judgment of value in the ground, as described below and pursuant to Section 4.3 [*Progress Measurement for Percent Complete*] of Schedule 16 [*Payment Mechanism*];

(i) Value in the ground is work that is installed, or incorporated, into its final place in the Infrastructure and does not include management, engineering, overhead, temporary works, mobilization, and materials or products not yet incorporated into the work as fixtures;

(ii) For items noted in the Work Breakdown Structure that include a break out item for delivery, those items will be considered delivered either when they are delivered to City Lands or when they are delivered to the care and control of the Design-Builder in a secure location in the greater Edmonton area;

(iii) An indicative unit of measure to assist in value in the ground progress estimation is included, for the sole purpose of supporting the assessment of Progress Measurement for Percent Completion in the column "Indicative Unit of Measure" in the Work Breakdown Structure;

(iv) The Parties may jointly agree to an alternative unit of measure prior to start of Construction on each respective Level 3 package;

(v) If the indicative unit of measure for a Level 3 package is a quantity (rather than a % complete), the quantity is to be provided by the Design-Builder prior to start of construction on the respective package and it is to be reflective of the Final Design for that package; and

(vi) The actual quantity completed as value in the ground is to be recorded on the progress measurement tracking sheet each month.

(b) The weighting that each Level 3 package contributes to the progress at its parent Level 2 Work Package is as specified in the "Percent for Level 3" column in the Work Breakdown Structure;

(c) A Level 2 Work Package or Level 3 package that does not contribute to value in the ground progress contains the label "N/A" in the "Percent for Level 3" column;

(d) Once the first Level 3 package has value in the ground progress that is greater than 0% as verified by the City, construction of the Infrastructure is deemed to have commenced in relation to the Monthly Construction Payment requirements;

(e) A Level 2 Work Package cannot achieve more than 99% progress until the applicable Design Certificate, Construction Certificate and Commissioning Certificate have been endorsed "Accepted" by the City; and

(f) A Level 2 Work Package cannot achieve more than 99% progress until the applicable Handover Index related to that scope and its associated Quality Records have been reviewed, found to be without Major Deficiencies and endorsed "Accepted" by the City.

(g) For greater clarity, measurement of progress does not include City Works.

4. DESIGN-BUILDER'S RESPONSIBILITIES

4.1 Design and Construction Responsibility

(a) Design-Builder must:

(i) have complete responsibility for the Design and Construction of the Infrastructure;

(ii) provide written notice to the City's Representative of any conflict or inconsistency in the Project Requirements, as soon as practicable, but no later than 15 days, after becoming aware of such conflict or inconsistency in the Project Requirements;

(iii) perform and complete the Design, the Construction and all other activities, including Testing and Commissioning, in accordance with all terms of this

Agreement, so as to provide a high floor, urban, Light Rail Transit system and supporting Infrastructure that, at the Construction Completion Date:

(A) is complete, safe, secure and operational in accordance with and as described in the Project Requirements;

(B) conforms to Section 1-3.1.2 *[Operations and Maintenance Compliance]* and Appendix 5-1B *[High Bloor Operations and Maintenance Parameters]* of Schedule 5 *[D & C Performance Requirements]*;

(C) complies with the specifications, criteria, terms, conditions and mitigation measures described in the applicable Project Approvals, including all Environmental Permits, provided that where more stringent specifications, criteria, terms, conditions or mitigation measures are specified in this Agreement, the provisions of this Agreement must, to the extent that they are not in conflict, take precedence over those in the applicable Project Approvals;

(D) is fully integrated with the City's existing transit system and conforms to the SUI requirements described in Part 2 *[Sustainable Urban Integration and Landscape Architecture]* of Schedule 5 *[D&C Performance Requirements]*; and

(E) reflects and captures the intent and benefits of the Bid Extracts;

(iv) ensure that, as at the Final Completion Date, the Lands are clear of all Temporary Works, including construction site offices;

(v) maintain a complete, unfolded hard copy, full-sized (nominally A1), original set of:

(A) all authenticated Design Drawings; and

(B) all shop or fabrication drawings required to be authenticated, together with all revisions thereto, on 24 lb. bond, until delivered to the City in accordance with this Agreement. The drawings set must be logically organized and structured and must be made available to the City's Representative upon request; and

(vi) comply with all Applicable Law and City Policies.

(b) Design-Builder must develop a process for requesting feedback from the City regarding Design and Construction matters that fall outside of the Submittal Schedule and Register. The process must:

(i) acknowledge the Design-Builder's responsibility for the Design and Construction;

(ii) provide the City adequate time and information to be able to provide meaningful feedback; and

(iii) acknowledge that the City's feedback does not constitute a Change.

4.2 Standard of Performance for Design and Construction

Design-Builder must, at all times during the Term and in all respects, perform the Design and Construction in accordance with Good Industry Practice, the Design and Construction Requirements, and to the standards required by Schedule 5 *[D&C Performance Requirements]*. The degree to which the Design-Builder conforms to those requirements will be verifiable and measured using the accepted procedures outlined in Appendix 9B [Design Quality Management Plan] and Appendix 9C *[Construction Quality Management Plan].*

4.3 Project Approvals for the Design and Construction

Design-Builder and the City each acknowledge and agree that risk and responsibility for all Project Approvals required for the Design and Construction must be as specified in this Agreement, including in Schedule 10 *[Environmental Performance Requirements]* and Schedule 28 *[Project Approvals and Utility Matters]* Part 1 *[Project Approvals]*.

4.4 LEED Silver Certification for Llew Lawrence OMF

(a) Design-Builder must ensure that all Design and Construction complies with the building sustainability requirements in Section 7-2.3 *[Sustainable Buildings and Infrastructure Rating Systems]* of Schedule 5 [*D&C Performance Requirements*], and must obtain LEED Silver Certification for the Llew Lawrence OMF using LEED Building Design and Construction: New Construction and in accordance with the following:

(i) prior to the Effective Date the City will register the relevant aspects of the Llew Lawrence OMF with the Canadian Green Building Council (CaGBC);

(ii) except as otherwise contemplated or permitted by this Section 4.4, Design-Builder must achieve all necessary prerequisites, credits and points under the LEED Rating System required to achieve the LEED Silver Certification, and may in its discretion determine which of the credits and points to pursue, except that the Design-Builder must not include any points or credits which require any action by or on behalf of the City without the City's prior written consent, which may be granted or withheld in the City's discretion. Where the City consents to the inclusion of points or credits which require any action by or on behalf of the City, the City shall take reasonable steps to cooperate with Design-Builder in respect of its achievement of such LEED points and credits, provided that such cooperation must not require the City to incur any liability, cost or expense;

(iii) if at any time after registration with CaGBC in accordance with this Section, the requirements to achieve LEED® Silver Certification under the LEED Rating System change and Design-Builder is required to comply with such change in order to achieve LEED Silver Certification of the Llew Lawrence OMF, the Design-Builder must forthwith notify the City of such change and such change must be handled in accordance with Schedule 13 *[Changes]*;

(iv) Design-Builder must compile and submit all required documents for LEED Silver Certification;

(v) If for any reason, Design-Builder fails to obtain LEED Silver Certification for the Llew Lawrence OMF by 24 months following the Construction Completion Date, Design-Builder must, upon written demand from the City, promptly and in any event, within three (3) Business Days, pay to the City the amount of [redacted] as liquidated damages; and

(vi) Design-Builder and the City acknowledge and agree that such liquidated damages are not a penalty but a genuine pre-estimate of the damages suffered by the City as a result of Design-Builder failing to obtain LEED Silver Certification for the Llew Lawrence OMF by 24 months following the Construction Completion Date and, upon payment of the amount, if any, owing under this Section 4.4, Design-Builder will have no further obligations or liabilities in respect of obtaining LEED Silver Certification, except to provide the City with such information and administrative assistance as the City may reasonably require in relation to obtaining LEED Silver Certification of the Llew Lawrence OMF. For greater certainty, the failure to obtain LEED Silver Certification will not be a Termination Event.

(b) Design-Builder must prepare and submit to the City no later than 30 days prior to the Construction Completion Date for the relevant aspects of the Llew Lawrence OMF:

(i) LEED checklists, generally in accordance with CaGBC requirements, together with a written confirmation that, in Design-Builder's judgment, LEED Silver Certification will be achieved as required by this Section 4.4 *LEED Silver Certification for Llew Lawrence OMF]*;

(ii) a written opinion from a LEED accredited professional, supporting the confirmation described in Section 4.4(b)(i) above.

(c) As security for Design-Builder's obligations pursuant to this Section (a)(v) above Design-Builder must deliver, or cause to be delivered, to the City no later than Construction Completion, an irrevocable letter of credit (the "**LEED Letter of Credit**") substantially in the form of Schedule 30 *[Performance Letter of Credit]*. The LEED Letter of Credit must be in an amount equal to two million dollars ([redacted]) (the "**LEED Amount**"). The LEED Letter of Credit must be subject to the following:

(i) The LEED Letter of Credit must be issued by one or more Permitted Letter of Credit Providers;

(ii) In the event that the LEED Letter of Credit must be renewed at any time, Design-Builder agrees to provide to the City reasonable evidence of the renewal of such LEED Letter of Credit no later than ten (10) Business Days prior to the renewal date, if any, of such LEED Letter of Credit;

(iii) In the event that Design-Builder does not deliver the LEED Letter of Credit in accordance with Section 4.4(c), the City may withhold from any amount otherwise due to Design-Builder by the City, including without limitation, any release of the Construction Completion Payment, an amount equal to the LEED Amount (the "**LEED Letter of Credit Holdback**"), which holdback must be held in an interest bearing account until such time as Design-Builder delivers the LEED Letter of Credit;

(iv) The City shall release the LEED Letter of Credit Holdback and together with all interest accrued thereon, no later than five (5) Business Days following delivery of the LEED Letter of Credit to the City;

(v) The City shall be entitled to draw on the LEED Letter of Credit or the LEED Letter of Credit Holdback, as applicable, in an amount equal to any unpaid liquidated damages owing by Design-Builder pursuant to and as a result of Design-Builder's breach of its obligations under this Section (a)(v);

(vi) Notwithstanding anything to the contrary in this Section 4.4(c), the City shall be entitled to draw on the LEED Letter of Credit:

(A) upon the failure of Design-Builder to renew the LEED Letter of Credit pursuant to Section 4.4(c)(ii);

(B) upon the downgrading of any of the banks or other financial institutions that issued the LEED Letter of Credit so that they no longer meet the requirements of a "Permitted Letter of Credit Provider" where the LEED Letter of Credit has not been replaced by Design-Builder with a replacement LEED Letter of Credit from a Permitted Letter of Credit Provider within 30 calendar days of such downgrading; or

(C) upon the bankruptcy or insolvency of any of the banks or other financial institutions that issued the LEED Letter of Credit, provided that the City shall provide Design-Builder at least two Business Days prior written notice before drawing on the LEED Letter of Credit pursuant to this Section 4.4(c)(v).

(vii) In the event that the LEED Letter of Credit is drawn down in accordance with Section 4.4(c)(v), the City shall hold the cash proceeds thereof in an interest bearing account (provided that such account must be at a Permitted Letter of Credit Provider*)* and such cash proceeds must thereupon stand in place of the LEED Letter of Credit until Design-Builder delivers (or causes the delivery of) a replacement LEED Letter of Credit to the City. All interest earned on such cash proceeds must be for the benefit of Design-Builder. The City must be entitled to withdraw such cash proceeds in the same manner that it is permitted to draw upon the LEED Letter of Credit pursuant to Section 4.4(c)(v). Upon the replacement of the LEED Letter of Credit by Design-Builder, the City shall return all remaining cash proceeds and all accrued interest thereon from such segregated bank account to Design-Builder or as Design-Builder may direct within five (5) Business Days

(viii) The City may make multiple calls on the LEED Letter of Credit in accordance with this Section 4.4(c); and

(ix) Unless the LEED Letter of Credit is fully drawn by the City in accordance with the provisions of this Agreement, the City shall, upon receipt of a written request from Design-Builder, release and deliver the LEED Letter of Credit to Design-Builder within five Business Days following the receipt of such request; provided that such request must not be made prior to the earlier of (i) the date Design-Builder obtains LEED Silver Certification for Llew Lawrence OMF; and (ii) the date Design-Builder pays the liquidated damages pursuant to and in accordance with this Section 4.4 *[LEED Silver Certification for Llew Laurence OMF]*.

4.5 Community Employment Benefits Plan

(a) Design-Builder must submit a completed Community Employment Benefits Plan within 90 Business Days of the Effective Date.

(b) Design-Builder must implement the approved Community Employment Benefits Plan. The Community Employment Benefits Plan must include:

(i) identification of the Design-Builder Person responsible for developing and implementing the Community Employment Benefits Plan and an overall team composition that will support the Community Employment Benefits Plan, including their roles and responsibilities. Individual(s) must have the necessary experience to undertake this initiative including a combination of the following: cultural competency training, diversity and inclusion training, experience with recruitment and maintaining employment of equity seeking groups, etc. Include an organizational chart demonstrating integration of the Community Employment Benefits Plan among Design-Builder and Design-Builder Persons.

(ii) planned initiatives to recruit, hire and train members of Targeted Groups, including identification and mitigation of barriers to employment of Targeted Groups;

(iii) planned initiatives to hire and/or procure services from small, medium, social or diversity-owned enterprises;

(iv) planned initiatives to ensure the Community Employment Benefits Plan is utilized by Subcontractors;

(v) planned initiatives to communicate and engage potential Stakeholders about employment opportunities that are available to Targeted Groups;

(vi) a description of Design-Builder's approach to monitoring the Community Employment Benefits Plan and the submission of annual reports to the City;

(vii) a description of Design-Builder's diversity and inclusion training that will be made available to Design-Builder and Design-Builder Persons; and

(viii) any other considerations, tools and mechanisms that Design-Builder will employ to meet, advance and achieve the goals and objectives for the Community Employment Benefits Plan in alignment and compliance with "Community Employment Benefits General Guidance" (Infrastructure Canada, June 22, 2018) provided as Disclosed Data.

(c) The Table 4-4.6 below must set the minimum standard target hours, contract value and employment opportunities to be met for each category of Targeted Groups:

Table 4-4.6: Minimum Standard Target Hours, Contract Value and Employment Opportunities for Categories of Targeted Groups

Targeted Groups	Definition	Target Ratio (% of total hours worked)	Employment Opportunities
Apprentices	Individuals receiving skills training for designated occupations under the supervision of a certified journeyperson.	50 Apprentices	All available project trades will have apprenticeship opportunities.
Indigenous Peoples	Original peoples of North America and their descendants which include First Nations (Status and Non-	10 %	Employment opportunities throughout the organization, including Project Management,

Targeted Groups	Definition	Target Ratio (% of total hours worked)	Employment Opportunities
	Status), Inuit and Metis		Engineering and Construction will be made available.
Women	Individuals who reported identifying with the female gender	20 %	Employment opportunities throughout the organization, focusing in areas traditionally underrepresented by women such as Project Management, Engineering and Construction will be made available.
Youth	Individuals between the ages of 15 to 29	10%	Training and employment opportunities for entry-level positions and intermediate positions throughout the organization.
New Canadians	Permanent residents or new citizens of Canada arriving within the past 7 years who are eligible to work in Canada	10 %	Employment opportunities throughout the organization, including Project Management, Engineering and Construction will be made available.
Targeted Groups	**Definition**	**Contract Value ($)**	**Contract Opportunities**
Small enterprise	Businesses with less than 100 employees	[redacted]	Providing contract opportunities for goods and services across the Project.
Medium enterprise	Business with between 100 and 499 employees	[redacted]	Providing contract opportunities for goods and services across the Project.
Social enterprise	Businesses owned by non-profit organizations, that produce and/or sell goods and services for the blended purpose of generating income and achieving social, cultural, and/or environmental aims	[redacted]	Providing contract opportunities for goods and services across the Project.
Diversity Ownership	Businesses owned by a visible minority, Indigenous peoples, women, persons with disabilities or any other underrepresented group	[redacted]	Providing contract opportunities for goods and services across the Project.

(d) On each anniversary of Commercial Close until the Construction Completion Date (on which date the last submission under this Section 4.5 *[Community Employment Benefits Plan]* must be made), Design-Builder must provide an annual report to the City on the implementation of the Community Employment Benefits Plan which report must include:

(i) an overall summary report including Design-Builder's overall experience in implementing the Community Employment Benefits Plan, finalized target ratios, lessons learned for application to future projects, as well as an executive summary for public release; and

(ii) detailed information setting out Design-Builder's progress toward achieving the objectives set out in the Community Employment Benefits Plan, including:

(A) identification of successes achieved by Design-Builder in meeting its objectives under the Community Employment Benefits Plan;

(B) an identification of any barriers that prevented Design-Builder from achieving its objectives and approaches to mitigate barriers;

(C) the number of hours worked by each class of Targeted Groups in the relevant annual period and cumulatively from the Effective Date; and

(D) the value of contracts provided to diversity ownership, small, medium and social enterprises;

(iii) if targets for each of the Targeted Groups as outlined in Table 4-4.6 are not met, a mitigation strategy and approach to achieving target ratios by the next annual report.

(e) The City may require Design-Builder to submit bi-annual and/or quarterly reports supporting going implementation of the Community Employment Benefits Plan, if in the City's opinion, acting reasonably, Design-Builder is failing to meet targets as outlined in Table 4-4.6 and mitigation strategies and results have failed to demonstrate continuous improvement to achieving target ratios.

(f) The City may require Design-Builder to amend its Community Employment Benefits Plan if in the City's opinion, acting reasonably, Design-Builder is failing to maximize employment opportunities on the Project pursuant to the then current Community Employment Benefits Plan.

(g) Design-Builder's Community Employment Benefits Plan must not be Confidential Information and the City may, in its sole discretion, release Design-Builder's Community Employment Benefits Plan to the public. The City shall consult and co-ordinate with Design-Builder in such release.

5. SYSTEM AND SAFETY ASSURANCE

5.1 General

Design-Builder must implement and execute a structured approach to system and safety assurance that includes the following activities as described in further detail in this Section 5 *[System and Safety Assurance]*:

(a) independent verification and validation;

(b) the Safety and Security Certification Program;

(c) Requirements Management;

(d) the RAM Program;

(e) Integration Management;

(f) Road Safety Audit;

(g) configuration management;

(h) Interface Management

(i) Ergonomic factors;

(j) climatic extremes; and

(k) Design Service Life.

5.2 Systems Engineering Management Plan

5.2.1 General

(a) Within 90 days after the Effective Date, or at an alternate date Accepted by the City in the Submittal Schedule and Register, Design-Builder must prepare and submit a systems engineering management plan, (the "**Systems Engineering Management Plan**") which must include:

(i) an Integration Management Sub-Plan, described in Section 5.2.2.1 *[Integration Management Sub-Plan]*;

(ii) a Requirements Management Sub-Plan, described in Section 5.2.2.2 *[Requirements Management Sub-Plan]*;

(iii) a Configuration Management Sub-Plan, described in Section 5.2.2.3 *[Configuration Management Sub-Plan]*;

(b) The Systems Engineering Management Plan must be developed in conjunction with the Design Management Plan.

5.2.2 Systems Engineering Management Sub-Plans

5.2.2.1 Integration Management Sub-Plan

The Integration Management Sub-Plan must:

(a) describe the processes and procedures required to satisfy the requirements of Section 5.6 *[Integration Management]* and how the Integration milestones will be delivered successfully on time;

(b) include details of the organization, roles and responsibilities for all Integration Management activities;

(c) describe the process to proactively identify, assign responsibility, co-ordinate, track, resolve and test system functions;

(d) describe any software tools to be used for Integration Management;

(e) describe the process for incorporating relevant interface and Integration issues into the other system and safety assurance activities; and

(f) be based on the preliminary Integration Management narrative included in the Bid Extracts.

5.2.2.2 Requirements Management Sub-Plan

The Requirements Management Sub-plan must:

(a) describe the processes and procedures required to satisfy the requirements of Section 5.8 *[Requirements Management]*;

(b) include details of the organization, roles and responsibilities for all Requirements Management activities;

(c) describe the processes and software tool(s) to be used to track and administer the Requirements Management activities;

(d) list all data categories and fields, including those required by Section 5.8.1(b) *[General]*, to be tracked including all verification and validation data fields;

(e) describe the process for acquiring, populating and updating the Requirements Management data, including the frequency of such updates; and

(f) describe the method for tracking Changes and their impacts, if any.

5.2.2.3 Configuration Management Sub-Plan

The Configuration Management Sub-Plan must all include:

(a) a detailed description of the overall configuration management strategy that will be implemented across all project phases;

(b) a demonstration of compliance with the configuration management processes detailed in IEEE 15288-2015 Systems and software engineering -- System life cycle processes and IEEE 828-2012 IEEE Standard for Configuration Management in Systems and Software Engineering;

(c) the roles, responsibilities, accountabilities, and authorities with respect to configuration management;

(d) the integration of configuration management with the Design Management Plan;

(e) a list of configuration items, including the hierarchy and structure of all information;

(f) the full details of the numbering scheme for all documents, drawings and products including all configuration items, including system, subsystem, components, hardware, firmware and software components;

(g) the description of all tools being used in the configuration management process;

(h) a disposition of, access to, release of and control of changes to configuration items;

(i) the necessary baselines to be established;

(j) the locations and conditions of storage, storage media and its environment, in accordance with designated levels of integrity, security and safety;

(k) the criteria or events for commencing configuration control and maintaining baselines of evolving configurations;

(l) the audit strategy and the responsibilities for assessing continual integrity and security of the configuration definition information;

(m) change management, including any planned configuration control boards, regular and emergency change requests and procedures for change management;

(n) a description of how configuration management will be coordinated across of Design-Builder supplier and supply chain organizations;

(o) the archive and retrieval approach for configuration items, configuration management artifacts and data; and

(p) a description of how the configuration management process will be integrated with the configuration management used by the City, including document nomenclature and numbering scheme.

5.2.3 Updates to the System Engineering Management Plan

Prior to implementation of any amendments or updates to the Systems Engineering Management Plan, Design-Builder must submit the proposed amendments or updates to the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

5.2.4 Compliance with the System Engineering Management Plan

Throughout the Construction Period, Design-Builder must implement and comply with, and ensure that all Design-Builder Persons implement and comply with, the System Engineering Management Plan, and any amendments or updates which have been Accepted by City.

5.3 Independent Safety Assessor

The Design-Builder must retain an independent safety assessor that must be accredited by the Standards Council of Canada pursuant to the Independent Safety Assessor for Railway Systems Accreditation Program developed and the Standards Council of Canada, who is acceptable to the City (the "**Independent Safety Assessor**"):

The Independent Safety Assessor must:

(a) be appointed for the purpose of performing independent verification and validation of the safety and security of the Infrastructure;

(b) verify and validate compliance with the Safety and Security Certification Program while considering the City's SUI Principles, such that the least intrusive combination of means consistent with Good Industry Practice are applied to the mitigation of identified Hazards;

(c) verify and validate that City Acceptance has been obtained for Hazard mitigations in the Hazard Analysis process as per Section 5.4 *[Safety and Security Certification Program]*, Subsection 5.4.1(j);

(d) be responsible to prepare and submit a Safety and Security Certification Verification Report in accordance with Section 5.4 *[Safety and Security Certification Program]*;

(e) be responsible to prepare and submit a Project Safety and Security Certificate in accordance with Section 5.4 *[Safety and Security Certification Program]*; and

(f) not be or include any Person who is an Affiliate of Design-Builder or any Design-Builder Person.

5.4 Safety and Security Certification Program

5.4.1 General

(a) Design-Builder must develop a program for the verification, validation and certification of the safety of the Infrastructure (the "**Safety and Security Certification Program'')** that demonstrates the achievement of compliance of complete system with overall safety requirements for entry into service. The Safety and Security Certification Program must be in accordance with the Systems Assurance Guideline and must meet the requirements for verification and validation activities necessary for design, manufacturing, test and other project phases. In addition to the standards specified in the Systems Assurance Guideline, the following APTA standards are applicable:

(i) Control and Communications Security

(A) APTA-SS-CCS-RP-001-10 - Securing Control and Communications Systems in Transit Environments Part 1;

(B) APTA-SS-CCS-RP-002-13 - Securing Control and Communications Systems in Rail Transit Environments Part 2;

(C) APTA-SS-CCS-WP-003-15 - Securing Control and Communications Systems in Rail Transit Environments, Part IIIa;

(D) APTA SS-CCS-RP-004-16 - Securing Control and Communications Systems in Rail Transit Environments Part IIIb;

(E) APTA SS-CCS-RP-006-23 - Operational Technology Cybersecurity Maturity Framework (OT-CMF) Overview;

(ii) Enterprise Cyber Security

(A) APTA SS-ECS-RP-001-14 - Cybersecurity Considerations for Public Transit;

(iii) Infrastructure & Systems Security

(A) APTA-SS-SIS-RP-001-10 - Security Lighting for Transit Passenger Facilities;

(B) APTA-SS-SIS-RP-002-10 - Security Lighting for Nonrevenue Transit Facilities;

(C) APTA-SS-SIS-RP-003-10 - Fencing Systems to Control Access to Transit Facilities;

(D) APTA-SS-SIS-RP-004-10 - Chain Link, Mesh, or Woven Metal Fencing Systems to Control Access;

(E) APTA-SS-SIS-RP-005-10 - Gates to Control Access to Revenue and Nonrevenue Transit Facilities;

(F) APTA-SS-SIS-RP-006-10 - Ornamental Fencing Systems to Control Access at Transit Facilities;

(G) APTA-SS-SIS-RP-007-10 - Crime Prevention Through Environmental Design (CPTED);

(H) APTA SS-SIS-S-010-13 - Security Considerations for Public Transit;

(I) APTA SS-SIS-RP-11-13 - Security Planning for Public Transit;

(J) APTA SS-SIS-RP-012-13 - Security Operations for Public Transit;

(K) APTA SS-SIS-RP-013-13 - Physical Security for Public Transit;

(L) APTA SS-SIS-WP-014-13 - Trash and Recycling Receptacles for Transit Facilities;

(M) APTA-SS-SIS-RP-015-13 - Equipment and Technology;

(N) APTA SS-SIS-RP-016-15 - Tunnel Security for Public Transit;

(O) APTA SS-SIS-S-017-21 - Security Risk Assessment Methodology for Public Transit;

(P) APTA-SS-ISS-RP-002-21 - Security and Design Considerations for Restrooms at Public Transportation Passenger Facilities;

(Q) APTA-SS-ISS-RP-003-23 - Sensitive Security Information Policy;

(R) APTA-SS-ISS-RP-004-23 - Security Considerations for Public Transit Passenger Stations and Stops; and

(S) APTA-SS-ISS-RP-006-23 - Security Plan.

(iv) Safety Risk Assessment

(A) CMREA/CSA R22 Canadian Method for Risk Evaluation and Assessment for Railway Systems

(b) Safety must be Design-Builder's primary design and performance requirement for the Project. The Infrastructure must be Designed and Constructed so that it demonstrates that the Capital Line South Extension will operate in a safe manner under all operating conditions. Safety components must be designed according to safety principles consistent with Good Industry Practice and must incorporate high reliability parts, selective redundancy and warning and protective devices, as required, to contribute to the achievement of the specified safety requirements.

(c) Design-Builder must ensure that all material Design and operating Hazards and safety risks are identified, evaluated, and properly controlled or mitigated as low as reasonably practicable, and Accepted by the City through the Hazard Analysis process.

(d) All verification and validation tasks, specifically the safety verification & validation reflected in the safety deliverables and safety cases, will be evaluated in accordance with the risk acceptance criteria by the City.

(e) The results of this evaluation must be recorded in an acceptance report. The acceptance report should include a confirmation that the delivered product, system or process is fit for entry into service.

(f) Design-Builder must co-ordinate and chair safety activities within the Term in accordance with the Systems Assurance Guideline (and safety program), and provides the safety deliverables, including Hazard and operability studies, reviews, inspections and technical discussions and decisions (between the City, and all other relevant persons, SRC) to substantiate the safety verification and validation activities.

(g) The Design-Builder and Independent Safety Assessor must provide the deliverables for the City including the results to be documented, containing:

(i) Acceptance report, and

(ii) Independent safety assessment report.

(h) Each independent safety assessment report must;

(i) evaluate the conformity of the safety processes including the verification and validation already undertaken;

(ii) identify and evaluate any deviations from the requirements;

(iii) give a judgment on the acceptability of the safety justifications;

(iv) carry out inspections on the overall system development process; and

(v) provide records of the independent safety assessment activities as a safety assessment report.

(i) Within 120 days after the Effective Date or an alternate date agreed by the City and Design-Builder jointly, Design-Builder must submit a Safety and Security Certification Program reviewed by the Independent Safety Assessor.

(j) The Safety and Security Certification Program' must:

(i) describe the series of processes to be implemented to collectively verify, validate and certify the safety of the infrastructure;

(ii) include details of the organization, roles and responsibilities for all safety activities;

(iii) implement the practices described in the Systems Assurance Guideline for verification and validation'.

(iv) Implement CPTED principles for security and safety through natural access control (entry and exit points, fences), boundaries (clear ownership, clearly marked private spaces) and natural surveillance (visibility, positive social activities), as set out in the City's "Design Guide for a Safer City" (December 1995) available on the City's website and as more particularly set out in the Project Requirements;

(v) implement the Hazard Analysis process stipulated by the Systems Assurance Guideline and update the safety deliverables;

(vi) identify the standards, consistent with Good Industry Practice, to be used to establish integrity levels and to be used in the development and validation of software for equipment, components, systems and subsystems in which software is performing a safety function;

(vii) be co-ordinated with the other system and safety assurance activities; and

(viii) include an outline of the contents of the Safety and Security Certification Verification Report and Hazard Log.

(k) Design-Builder must prepare, update and submit based on the Systems Assurance Guideline, the all Hazard Analyses which have been performed in a Hazard Log, including the resulting outputs, as part of the 'Safety and Security Certification Program' including the mitigation measures proposed in accordance with the following:

(i) Preliminary Hazard Assessment ("PHA") – within 150 days after the Effective Date, or an alternate date agreed by the City and design-builder jointly;

(ii) Operational Hazard Assessment ("OHA") - at first Interim Design and updated and resubmitted at second Interim Design and Final Design; and

(iii) FMECA – at first Interim Design and updated until Final Design.

(l) As part of the Safety and Security Certification Program', and not less than 20 Business Days prior to the Construction Completion Date a safety and security verification report (the **"Safety and Security Certification Verification Report"**) that summarizes the readiness of the Infrastructure for Construction Completion, must be provided by Independent Safety Assessor that includes:

(i) an executive summary describing the status of the Safety and Security Certification Program;

(ii) a description of all activities performed under the Safety and Security Certification Program;

(iii) a description of the certification;

(iv) a list of any proposed operating restrictions mitigations for review and Acceptance by the City;

(v) actions required to mitigate or minimize the consequences of any remaining operating restrictions; and

(vi) a schedule for eliminating all remaining deficiencies; and

(vii) a safety and security certificate, authenticated in accordance with the Systems Assurance Guideline (the "**Project Safety and Security Certificate**").

5.4.2 Updates to the Safety and Security Certification Program

Prior to implementation of any amendments or updates to the Safety and Security Certification Program, Design-Builder must submit the proposed amendments or updates to the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

5.4.3 Compliance with the Safety and Security Certification Program

Throughout the Term, Design-Builder must implement and comply with, and ensure that the Independent Safety Assessor and all Design-Builder Persons implement and comply with, the Safety and Security Certification Program and any amendments or updates which have been accepted by the City.

5.5 Reliability, Availability, Maintainability (RAM) Program

5.5.1 Objective

(a) The RAM Program specifies the management process for performing reliability, availability, and maintainability tasks and activities related to RAM aspects for the Project based on RAMS standards and in accordance with the Systems Assurance Guideline.

(b) RAM program includes:

(i) the responsibilities and tasks of the various stakeholders in terms of RAM management, as well as the relations between the City, the Design-Builder, and the Subcontractors;

(ii) the organization, means and resources put in place as part of the RAM management process;

(iii) the methodology and organization for checking that RAM aspects have been considered and implemented for the Project;

(iv) the activities carried out by the Design-Builder to specify RAM requirements to achieve RAM targets;

(v) the breakdown of subsystems for the verification of the RAM performance during the Warranty Period;

(vi) The deliverables specific to the RAM management process and the associated schedule for the project phases up to the end of Testing and Commissioning Work.

(c) The RAM Program aims to ensure efficient lines of communications between the different stakeholders in the RAM process, the consistency of their interventions and the controls that will guarantee the achievement of RAM requirements.

5.5.2 Guidelines and Standards for RAM Program

(a) The following list of guidelines and standards is used for the RAM Program.

(b) In the event of a conflict between the criteria, commitments or requirements contained within these guidelines or standards when compared with another, the more stringent must apply.

(c) In the event that any standards within the Systems Assurance Guideline have been superseded, the more recent standard shall apply for the purposes of CLSE.

Table 5.5.2 Guidelines and Standards Applicable to the RAM Program

Reference	Application
HFDG	City of Edmonton LRT Design Guidelines
Systems Assurance Guideline	Systems assurance approach for CLSE
IEC 61703	Mathematical expressions for reliability, availability, maintainability, and maintenance support terms
IEC 61078	Reliability block diagrams
IEC 60812	Failure Modes and Effects Analysis (FMEA) or Failure Modes Effects and Criticality Analysis (FMECA)
ISO 9001	Quality management systems - Requirements
NSWC-11	Handbook of Reliability Prediction Procedures for Mechanical Equipment, logistics technology support, naval surface warfare center
MIL-HDBK-785 B	Reliability program for systems and equipment development and production

Reference	Application
MIL-HDBK-217 F	Reliability prediction of electronic equipment
MIL-STD-882E	Department of defense standard practice system safety
MIL-HDBK-338B	Electronic Reliability Design Handbook
CSA R114:22	Canadian method for risk evaluation and assessment (CMREA) for railway systems

5.5.3 Glossary

For the purposes of this Section 5.5 *[Reliability, Availability, Maintainability (RAM) Program]*, the following terms have the following meanings:

Table 5.5.3 RAM Glossary

Term	Definition	Reference
Apportionment	Process whereby RAMS elements for this system are subdivided between the various items that make up the system to provide individual targets.	CENELEC 50126-1
Failure	A deviation from the specified performance of a system. A failure is the consequence of a fault or error in the system.	CENELEC 50129
Failure Mode	Predicted or observed results of a failure cause on a stated item in relation to the operating conditions at the time of the failure.	CENELEC 50126-1
Fault Tree Analysis	Analysis to determine which fault modes of the product, sub-products or external events, or combinations thereof, may result in a stated fault mode of the product, presented in the form of a fault tree.	CENELEC 50126-1
Maintainability	Probability that a given active maintenance action for an item under given conditions of use can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources.	CENELEC 50126-1
Operator	The City of Edmonton's Edmonton Transit Services Branch who both operate and maintain the LRT System.	City of Edmonton LRT Design Guidelines
Owner	The City of Edmonton.	City of Edmonton LRT Design Guidelines

Term	Definition	Reference
Reliability	The probability that an item can perform a required function under given conditions for a given time interval (t1, t2).	CENELEC 50126-1
RAM program	A documented set of time scheduled activities, resources and events serving to implement the organisation structure, responsibilities, procedures, activities, capabilities, and resources that together ensure that an item will satisfy given RAM requirements relevant to a given contract or project.	CENELEC 50126-1
Risk	The probable rate of occurrence of a Hazard causing harm and the degree of severity of the harm. A combination of the severity of the mishap and the probability that the mishap will occur.	CENELEC 50126-1 MIL-STD-882E
Safety	Freedom from unacceptable risk of harm. Freedom from conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.	CENELEC 50126-1 MIL-STD-882E
System	The organization of hardware, software, material, facilities, personnel, data, and services needed to perform a designated function within a stated environment with specified results.	CENELEC 50126-1
Validation	Confirmation by examination and provision of objective evidence that the requirements for a specific intended use have been fulfilled.	CENELEC 50126-1
Verification	Confirmation by examination and provision of objective evidence that the specified requirements have been fulfilled.	CENELEC 50126-1

5.5.4 Acronyms and Abbreviations

For this Section 5.5 *[Reliability, Availability, Maintainability (RAM) Program]*, the following abbreviations are used:

Acronym or Abbreviation	Definition
CENELEC	European Committee for Electro technical Standardization

Acronym or Abbreviation	Definition
FMECA	Failure Mode Effect and Criticality Analysis
FRACAS	Failure Reporting Analysis and Corrective Action System
FTA	Fault Tree Analysis
RAMS	Reliability, Availability, Maintainability, Safety
RCIL	Reliability Critical Items List
SCIL	Safety Critical Items List

5.5.5 RAM Management

(a) The RAM activities carried out by the Design-Builder will follow the project development cycle, in accordance with the Systems Assurance Guideline.

(b) The Design-Builder must establish a RAM management of process including:

(i) Preparation of a RAM program containing RAMS requirements; RAM requirements assessment and control, planning tasks, monitoring the achievement of RAM requirements during the Term;

(ii) Coordination of RAM activities defined in RAM program;

(iii) Review and verification of Design-Builder's RAM programs and reports;

(iv) Apportionment of high-level objectives to Design-Builder;

(v) Managing RAM data collection from testing and commissioning activities.

(c) The RAM process and procedures must be programmed, integrated, and developed for the project in accordance with Section 7 of the Systems Assurance Guideline.

(d) The Design-Builder must develop its internal organisation required to perform RAM activities, RAM requirements, identifying and integrating the RAM requirements. The Design-Builder must ensure that all stakeholders follow the RAM management process.

5.5.6 RAM Tasks

(a) The Design-Builder must prepare a RAM Program in accordance with the Systems Guideline for the Term that meets the determined requirements for the Project, to carry out tasks, achieve the goals and prepare the required deliverables.

(b) To ensure that the RAM requirements are satisfied, the Design-Builder must carry out the following activities based on the guidelines and standards specified in Section 5.5.2 *[Guidelines and Standards for RAM Program]*:

(i) Implement a RAM management system based on:

(A) Systems Assurance Guideline;

(B) The RAM Program prepared by the Design-Builder; and

(C) Related RAM standards, including MIL-STD-338B and MIL-472.

(ii) Consolidate all data at the level of all components of the LRT system included in the Project;

(iii) Establish a system breakdown structure that clearly defines the physical and hierarchical breakdown of each system that is being provided as follows:

(A) the top element level will be the complete system;

(B) show discrete equipment or plant that may comprise the complete system down to LLRU level;

(C) identify functional elements for primary functions and secondary functions as far as is practicable; and

(D) include a written description of each item.

(iv) Perform FMECA in accordance with Section 5.5.10.3 *[Preparation of a FMECA]*;

(v) Perform the allocation of RAM requirements to sub-systems and LRUs;

(vi) Perform RAM analysis to verify requirement compliance to RAM performance of each system as per RAM indicators defined in Section 5.5.7 *[RAM Indicators];*

(vii) Perform recommended spare parts analysis as provided in Appendix 4F *[Poisson Distribution Methodology];*

(viii) Conduct maintainability analysis and requirements from the start of the design, based on assumption and best practices, and update it during the different phases of the project;

(ix) Develop a RAM validation plan in accordance with the Systems Assurance Guideline;

(x) Define and propose the strategy for RAM demonstration in accordance with Section 5.5.10.5 *[RAM Demonstration]*

(xi) Propose an operational procedure for measuring RAM requirements during Warranty Period;

(xii) Implement corrective actions plans to support operation after Construction Completion in the event of a deviation from the required RAM performance;

(xiii) Coordinate RAM activities with the City,

(xiv) Participate in RAM meetings and City coordination meetings as a means of exchange with stakeholders to transfer RAM information and requirements;

(xv) Manage non-conformities;

(xvi) Complete a RAM processes and procedures audit

(xvii) Undertake RAM reviews during different phases of the project such as review of constraints exported to operation and maintenance;

(xviii) Complete a RAM review before the end of the Warranty Period;

(xix) Participate in joint work groups and progress meetings;

(c) Proposed methods other than FMECA (e.g., FTA) could be accepted for studies on condition they provide the impact of critical LRUs (or equivalent) failure modes on the systems and operation;

(d) Design-Builder must redesign the systems or equipment under its responsibility, in the absence of a recovery strategy;

(e) If new technology systems or equipment are used and/or for which there is no feedback on its RAM performance, Design-Builder must carry out a specific RAM analysis to estimate their performance;

(f) If the Design-Builder demonstrates that RAM requirements are not achievable as a result of prescribed Design and Construction Requirements, then the Design-Builder shall submit to the City the targets demonstrated by the Design-Builder to be achievable with the prescribed Design and Construction Requirements. If the City does not accept the presented achievable targets, identification and implementation of resulting corrective actions to be undertaken by the Design-Builder to achieve the RAM requirement shall be considered a Change subject to and in accordance with Schedule 13 *[Changes];*

(g) Design-Builder must justify its proposal for a list of LRUs necessary for the demonstration of maintainability;

(h) Design-Builder shall submit a FRACAS plan;

5.5.7 RAM Indicators

(a) The Design-Builder must calculate the reliability of a subsystem by the MTBF indicator (Mean Time Between Failures), corresponding to the mathematical expectation of the time between two failures;

$$\mathbf{MTBF = 1/ \lambda}$$

Where **λ: Failure rate**

(b) The reliability analysis of all CLSE systems shall be performed by the Design-Builder and included in the RAM analysis report.

(c) The Design-Builder must calculate the maintainability of a subsystem by the MTTR (Mean Time to Repair) indicator, corresponding to the mathematical expectation of the duration of the repair times associated with a corrective maintenance action. Administrative and logistical delays are not considered in the MTTR.

(d) The RAMS engineer will identify the maintenance tasks and activities including maintenance logistics for corrective and preventive maintenance for both level 1 and level 2 maintenance as follows:

(i) Maintenance Level 1: maintenance activities performed at site or at the point of falure.

(ii) Maintenance Level 2: maintenance activities performed and equipment repaired at a maintenance facility.

(e) The Design-Builder must calculate the Inherent Availability of each subsystem reflecting its ability to perform the functions necessary for the operation of the transport system for which it was designed. The availability of a subsystem will generally be characterized by the indicator "A", corresponding to the ratio between the duration of actual operation of the subsystem and the total duration of use which was planned. Inherent Availability (A) is therefore defined by a percentage corresponding to the ratio:

$$A = MTBF / (MTBF + MTTR)$$

(f) Calculations for equipment cumulative operating time is based on its operation for the period under consideration. For example 24 hours, 365 Days, number of units for a year.

5.5.8 RAM Requirements

(a) The RAM requirements for the following systems/subsystems and LRUs shall be defined in the technical specifications developed by the Design-Builder for procurement of relevant Equipment. Also, these requirements and objectives shall be reviewed and verified by the Design-Builder during various phases of the project.

(b) Specific RAM requirements are set out in Table 5.5.8 *[RAM Requirements for Systems and Subsystems]* below.

Table 5.5.8: RAM Requirements for Systems and Subsystems

System/Subsystem/Equipment	RAM Requirement
SCADA	Inherent Availability > 99.99% SCADA remote terminal units (outstations) must have an MTBF of 20,000 hours, and an MTTR of < 2 hours.
Fibre Optic backbone	Inherent Availability > 99.995% Fibre Optic Nodes must have an MTBF of 20,000 hours, and an MTTR of < 1 hours.
Radio System	Inherent Availability > 99.99% Individual radios must have an MTBF of 20,000 hours,

System/Subsystem/Equipment	RAM Requirement
	and an MTTR of < 2 hours.
TPSS	Switchgear must have an MTBF of 20,000 hours, and an MTTR of < 4 hours. Transformer/Rectifier Unit MTBF of 20,000 hours, and an MTTR of < 4 hours.
OCS	The Overhead Catenary System (inclusive of poles, mounts, messenger and contact wire, tensioners, mounts etc.) must have an MTBF > 6,000 hours for the system. MTTR < 4 hours.
Train Control System	Inherent Availability > 99.99% Train Control System must have an MTBF of 20,000 hours, and an MTTR of < 2 hours.
Elevators	Inherent Availability > 97% MTTR < 4 hours.
UPS	Each UPS must have an MTBF of 30,000 hours, and an MTTR of < 0.25 hours
Network Management System	MTBF of 500,000 hours. MTTR < 0.5 hours
Telephones:	Each outdoor phone must have a minimum MTBF of 50,000 hours, and MTTR of < 2 hours Each indoor phone must have a minimum MTBF of 130,000 hours and MTTR of < 2 hours.
Public Address (PA)/variable message signs	Each PA loudspeaker must have a minimum MTBF of 120,000 hours. Each variable message sign must have a minimum MTBF of 50,000 hours. MTTR < 0.5 hours.
CCTV	Overall CCTV system Inherent Availability must be 99.99% Each camera must have a minimum MTBF of 90,000 hours with an MTTR < 0.5 hours.

(c) MTTR must be calculated for equipment elements defined as either LRU's or lowest level replaceable units. All elements with the same part number or equipment with the same form, fit, and function within the replaced part shall be used for the calculation. MTTR must be calculated for all in-service corrective maintenance and out-of-service corrective maintenance. It must include any time required to perform fault isolation,

troubleshooting and repair following failure of an element. It must not include travel time to site.

(d) The replacement component shall be directly replaceable and be compatible with form, fit, and functions of the replaced part.

5.5.9 RAM Organization

(a) The Design-Builder must perform the RAM studies by a dedicated team. This team should be an integral member of the project team, however, must also be independent from other Design-Builder design teams and must provide an independent point of view for project RAMS related matters, during all phases of the project.

(b) In this case, it must report independently and directly to the Integration Manager to ensure its assessment ability.

(c) In its field of competence, the RAM team must define independently its methods and organization. Using their internal resources, they must ensure the execution of their activities.

(d) The RAM team and the safety team can be the same if both are covered by relevant expertise under system assurance lead supervision.

5.5.10 RAM Program

5.5.10.1 RAM Program Plan

(a) A RAM Program must be prepared by the Design-Builder in accordance with the Systems Assurance Guideline to cover the Term.

(b) The Design-Builder must consider the RAM Program for the Infrastructure and must contain, as a minimum, the following information:

(i) Define the process for the specification, verification, and control of the RAM requirements for the Project;

(ii) Guide and co-ordinate the RAM Program activities through all project phases;

(iii) Define RAM requirements for each relevant subsystem of the infrastructure;

(iv) Define a RAM organization;

(v) Define the general RAM specification and the tasks related to this activity;

(vi) Define a RAM program schedule in accordance with the Systems Assurance Guideline;

(vii) Enlist RAM documents to be produced in accordance with the Systems Assurance Guideline;

(viii) Coordinate and control the RAM activities inside its organization and manage the interfaces between the different subsystems;

(ix) Define the operating specifications and recommendations, as well as the maintenance policy, tools, methods and processes that the entity in charge of operation and maintenance must respect to reach the specified performances;

(x) These operating rules and maintenance policy must be relevant and realistic and must be in accordance with Appendix 5-1B *[High Floor Operations and Maintenance Parameters*] of Schedule 5 [*D&C Performance Requirements*] ;

(xi) Ensure the monitoring of the RAM performance of the system until the end of its Warranty period;

(xii) Be coordinated with the other activities described in Section 5 [*System and Safety Assurance*], Schedule 6 [*Testing and Commissioning*], and Schedule 7 [*Construction Completion, Service Readiness and Final Completion*];

(c) The RAM program must be updated throughout the course of the Term.

(d) The RAM Program must address how the Design-Builder will monitor the contractual performance of the infrastructure, from a technical and organizational point of view and for each purpose of the performance monitoring. It must address at least the following items:

(i) Contractual and technical indicators and objectives to be monitored, as outlined in Table 5.5.8 *[RAM Requirements for Systems and Subsystems]*;

(ii) Means and procedures for measurement of each criterion;

(iii) Templates for Performance reports; and

(iv) Performance reports acceptation process.

5.5.10.2 Reliability, Availability and Maintainability (RAM) Analysis

(a) The Design-Builder shall submit a reliability, availability and maintainability analysis report for all subsystems included in the CLSE.

(b) The Design-Builder shall allocate MTBF and MTTR values as applicable to each subsystem and element of the CLSE to develop reliability block diagrams which shall support and meet the subsystem RAM requirements.

(c) The RAM analysis report must demonstrate that the proposed equipment meets the RAM requirements.

(d) The RAM analysis report must include the following:

(i) Functional architecture of the equipment, for example: redundancy management;

(ii) Systems breakdown structure of each subsystem in accordance with Section 5.5.6(b)(iii);

(iii) Assumptions for component failure rates, MTBF and MTTR included in calculations and data sources;

(iv) MTBF values based on equipment specifications used for reliability prediction;

(v) Component quantities in the CLSE;

(vi) Techniques for allocation of quantitative RAM requirements for subsystems and lower levels to substantiate the Design of the equipment indicating the compliance to RAM requirements and criteria defined in Section 5.5.8 *[RAM Requirements]*;

(vii) An analysis to predict the Inherent Availability in accordance with Section 5.5.7 *[RAM Indicators].*

(e) The Design-Builder shall apportion quantitative RAM requirements for subsystems equipment and components comprising the system elements. In addition to the quantitative goals to be met, the Design-Builder shall meet requirements defined for RAM Program plan, specific analyses, RAM prediction, and RAM demonstration tests.

(f) The maintainability analysis shall describe the historical, statistical, and experimental basis for the analysis as well as identify the maintenance tasks and activities including maintenance logistics for corrective and preventive both level 1 and level 2 maintenance as described in Section 5.5.7 *[RAM Indicators].*

(g) All assumptions, such as level of training of maintenance personnel, availability of spare parts, maintenance response time, corrective and preventative maintenance activities for each device, shall be listed with the calculated MTTR for the systems.

(h) All necessary preventive maintenance and corrective maintenance tasks for Infrastructure shall be considered and included in the maintainability analysis.

(i) The Design-Builder shall formalize the results of the hardware maintainability analysis for each subsystem and include the results in the RAM analysis report.

(j) The RAM analysis report must be submitted with each Interim Design and Final Design.

(k) The objective of this analysis is to estimate the first line replacement, due to unscheduled maintenance of the system, showing the time to replace, non-standard equipment required and personnel requirements.

5.5.10.3 Preparation of FMECA

(a) The Design-Builder must carry out FMECA for the Infrastructure to analyze the effects of each failure on the Infrastructure, from the point of view of the effect of service reliability and safety.

(b) The FMECA analysis must determine the RAM critical items, determine the applicable requirements for each item of equipment or sub-system and highlight the most critical elements. Design-Builder to define the criteria for the identification of RAM critical items.

(c) The Design-Builder must use a common FMECA table for the RAM analysis. For each sub-system, the Design-Builder must describe the following items

(i) description of the item under consideration;

(ii) list of failure modes;

(iii) description of the subsystem effects on the quality of service, on the operation, and on the Maintenance;

(iv) their criticality level;

(v) LRUs making up the sub-system and which may fail;

(vi) failure rate of these LRUs, according on experience or predicted data;

(vii) recovery time for each type of failure; and

(viii) methods of detection of the failure such as built-in test.

(d) The criticality levels and categories in accordance with the Systems Assurance Guideline must be grouped in categories that must be accepted by the City.

(e) In case of not preparing FMECA analysis, other methods, and analysis such as reliability building diagram and fault tree analysis could be prepared instead. This methodology must be described in the RAM Program and submitted for Acceptance of the City.

(f) As practically needed, reliability building diagrams must address the components of each system down to LRU level.

5.5.10.4 Spare Parts

(a) At Final Design, the Design-Builder must prepare and submit a list of Spare Parts (the "**Spare Parts List**") in accordance with Schedule 2 [*Submittal Review Procedure*] which must include, at a minimum, all of the items listed in Section 1-9 [*Spare Parts*] of Schedule 5 [*D&C Performance Requirements*] as well as any other spare parts and replacement components which have been identified through the RAM Program as being necessary to maintain the Inherent Availability requirements of Section 5.5.8 [*RAM Requirements*].

(b) The Spare Parts List must identify, for each Spare Part in an electronically editable format suitable for importing into the Asset Management System:

(i) name and description of part;

(ii) recommended quantity to be supplied as part of the Project Work, which must be:

(A) a sufficient quantity to allow the City to support all operations and maintenance (including all preventative and corrective) for a period of three years following the Service Readiness Date; and

(B) at a minimum, the quantity set out for that Spare Part in Section 1-9 [*Spare Parts*] of Schedule 5 [*D&C Performance Requirements*];

(iii) recommended spare quantity calculations should be based on the methodology specified in Appendix 4F *[Poisson Distribution Methodology]* and include the results in the final RAM analysis report;

(iv) type of assembly;

(v) design drawing reference number;

(vi) sub-assembly or larger assembly in which part is used. Identify if used in different assemblies;

(vii) suggested Spare Part strategy - replace components or larger assembly;

(viii) recommendation for the minimum number of Spare Parts, at which point the Spare Parts should be reordered;

(ix) recommended re-order quantity;

(x) procurement lead time;

(xi) commercial supplier of Spare Part, including name and address, and appropriate contact information. Identify if manufacturer, distributor, agent or other. Local and Canadian distributors are preferred by the City for logistical reasons;

(xii) Design-Builder's part number, if applicable;

(xiii) supplier's and/or manufacturer's part number(s);

(xiv) the dimensions and mass of the Spare Parts individually and the sum of those listed in (ii) above; and

(xv) unit price, price break quantities and prices.

(c) The Spare Parts described in this Section must exclude those Spare Parts required for Testing and Commissioning Work and Warranty Work.

(d) Spare Parts required for Testing and Commissioning Work and Warranty Work must be segregated from the Spare Parts defined in the Spare Parts List and stored off Site.

(e) All Spare Parts should be maintained in their original packaging and stored in a climate-controlled environment. Each Spare Part must be always held in the anti-static covering until installation. However, it is required to test or check Spare Parts during storage as recommended by the supplier or manufacturer.

(f) The Design-Builder shall be responsible for delivery of all Spare Parts, including the return of defective components as may be required.

5.5.10.5 RAM Demonstration

The Design-Builder is required to perform RAM demonstration to ensure that the RAM requirements specified in the Section 5.5.8 *[RAM Requirements]* are achieved. The RAM demonstration will begin upon Construction Completion.

(a) RAM Validation Plan

(i) The Design-Builder shall prepare and submit the RAM validation plan in accordance with the Systems Assurance Guideline.

(ii) The RAM validation plan shall outline:

(A) A systematic approach for the overall demonstration, process and procedures as well as validation tasks for subsystems and components including their interfaces to ensure compliance with the subsystem and/or component requirements.

(B) The program shall outline the organization in place to support the program and the approach taken by the Design-Builder to detect, collect, diagnose and correct and analyze the respective failure as a minimum.

(C) Acceptance criteria for the performance of the Infrastructure.

(D) The equipment to be tested, and test conditions to be applied for the RAM demonstration.

(b) RAM Validation Report for the Demonstration Period

(i) The Design-Builder shall prepare and submit the RAM validation reports outlining the performance of the Infrastructure in accordance with the RAM validation plan for the period following Construction Completion until Service Readiness has been achieved.

(ii) The City will review the RAM validation report for

(A) Confirmation that the RAM requirements are being met;

(B) Assessment of any major failures and the RAM implications; and

(C) Confirmation that Service Readiness has been achieved.

(c) FRACAS Plan

(i) Design-Builder shall establish and submit a FRACAS Plan in accordance with the Systems Assurance Guideline.

(ii) The FRACAS Plan shall contain:

(A) FRACAS organization, roles and responsibilities;

(B) implementation of FRACAS;

(C) a failure analysis process and defining corrective actions;

(D) recommendations regarding key stakeholders and other relevant parties required for input data collection for calculations/analysis; and

(E) FRACAS report template preparation.

5.5.10.6 RAM Assessment

(a) The Design-Builder must perform RAM assessment, demonstrating the achievement of the RAM requirements and requirements of the project.

(b) The Design-Builder must develop procedures and performance analysis routines to confirm achievement of the RAM performance requirements. The Design-Builder must prepare this RAM assessment report in accordance with the Systems Assurance Guideline.

(c) The Design-Builder must estimate the RAM performances of the Infrastructure considering:

(i) the reliability and maintainability predictions performed for all sub-systems;

(ii) the RAM studies;

(iii) Appendix 5-1B [*High Floor Operations and Maintenance Parameters*] of Schedule 5 [*D&C Performance Requirements*]; and

(iv) any other factor that could have any impact on RAM performances.

(d) For reliability predictions, the Design-Builder shall estimate the reliability of each LRU, based upon the knowledge of previous equivalent systems and part failure rates, considering maintenance intervention times.

(e) The Design-Builder shall perform maintainability predictions (the estimation of the duration and workload of maintenance tasks at all maintenance levels, and for both corrective and preventive maintenance) in accordance with the operating conditions of the LRT system and shall also present a synthesis of the maintenance time and workforce for every Failure Mode of each sub-system.

5.5.10.7 RAM Reviews

(a) The Design-Builder must carry out RAM reviews after each major development phase at least (30% design, 60% design, 100% on an on-going basis).

(b) These RAM reviews must be managed by the Design-Builder's RAM team in collaboration with the Integration Manager.

(c) The aim of each RAM review is to assess the conclusions of the RAM tasks to:

(i) Estimate whether the RAM requirements have been correctly considered;

(ii) Identify the consequences of these conclusions on the remaining RAM tasks;

(iii) Identify the consequences of these conclusions on the design.

(d) Any potential concern must be identified as soon as possible and tracked for remedial action.

(e) During these reviews, the Design-Builder must pay particular attention to changes that may affect earlier decisions and next phases.

(f) The Design-Builder will be required to coordinate the RAM activities with stakeholders and share the progress with the City.

(g) As an output from the RAM reviews, the following must be documented and submitted:

(i) preparation of report(s) on achievement of RAM requirements;

(ii) an overview of work performed;

(iii) identification of any problems or delays in completing the RAM work; and

(iv) identification of any potential shortfalls in achievement of RAM targets.

5.5.11 Obsolescence Management

At Final Design, the Design-Builder must prepare and submit an obsolescence management plan for the Project, including the following requirements related to RAM:

(a) A proactive obsolescence management strategy in accordance with BS EN IEC 62402:2019.

(b) In the event any equipment, Spare Parts or special tools become obsolete or unavailable, the Design-Builder shall work with the City to identify alternate sources that are demonstrably capable of supplying the equipment, Spare Parts, or special tools upon request by the City.

(c) The Design-Builder shall ensure that all components shall not be obsolete or reach its end-of-life during the Warranty Period.

(d) Otherwise, the Design-Builder shall ensure that replacement of the obsolete or end-of-life component is readily available.

(e) The replacement component shall be directly replaceable and forward compatible with form, fit and functions of the replaced one.

(f) In the event that any obsolete or end-of-life component is informed by the supplier, the Design-Builder shall report to the City immediately and provide detailed specification of the replacement component for acceptance.

5.5.12 Responsibilities of Stakeholders

5.5.12.1 The City

(a) As a rail authority, the City accepts the approach presented in the RAM plan of the Design-Builder and monitors the implementation of the RAM approach.

(b) The City shall:

(i) monitor the implementation of the RAM approach by the Design-Builder;

(ii) allow the continuous monitoring of the RAM activities; and

(iii) determine the adequacy of the approach presented in the RAM Program and the RAM requirements which will be defined or reviewed in the specifications.

(c) The City, as an operational organization, must report on anomalies and the confirmation of their disappearance after correction of these anomalies during the demonstration period.

(d) The City:

(i) identifies and documents operating incidents during the Warranty Period;

(ii) transmits to Design-Builder the quality records relating to the operation and maintenance necessary for the monitoring of the RAM performance of the Infrastructure during the Warranty Period

5.5.12.2 Design-Builder

(a) Described in its RAM program, Design-Builder oversees the project's RAM approach. In this context, Design-Builder:

(i) appoints an RAM manager, responsible for all RAM activities for which he is responsible;

(ii) ensures the demonstration and achievement of specified RAM performance;

(iii) defines the organization of the RAM;

(iv) defines the tasks related to RAM;

(v) defines the RAM indicators through which the specification of the objectives will be carried out;

(vi) establishes RAM specifications applicable to each Subcontractor; and

(vii) approves Subcontractor's RAM documents and plans and checks that RAM provisions have been considered in accordance with the principles of EN 50126.

(b) The Design-Builder RAM manager in collaboration with RAM person responsible of other stake holders will ensure integration of all RAM aspects.

(c) The Design-Builder RAM manager:

(i) performs impact analysis in case of any modification and re-applies the process if necessary and maintains records to trace RAM tasks undertaken; and

(ii) prepares RAM performance analysis and evaluation reports.

(d) The Integration Manager must:

(i) set up monitoring of the RAM activities of subcontracted systems and subsystems or equipment to achieve the RAM requirements of the systems for which it is responsible;

(ii) export all the integration and obligations related to RAMS;

(iii) set up general monitoring accomplished RAM activities and works, modifications, chosen technological solutions for achievement of RAM requirements;

(iv) set up monitoring of non-compliance with allocated objectives and the possible reassignment of these objectives;

(v) set up internal reviews to ensure the consistency of the various studies, their compliance with the methods used and the adequacy of their results to the requirements;

(vi) set up a mechanism allowing decisions to be made with the various teams on specific points that may impact RAM; and

(vii) propose an organization that allows the early disclosure of problems or anomalies related to RAM aspects.

5.5.13 RAM Deliverables

(a) The Design-Builder must submit the following documents as minimum in support of the RAM Program:

Table 5.5.13 RAM Program Deliverables

Phase	RAM Deliverables
Preliminary design	• Preliminary RAM Plan
Detailed design	• FMECA including reliability critical items list • RAM apportionment report for all subsystems and systems • Update of RAM Plan • RAM prediction analysis reports for all subsystems and systems • RAM validation plan • RAM requirements for Subcontractors • Spare Parts List
Test and verification	• Final RAM report • RAM validation and verification reports (demonstration period – monthly) • Final RAM validation and verification report • FRACAS plan

(b) The documents noted in Table 5.5.13 *[RAM Program Deliverables]* should be updated as the Design progresses as applicable.

5.5.14 Updates to the RAM program

Prior to implementation of any amendments or updates to the RAM Program, Design-Builder must submit the proposed amendments or updates to the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

5.5.15 Compliance with the RAM Program

Throughout the Construction Period, Design-Builder must implement, comply, and ensure that all Design-Builder Persons comply with the RAM Program and any amendments or updates which have been Accepted by the City.

5.6 Integration Management

5.6.1 General

(a) Design-Builder must be responsible for establishing a formal Integration management process ("**Integration Management**") prior to the Acceptance of the Systems Engineering Management Plan, that contains the following:

(i) detailed planning for the systems integration including integration sequences, schedules and procedures;

(ii) the integration steps, and identifies the responsibilities and roles for each stakeholder, including integration points with the City and third parties;

(iii) the identification of all the functional requirements that need to be addressed in order to achieve a desired functionality of the CLSE as a whole;

(iv) the identification of integration issues and its associated functional requirements;

(v) the implementation procedure to ensure that low-level subsystems are capable of being integrated into high-level systems to meet the functional requirements;

(vi) identification of subsystems, including those included in City Works, that are integration-enabling for other functional requirements;

(vii) to link the processes to the Testing and Commissioning Plan and the Static System Integration Testing and Commissioning Sub-Plan;

(viii) appropriate support documentation such as special procedures for performing product verification and product validation;

(ix) guidelines that should be followed by the City to perform the integration activities;

(x) an integration register (the "**Integration Register**") to proactively link, identify, and record all integration issues. Each recorded issue must be assigned specific functional requirements, assembly plans or documentation, and designated responsibilities for Persons involved. The Integration Register shall facilitate efficient tracking, resolution, and functional testing of each identified issue, serving as evidence of the assembly's readiness and the system's ability to perform the design functions effectively; and

(xi) the Integration Manager has direct oversight of Integration Management.

Design-Builder must comply with such Integration Management process throughout the Term.

(b) The Integration Register must:

(i) include the interfaces linked to achieve the integration issues and the functional requirements identified through the Requirements Management and Requirements Management Sub-Plan activities;

(ii) include all of the data and tracking fields identified in the Integration Management Sub-Plan;

(iii) be co-ordinated with the other system and safety assurance activities described in Section 5 *[System and Safety Assurance]*;

(iv) be updated to prepare the integration environment in which assembly and integration will take place;

(v) be maintained and updated in accordance with the Integration Management Sub-Plan, and

(vi) be updated to reflect the readiness of the sub-system to be validated.

(c) Design-Builder must develop and populate the Integration Register with the integration issues and all linked interfaces and demonstrate how they have been satisfactorily addressed in Design and Construction and Testing and Commissioning to achieve the design functions, must include the following:

(i) City Works to Project Work;

(ii) LRV wheel to Track interface;

(iii) LRV pantograph to Overhead Catenary System interface;

(iv) LRV door threshold to Platform gap (horizontal and vertical) interface;

(v) SCADA to end device interfaces;

(vi) Public Address intelligibility;

(vii) Station surface finish interfaces;

(viii) Driver sightlines, Passenger sightlines, CCTV sightlines and other Roadway user sightlines, in each case taking into account all potential obstructions including signals, signs, OCS poles, Passenger information displays, and landscaping;

(ix) noise and vibration from the Infrastructure;

(x) grounding and bonding interfaces;

(xi) Electromagnetic Compatibility;

(xii) Stray Current and corrosion control;

(xiii) duct bank and Vault drainage requirements;

(xiv) cable and duct routing;

(xv) Roadway to rail elevations;

(xvi) Utilities to Infrastructure;

(xvii) Capital Line LRT to Capital Line South Extension interface; and

(xviii) any other interfaces that need to be addressed to ensure the Design and Construction are functional and integrated with operations and maintenance of the Capital Line Extension LRT.

(d) Integration Management must follow the Integration Management Sub-Plan as defined in Section 5.2.2.1 *[Integration Management Sub-Plan]*.

5.6.2 Updates to Integration Management

Prior to implementation of any amendments or updates to the Integration Management process, Design-Builder must submit the proposed amendments or updates to the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

5.6.3 Compliance with Integration Management

Throughout the Construction Period, Design-Builder must implement and comply with, and ensure that all Design-Builder Persons comply with, the Integration Management process, including any amendments or updates which have been accepted by the City, to ensure that all interface solutions and integration issues concerning the CLSE Project are tracked and managed to eliminate the likelihood of errors.

5.6.4 Integration Sub-committee

(a) The Integration Sub-committee must be convened within 60 days of the Effective Date maintained throughout the Construction Period, be chaired by the Integration Manager, and meet a minimum of bi-monthly. The Integration Sub-committee must be comprised of representatives from the City and Design-Builder. Design-Builder must require any other relevant Design-Builder Persons to attend meetings of the Integration Sub-committee at the request of the City.

(b) The Integration Sub-committee must provide a formal forum for escalation and resolution of integration issues between Design-Builder and the City that have not been satisfactorily resolved at a working level by Design-Builder and to oversee the consultation and cooperation in all matters relating to the interface between, and the Integration of the Capital Line LRT.

(c) Design-Builder must provide agendas identifying the issues for discussion and relevant background two Business Days before each meeting, Design-Builder must keep an action register updated and minutes of all decisions, recommendations, action items and meetings of the Integration Sub-Committee and must circulate such minutes to the City and the other members of the Integration Sub-Committee within five Business Days of the holding of the meeting, the making of the recommendation or the identification of the action item. Meeting minutes must clearly identify all agreed upon items.

(d) Design-Builder must participate in technical working group meetings every second month to coordinate the integration of City Works at the request of the City.

5.7 Interface Management Plan

5.7.1 Interface scope

(a) The Design-Builder must prepare an interface management plan that defines the work activities required to manage system interfaces (the "**Interface Management Plan**").

(b) The Design-Builder must describe how it intends to ensure the harmonious links between subsystems and systems in a controlled way to ensure their correct and safe resolution at all times.

(c) The Design-Builder must describe how it intends to manage during the detailed design phase and subsequent stages, the interfaces between the systems that Design-Builder will develop, the City Works, and the Capital Line LRT.

(d) The Design-Builder must demonstrate that the Infrastructure complies with the Project Requirements so as to enable the City to obtain a system that meets their requirements and the global safety case for the operation of the Project and Capital Line LRT.

(e) The Designer must describe in the Interface Management Plan how they will manage the following:

(i) official communication between Stakeholders;

(ii) interface schedule plan;

(iii) agreements through meetings and minute of meetings;

(iv) gap zones between systems;

(v) responsibility of Stakeholders;

(vi) follow-up of interfaces in the different stages of the evolutive life

(vii) low complexity interfaces;

(viii) validation and closure of interfaces;

(ix) monthly reports with the current status of the interfaces.

5.7.2 General Objectives and Requirements

The Design-Builder must guarantee the correct management and solution of the interfaces by means of an Interface Management Plan that seeks to guarantee the totality of the functions required in the Project Requirements. The Interface Management Plan must be submitted to the City. The Interface Management Plan must consider the following:

5.7.2.1 System Breakdown Structure

(a) The Design-Builder must adapt the system breakdown structure in accordance with Section 5.5.6(b)(iii) that separates the system to a level that allows for management of the interfaces, considering the scope distribution of systems and subsystems along its own subcontractors and the different stakeholders.

(b) The Design-Builder must consider that there will exist interfaces between existing operating systems and the new ones, and it will be their responsibility to ensure the complete compatibility between the new equipment and the existing ones, considering the continued operability of the existing line.

(c) The Design-Builder must consider in the development of the system breakdown structure the systems related to external entities.

5.7.2.2 Interface Matrix

(a) The Design-Builder must develop a matricial document where systems and subsystems involved in the Project, must be listed in the "X axis" and the "Y axis" defining a co-ordinate system where the interfaces will be identified with the ID number defined for this crossing (the "**Interface Matrix**"). This ID number will be the same referenced into the Interface Log and in the Interface sheets.

(b) The main function of this tool is to identify through the convergence of one subsystem with another one, the point where there exists an interface that can be of several types or levels.

(c) This document is a living document, so the design-builder must define in his interface management plan, how it is intended to ensure the traceability of the evolution of the document.

5.7.2.3 Interface Log

The Design-Builder will be responsible to develop a list of all identified interfaces (the "**Interface Log**"); The Interface Log must contain at least the following information

(a) interface description;

(b) the type and its level;

(c) the assignment of the leader;

(d) the activities that both the interface leader and the interface follower have to develop to ensure the correct and safety resolution of the interface and;

(e) the evolution status of the interface.

5.7.2.4 Interface Control Document (ICD)

(a) The Design-Builder must track and follow the interface status through an interface control document (ICD) that will be a live document in constant evolution.

(b) For each interface, a specific ICD must be generated to precisely define:

(i) the ID of the interface,

(ii) the criticality levels,

(iii) the current interface status of evolution,

(iv) the reference of the subsystems involved,

(v) scope of the subsystems involved (split of work),

(vi) the boundary of the interface: functional, physical, description of the activities to be performed,

(vii) the name of the interface leader and follower,

(viii) the reference document describing the interface,

(ix) the actions for the treatment of the interface,

(x) dates for the treatment of the interface, and

(xi) the safety requirements.

5.7.2.5 Interface Classification (Level and Type)

(a) Level of Interfaces. The interfaces will be classified in Levels according to the nature of their interaction, i.e., depending on the parties involved, as listed below:

(i) Level 1: The interfaces with entities external to the project, (Public services, EPCOR, Water, etc.).

(ii) Level 2: Interfaces involving the Design-Build Agreement and the adjacent project and the existing systems and subsystems.

(iii) Level 3: Interfaces involving systems and subsystems under the responsibility of the same entity.

(iv) Level 4: Interfaces within subsystems, i.e., those between elements of the same subsystem.

(b) Classification per Type. These interfaces will be further subclassified into the following classification types:

(i) Functional (F)

(ii) Physical or dimensional (D) for the fit between two systems sharing space

(iii) Mechanical (M), in all those where there is a transmission of forces

(iv) Electrical (E), for the power supply of each of the systems

(v) Data, Communications, Computing and Electronic Systems (I)

(vi) Safety (S) that interface that may arise for the fulfillment of the safety criteria.

(vii) Where they are defined as follows:

(A) Functional: functions that the interface design must fulfil, e.g. visual coverage by CCTV at stations and OMF.

(B) Physical or dimensional: Refers to compliance with the dimensions required to house equipment, components, and sufficient space for subsequent maintenance activities.

(C) Mechanical: Refers the interfaces where efforts or stresses are transmitted by one system to another one, as the interface between the rolling stock and the track or rolling stock and the catenary.

(D) Electrical: Refers to voltages, tolerances, currents, protections, consumptions, connection types, etc.

(E) Data/Communication: Refers the communication protocols between systems. For example, the definition of structure and content of messages between systems.

(F) RAMS: Refers the interfaces related to satisfy RAMS requirements, For example, the determination of appropriate fault detection systems for compliance with safety and availability parameters.

(G) According to the nature of the interface, it will be possible for some to adopt multiple classifications; such is the case of the Signalling - Rolling Stock interface, which corresponds to: Dimensional, Physical, Electrical, Data, Functional and RAMS.

(viii) For safety interfaces, the Design-Builder must define in the Safety and Security Certification Program, how safety interfaces will be managed, according to the mitigation of risks identified for the safety crew, referring the #ITEM of the Hazard Log.

5.7.2.6 Technical Specification of Interfaces

The Designer will identify high complexity interfaces between all systems and due the nature of those, will be responsible to develop and define through a “Technical Specification of Interfaces” how the interface will be managed and solved. As an example, the Designer must define a “Technical Interface Specification between Rolling Stock and Catenary system” where the studies and the technical solution between systems will be expressed, and also the requirements will be listed.

5.8 Requirements Management

5.8.1 General

(a) Design-Builder must be responsible for establishing a formal protocol for requirements management that identifies, captures, documents, traces, manages, verifies and validates compliance with the Project Requirements (the “**Requirements Management**”) prior to the Acceptance of the Systems Engineering Management Plan and must comply with such Requirements Management protocol throughout the Construction Period.

(b) The Requirements Management protocol must include a commercially available requirements management database software tool to record and keep current all data and tracking fields required to identify, capture, document, trace, manage, verify and validate compliance with the Project Requirements, including:

(i) Design requirements;

(ii) Construction requirements;

(iii) Testing and Commissioning requirements;

(iv) operational requirements;

(v) safety requirements;

(vi) security requirements;

(vii) environmental requirements;

(viii) RAM requirements;

(ix) functional requirements;

(x) performance requirements;

(xi) interface requirements;

(xii) Integration requirements;

(xiii) expandability requirements;

(xiv) SUI requirements;

(xv) quality requirements;

(xvi) Public communications requirements specifically the deliverables required by 5.1 [*Deliverables*] of Schedule 12 *[Communications and Engagement]*;

(xvii) Community Employment Benefit Plan requirements;

(xviii) requirements in accordance with the Work Systems Ergonomics Report; and

(xix) all other derived requirements.

(c) Design-Builder must maintain and keep current all Requirements Management data.

(d) The Final Design(s) for each Work Package must include clear and complete evidence of traceability between the content of the Final Design and all applicable Project Requirements.

(e) Design-Builder must submit the Requirements Management data in the native format of the Requirements Management database software tool at the first and second Interim Design, and Final Design and throughout the Construction Period when requested by the City.

(f) Design-Builder must provide full read-only access to the Requirements Management data, with access to all content, attributes and links, ensuring that the chosen methodology for access allows the user to create views showing attributes of his or her choosing and provides the ability to seamlessly follow traceable links.

(g) With the Requirements Management Sub-Plan, Design-Builder provide the Requirements Management database software tool along with two read-only licenses to the City, which licenses must be maintained throughout the Term. Design-Builder must transfer the administrative rights to the Requirements Management database software tool and all data base files associated with the Requirements Management database to the City following the achievement of Construction Completion and must provide the City with one administrator license and one read/write access license, which license must be maintained for a period of two years following achievement of Construction Completion.

(h) Requirements Management must follow the Requirements Management Sub-Plan as defined in Section 5.2.2.2 *[Requirements Management Sub-Plan]*.

5.8.2 Updates to Requirements Management

Prior to implementation of any amendments or updates to the Requirements Management protocol, Design-Builder must submit the proposed amendments or updates to the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

5.8.3 Compliance with Requirements Management

Throughout the Construction Period, Design-Builder must implement and comply, and ensure that all Design-Builder Persons comply, with the Requirements Management process and any amendments or updates, which have been accepted by the City.

5.9 Road Safety Audits

5.9.1 General

(a) No later than 120 days after the Effective Date, Design-Builder must engage a road safety auditor, independent of the Design Team and acceptable to Design-Builder and the City, acting reasonably, (the "**Independent Road Safety Auditor**"). The Independent Road Safety Auditor must have the following minimum qualifications:

(i) recognized expert in the field of road safety engineering;

(ii) be a Professional Engineer;

(iii) minimum of 15 years of road safety engineering experience on projects with similar scope and complexity as the Project; and

(iv) having completed a minimum of three (3) road safety audits on projects involving integration of roads with light rail in an urban environment using the procedures set out in *The Canadian Road Safety Audit Guide*.

(b) Where, for any reason during the Construction Period, the Independent Road Safety Auditor is, or becomes, unable or unwilling to continue to perform the Independent Road Safety Auditor's services as set out herein Design-Builder must promptly engage a replacement Independent Road Safety Auditor, acceptable to Design-Builder and the City, acting reasonably.

(c) Design-Builder must carry out all of its obligations set out in this Section 5.9 *[Road Safety Audits*];

(d) Design-Builder must cause the Independent Road Safety Auditor to:

(i) carry to out all of its obligations in accordance with the *Canadian Road Safety Audit Guide;*

(ii) carry out a road safety audit on the Second Interim Design for each Roadway Work Package (each, a "**Detailed Design Road Safety Audit**");

(iii) prepare a report setting out the findings of such each Detailed Design Road Safety Audit (each, a "**Detailed Design Road Safety Audit Report**"); and

(iv) promptly after completion, provide a copy of each Detailed Design Road Safety Audit Report concurrently to Design-Builder and the City.

(e) As soon as practicable following receipt of each Detailed Design Road Safety Audit Report, Design-Builder must prepare a response to the Detailed Design Road Safety Report (each, a "**Detailed Design Road Safety Response Report**") and submit it to the City.

(f) Design-Builder must implement all measures contained in the Accepted Detailed Design Road Safety Audit Response Report, unless otherwise directed by the City, after which Design-Builder must cause the Independent Road Safety Auditor to issue a certificate to this effect, in the form of the "Road Safety Audit Certificate" as included in Appendix 4B *[Certificate Forms]*, which Design-Builder must submit to the City with the associated Final Design of the applicable Roadway Work Package, in accordance with Section 6.10 *[Final Designs]*.

5.9.2 In-Service Road Safety Audit

(a) Not later than 60 Business Days prior to the Target Construction Completion Date, Design-Builder must cause the Independent Road Safety Auditor to:

(i) complete a comprehensive Project wide "In-Service" road safety audit, (the "**In-Service Road Safety Audit**").

(ii) prepare a report setting out the findings of the In-Service Road Safety Audit (the "**In-Service Road Safety Audit Report**"); and

(iii) promptly following completion, provide a copy of the In-Service Road Safety Audit Report concurrently to Design-Builder and the City.

(b) As soon as practicable following receipt of the In-Service Road Safety Audit Report, but prior to Construction Completion, Design-Builder must prepare an In-Service Road Safety Response Report (the "**In-Service Road Safety Response Report**") and submit it to the City.

(c) Design-Builder must implement all measures contained in the Accepted In-Service Road Safety Response Report prior to Construction Completion, unless otherwise directed by the City, after which Design-Builder must cause the Independent Road Safety Auditor to issue a certificate to this effect, in the form of in the form of the "Road Safety Audit Certificate" as included in Appendix 4B *[Certificate Forms]* (the "**In-Service Road Safety Audit Certificate**").

5.10 Work Systems Ergonomics Specialist

Design-Builder must provide a Work Systems Ergonomics Specialist, with work experience of comparable complexity and scope, to perform the following services:

(a) advise the Designers of the Llew Lawrence OMF of all Design considerations that the Work Systems Ergonomics Specialist considers appropriate including how this relates to interactions and interfaces with infrastructure, equipment and vehicles; and

(b) prepare and submit at the second Interim Design and Final Design, a Works Systems Ergonomics Report (the "**Work Systems Ergonomics Report**") in accordance with Schedule 2 *[Submittal Review Procedure]*, showing compliance of the Llew Lawrence OMF with the fundamental principles of ergonomics in accordance with ISO 6385:2016 – Ergonomics Principles in the Design of Work Systems.

5.11 Operational and Maintenance Readiness Sub-committee

(a) The City shall convene the Operational and Maintenance Readiness Sub-committee no less than six months prior to the commencement of any Testing and Commissioning activities and maintained until Construction Completion. The Operational and Maintenance Readiness Sub-committee must be comprised of representatives from the City, and Design-Builder. Design-Builder must require the O&M Lead and any other relevant Design-Builder Persons to attend meetings of the Operational and Maintenance Readiness Sub-committee at the request of the City.

(b) The Operational and Maintenance Readiness Sub-committee must provide a formal forum to consult and cooperate in all matters relating to the operational and maintenance readiness of the Project.

(c) The City shall provide agendas identifying the issues for discussion and relevant background two Business Days before each meeting. The City shall keep an action register updated and must keep minutes of all decisions, recommendations, action items and meetings of the Operational and Maintenance Readiness Sub-Committee and circulate such minutes to Design-Builder and the other members of the Integration Sub-Committee within five Business Days of the holding of the meeting, the making of the recommendation or the identification of the action item.

6. DESIGN, CERTIFICATION, AND SUBMISSION PROCEDURES

6.1 General Design Considerations

(a) Design-Builder must undertake and perform the Design activities so that the Design of the Infrastructure:

(i) is undertaken by a Design Team exercising such degree of care, skill and diligence as would reasonably be expected from consultants qualified to perform services similar in scope, nature and complexity to the Design activities;

(ii) includes specific consideration of safety, constructability, operations, maintainability and life cycle cost issues at all stages of the Design development process, as appropriate; and

(iii) includes consideration of safe, efficient and cost-effective operation and maintenance of the Infrastructure.

(b) Design-Builder must appoint a Design Team that:

(i) includes (as required by Applicable Law or Good Industry Practice) Professional Engineers;

(ii) includes architects who are registered or licensed to practice as architects under the *Architects Act* (Alberta);

(iii) has sufficient expertise and experience to expeditiously and efficiently perform all of the Design activities in a proper and professional manner to the standards set out in this Agreement; and

(iv) includes core Design personnel whose primary place of business during the Design Development Phase, is within a joint project office located in the greater Edmonton area and is comprised of, at a minimum, the Design Manager, Integration Manager, O&M Leader, and representatives from each Design discipline including all Appropriate Persons.

6.2 Design and Certification Procedure

(a) Throughout the Construction Period, Design-Builder must implement and enforce the Design development, certification, submission and implementation procedures set out in:

(i) this Schedule 4 [*Design and Construction Protocols*]; and

(ii) the Design Management Plan, and any subsequent amendments or updates thereto,

(collectively, the "**Design and Certification Procedure**").

(b) The Design and Certification Procedure must apply to all Design Data prepared or adopted in connection with the Design and Construction and any other construction activities taking place during the Construction Period, including any further Design development or changes to a Design submitted and Accepted in accordance with Schedule 2 *[Submittal Review Procedure]*.

(c) Design-Builder must ensure that all certification procedures referred to in the Design and Certification Procedure are complied with by the Appropriate Persons, including the members of the Design Team and any independent team, and that all Appropriate Persons are at all relevant times duly authorized and qualified to carry out such procedures and to sign the relevant Certificates. Any failure by any Appropriate Person to fulfill the obligations required of him under the Design and Certification Procedure must be a breach of Design-Builder's obligations under this Agreement.

(d) Upon Acceptance of all Final Designs, the Integration Manager must provide an authenticated report that explains how Design integration was managed and executed for the Project, including successes, challenges and lessons learned. This report must also be appended to the "Assurance of Design Coordination Certificate", in the form included in Appendix 4B [*Certificate Forms*] of this Schedule.

(e) In the case of an Emergency, Design-Builder may proceed with such measures as are immediately necessary for the protection of persons and/or property prior to complying with the applicable provisions of the Design and Certification Procedure, provided that

Design-Builder must comply with the provisions of the Design and Certification Procedure as soon as reasonably possible in the circumstances.

6.3 No Limitation

A requirement for certification or for any check, audit or review pursuant to, and for purposes of, this Schedule is in addition to, and does not in any way limit, qualify, replace or relieve Design-Builder from, the obligation to comply with any other certification, check, audit or review requirement provided elsewhere in this Agreement or in any of the Project Requirements or pursuant to any Applicable Law, professional standards or practices.

6.4 Design Management Plan

6.4.1 General

Within 60 days after the Effective Date, or at an alternate date Accepted by the City in the Submittal Schedule and Register, Design-Builder must prepare and submit a design management plan, (the "**Design Management Plan**"), which must include:

(a) an organization chart for all Design activities;

(b) the identification of the procedures to be used for designing and checking, including:

(i) inter-disciplinary Integration and interface between Design elements, including;

(A) the proposed timing for inter-disciplinary review meetings based on the Submittal Schedule for Design Submittals;

(B) how actions recorded during inter-disciplinary review meetings will be documented and tracked by the Designer for each discipline during the Design Development Phase; and

(C) the requirements of the Design Quality Management Plan in part or in whole, as practical, and as needed, in order to address design quality control and design quality assurance requirements pursuant to Appendix 9B *[Design Quality Management Plan]*.

(ii) compliance with the Design and Construction Requirements, including adherence to the SUI requirements described in Part 2 *[Sustainable Urban Integration and Landscape Architecture]* of Schedule 5 *[D&C Performance Requirements]* and compliance with environmental obligations described in Schedule 10 *[Environmental Performance Requirements]*;

(c) the following management sub-plans, each as further described in Section 6.4.5 *[Design Management Sub-Plans]*:

(i) Vibration Control Sub-Plan; and

(ii) Noise Control Sub-Plan;

(d) the form of review to be undertaken by the Appropriate Persons for each Work Package;

(e) the identification of the proposed Checking Team(s), including the Independent Safety Assessor;

(f) details of the Integration of the following into the Design Development process:

(i) resolution of Integration and interface issues;

(ii) mitigation of risks and vulnerabilities identified through the Safety and Security Certification Program;

(iii) elimination of Deficiencies and other Nonconformities and mitigation of risks including those identified through the RAM Program; and

(iv) applicable Project Requirements, including the requirements of Schedule 10 *[Environmental Performance Requirements]*;

(g) details of the timing, development, review and verification of models, mock-ups and prototypes;

(h) Building Information Modelling Execution Plan (BEP) that must:

(i) provide a narrative describing the Design- Builder's approach to BIM in order to promote an integrated design approach and define the specific uses of BIM throughout this Project. List those specific elements of the Project which will utilize BIM data in the creation of their deliverables;

(ii) Modelling Requirements:

(A) provide details of the chosen BIM program, including software version and build number;

(B) define the level of development used at each phase of the Project for BIM elements;

(C) describe the procedure for compartmentalizing the system elements of each model, where applicable;

(D) prescribe and confirm the unit of measure and co-ordinate system used in each model. Define the procedure used to maintain integrity of these across multi-discipline models and platforms.

(iii) BIM Collaboration Strategy:

(A) describe the Design-Builder's approach to BIM collaboration among its team members, including the specific methods and common data environment in which model data must be shared;

(iv) BIM collaboration meetings:

(A) describe Design-Builder's approach to BIM meetings and collaboration sessions that must be held throughout the project phases, including their frequency;

(B) define the meeting frequency through the Project phases, participants required, and locations of meetings

(v) BIM Quality Control (QC) and Quality Assurance (QA):

(A) provide a plan that defines the QC and QA strategy for the use of BIM on the Project; this plan must outline tasks and responsibilities of each team member involved; and

(B) describe the procedure that must be used for checking interferences among those components which utilize multi discipline BIM data.

(vi) BIM Delivery and updates:

(A) list the Project BIM deliverables, including their file formats and model structure hierarchy, including their relationships with other related BIM deliverables; and

(B) describe the procedure for, and frequency at which model updates must be submitted to the City during the design phase.

(vii) BIM for record data:

(A) describe the process for updating and maintaining the design BIM data during the construction phase; and

(B) define which models will be included in the handover of record documents to the City, and what as-built data the models will contain.

(i) the contents and format of Interim Designs, if applicable, and Final Design submissions for each Work Package and a description of how these submissions will be integrated into the City's information management system (Aconex);

(j) a detailed Design review and audit schedule, indicating the dates that Design-Builder plans to:

(i) conduct internal audits of the Design verification process;

(ii) submit each Interim Design and Final Design;

(iii) undertake review meetings in accordance with Section 6.8(e); and

(iv) verify implementation of the Design of the Infrastructure, by field review, during Construction, including during Testing and Commissioning and throughout performance of the Deconstruction Work; such verification will be supported by the findings and any associated Corrective Actions resulting from Quality Audits;

(k) details of the organization and hierarchy of all Design Data;

(l) details of the plans for implementing, and verifying the implementation of, the Design of the Infrastructure throughout the Construction;

(m) the procedures to be used to ensure consideration of Construction constraints including, but not limited to, those in Section 1-4 *[Construction Requirements]* of Schedule 5 *[D&C Performance Requirements]*;

(n) the procedures to be used to ensure compliance with the High Floor Operations and Maintenance Parameters of Appendix 5-1B *[High Floor Operations and Maintenance Parameters]*;

(o) the procedures to be used to ensure compliance with the quality assurance and quality control requirements of Schedule 9 *[Quality Management]*;

(p) details of the plans and procedures for the identification of all Project Intellectual Property pursuant to Schedule 8 *[Intellectual Property]*;

(q) appropriate metrics to measure the progress of the Design activities for each discipline;

(r) a Submittal schedule (including detailed Design Submittals) and tracker (the "**Submittal Schedule and Register**") which must:

(i) provide for a progressive and orderly flow of Design Data and other Submittals from Design-Builder to the City appropriately staged to allow sufficient time for consideration of each Submittal by the City's Representative in accordance with Schedule 2 *[Submittal Review Procedure]*, taking into account, after consultation with the City, the volume and complexity of the Submittals and the resources required by the City to consider such Submittals;

(ii) be in a table format with columns that identify the following for each Submittal:

(A) unique Submittal tracking number;

(B) Submittal revision;

(C) name of Design-Builder Person responsible for preparation of the Submittal;

(D) Work Package identifier(s) (if applicable);

(E) Requirements Management reference(s) to applicable Project Requirement(s);

(F) submission status (e.g. not started, in progress, submitted, endorsed, revise and resubmit);

(G) target submission date;

(H) actual date of submission;

(I) target date of City endorsement; and

(J) endorsement status under Section 4 *[Review Procedure]* of Schedule 2 *[Submittal Review Procedure]*;

(iii) allow adequate time prior to performance of the Design and Construction that is the subject of the applicable Submittal for review of the Submittal, including all

Design Data and safety, security and RAM assessments, and for Design-Builder to make changes to the Submittals as may be required to account for any comments received from the City; and

(iv) as an appendix to the Submittal Schedule and Register, provide a detailed description of the Design Data that will be included in each Submittal.

(s) be developed in conjunction with the Systems Management Plan;

(t) the procedures to be used to ensure consideration of the Work Systems Ergonomics Specialist's requirements and recommendations in accordance with Section 5.10 [*Works Systems Ergonomics Specialist*].

6.4.2 Updates to the Design Management Plan

Prior to implementation of any amendments or updates to the Design Management Plan, Design-Builder must submit the proposed amendments or updates to the City on a quarterly basis in accordance with Schedule 2 *[Submittal Review Procedure]*.

6.4.3 Compliance with the Design Management Plan

Throughout the Construction Period, Design-Builder must implement and comply, and ensure that all Design-Builder Persons comply, with the Design Management Plan and any amendments or updates which have been Accepted by the City.

6.4.4 Submittal Schedule and Register Updates

(a) On or before the last day of each month, up to and including the Construction Completion Date, Design-Builder must submit an updated Submittal Schedule and Register to the City. Each updated version of the Submittal Schedule and Register must:

(i) comply with the requirements of Section 6.4.1(r) *[General]*; and

(ii) include a design register showing all known, submitted and proposed Design Drawings and other documents, including the drawing number or document number, title, certifying engineer, revision number, issued date and status.

(b) Design-Builder must bear the risk of delays and additional costs caused as a result of:

(i) the late, incomplete or non-compliant submission of any Submittal to the City; and

(ii) Submittals which are endorsed "Rejected" or required to be corrected and resubmitted in accordance with the terms of this Schedule or Schedule 2 *[Submittal Review Procedure]*.

6.4.5 Design Management Sub-Plans

6.4.5.1 Vibration Control Sub-Plan

The Vibration Control Sub-Plan must:

(a) describe the processes and procedures required to satisfy the requirements of Section 1-4.4 *[Construction Vibration Control]* of Schedule 5 *[D&C Performance Requirements]*;

(b) include details of the organization, roles and responsibilities for all vibration control activities;

(c) describe the method of verification and validation of the protective provisions to be employed to ensure that the vibration from the Infrastructure does not exceed the levels specified in Section 1-4.4 *[Construction Vibration Control]* of Schedule 5 *[D&C Performance Requirements]*;

(d) describe the approach(es) to be applied along the LRT Corridor to mitigate vibration from the Infrastructure; and

(e) consider the noise and vibration impact report based on the Reference Design which has been prepared by the City and is included in the Disclosed Data.

6.4.5.2 Noise Control Sub-Plan

The Noise Control Sub-Plan must:

(a) describe the processes and procedures required to satisfy the requirements of Section 1-4.3 *[Construction Noise]* of Schedule 5 *[D&C Performance Requirements]*;

(b) include details of the organization, roles and responsibilities for all noise control activities;

(c) describe the methods of verification and validation of the protective provisions to be employed to ensure the noise from the Infrastructure does not exceed the levels specified in Section 1-4.3 *[Construction Noise]* of Schedule 5 *[D&C Performance Requirements]*;

(d) describe the approach(es) to be applied along the LRT Corridor to mitigate noise from the Infrastructure; and

(e) consider the noise and vibration impact report based on the Reference Design which has been prepared by the City and is included in the Disclosed Data.

6.5 Design Certification

6.5.1 Design Certificates

(a) Each Final Design must be submitted with the associated Design Certificate(s). Each Work Package may be comprised of more than one Final Design.

(b) Design-Builder must issue the applicable Design Certificate(s) in accordance with Section 6.5.3 *[Submission of Design Certificates]* for each Work Package, together with the applicable Final Design(s).

(c) For elements of the Infrastructure that are governed by the NBCAE, the Design Certificates must be in addition to the forms required by the NBCAE. For all other elements of the Infrastructure, the Design Certificates must be in the form attached hereto as Appendix 4B *[Certificate Forms] [3-Certification for Design and Commitment for Field Review]* must be authenticated by the Designer.

6.5.2 Design Coordination Certificate

(a) The Final Design which constitutes the conclusion of the Design Development Phase must be submitted with the Design Coordination Certificate.

(b) Design-Builder must issue Design Coordination Certificates in accordance with Section 6.5.3 *[Submission of Design Certificates*].

(c) The Design Coordination Certificates must be in the form of the "Assurance of Design Coordination" as included in Appendix 4B *[Certificate Forms]* and must be authenticated by the Design Manager.

6.5.3 Submission of Design Certificates

All Design Certificates and the Design Coordination Certificate, together with the supporting documentation, must be submitted to the City in accordance with Schedule 2 *[Submittal Review Procedure]* with original signatures, stamps and registration numbers and in such form as to allow the City to perform its review in respect of such Design Certificate or the Design Coordination Certificate without delay.

6.6 Design Submissions

(a) All submitted Design Data must be organized in design folders with indexes and sectional dividers.

(b) All Design Data must be prepared under the supervision of the Designer. Prior to submission of any Design Data, the Designer and the relevant Checking Team(s) (where applicable) must satisfy themselves that the Design Data meets all the Project Requirements and otherwise complies with the requirements of this Agreement.

(c) Design-Builder may propose separating out from a Work Package and submitting independently from and prior to the rest of the Work Package**,** Design Submittals that require early submission in order to facilitate achievement of the Construction Schedule, subject to acceptance by the City. These early-submitted Design Submittals would not be subject to the full requirements of Appendix 4D [*Project Specific Submission Requirements*], subject to acceptance by the City, as the final Quality Records associated with the early-submitted Design Submittals would meet the minimum requirements of the Design Quality Management Plan and Schedule 9 *[Quality Management]*.

6.7 Models, Mock-Ups, and Prototypes

(a) Design-Builder must prepare and submit the following models and mock-ups:

(i) Traction Power modeling in accordance with Section 6-2.3.2 *[Design Requirements and Criteria]* of Schedule 5 *[D&C Performance Requirements]* within 180 days after the Effective Date and at any time when the Design development materially changes the outcome of the model;

(ii) simulated CCTV camera views, as part of the the Final Design of each Station; and

(iii) any other models or mock-ups specified in the Project Requirements.

(b) All physical models and mock-ups must be constructed at locations acceptable to City, acting reasonably.

6.8 Interim Design Reviews

(a) Design-Builder must submit, at a minimum, two (2) Interim Designs for each Work Package, unless otherwise stated in Schedule 5 *[D&C Performance Requirements]*

(b) Notwithstanding Section 6.8(a) *[Interim Design Reviews]*, Design-Builder may submit, at a minimum, one (1) Interim Design for each of the following Work Packages:

(i) retaining walls; and

(ii) OCS Foundations.

(c) Notwithstanding Section 6.8(a) *[Interim Design Reviews]*, Design-Builder need not submit any Interim Designs for each of the following Work Packages:

(i) Public Art.

(d) Interim Design submissions must be informal and must not be subject to review under the provisions of Schedule 2 *[Submittal Review Procedure]*; instead, such informal Interim Design submissions must be used to inform the City of the development of the Design and to provide an opportunity for a dialogue on compliance with the Project Requirements before the applicable Design is complete.

(e) The minimum content of each Interim Design submission is described in Appendix 4D *[Project Specific Submission Requirements]*. The content of each Interim Design submission must be appropriate to the subject and discipline. The information provided must be adequate to show that the design is proceeding in compliance with Schedule 5 *[D&C Performance Requirements]* and must highlight any key integration points with other disciplines.

(f) Each Interim Design submission must include a summary of commitments included in Bid Extracts to confirm that the Design incorporates these commitments.

(g) An Interim Design Review Sub-committee must be convened within 60 days of the Effective Date and meet at a minimum monthly through the Design period. The Interim Design Review Sub-committee must be comprised of the Design Manager, Design Quality Managers (as required), Integration Manager, SUI Leader, O&M Leader, City representatives and other individuals who Design-Builder or the City deem appropriate. The Interim Design Review Sub-committee must:

(i) confirm the Design Data to be submitted for review in each Interim Design submission;

(ii) confirm the schedule of each Interim Design submission in the context of the Submittal Schedule and Register;

(iii) confirm the review timelines of each Interim Design submission; and

(iv) schedule any interim Design review meetings as required.

(h) Design-Builder must organize Interim Design and other review meetings with the City's Representative in accordance with the Design Management Plan, for the purpose of reviewing the applicable Interim Designs and other Design Data. Unless otherwise agreed, the meetings must be convened in the city of Edmonton. Design-Builder must provide not less than 2 days' notice of any such meeting, along with proposed agenda topics and proposed attendees.

(i) Design-Builder must prepare minutes of all review meetings, including recording the City's comments, and submit the minutes to the City within five (5) Business Days following the review meeting; Design-Builder must promptly address the City's comments to the reasonable satisfaction of the City.

(j) Design-Builder must develop, implement and manage a comment workflow for all Interim Design submissions and other design meetings to capture and provide responses to all informal comments collected.

(k) The minutes of such meetings, including any City comments included or addressed therein, must not constitute Changes or Innovation Proposals.

6.9 Independent Checking

(a) Concurrent with submission of the Design Management Plan, Design-Builder must submit a proposal as to the individuals and organizations who must serve as the Checking Team, including resumes for each proposed team member, and the proposed terms and conditions of their retainer. The Checking Team must:

(i) be appointed for the sole purpose of performing independent detailed checks of the Design and Design Data;

(ii) submit their reports directly to the Design Quality Manager;

(iii) be from an organization(s) which is not an Affiliate of Design-Builder or any Design-Builder Person;

(iv) consist of individuals who are registered or qualified to be registered as professional engineers or architects in their Canadian home jurisdiction;

(v) have demonstrable expertise in all design disciplines involved in the Design, including the following disciplines:

(A) geotechnical;

(B) structural;

(C) systems; and

(D) track; and

(vi) in the case of the Independent Safety Assessor, meet the requirements of Section 5.3 *[Independent Safety Assessor]*.

(b) Design-Builder must ensure that the Checking Team remains independent from the Design Team and Design-Builder at all times. The methods of analysis employed by

the Design Team and the Checking Team need not be the same. However, they may consult each other to ensure that the results they are obtaining are directly comparable.

(c) Design-Builder must cause the Checking Team to perform an independent detailed check of the Design Data relating to each Project element listed in Section 6.9(d) *[Independent Checking]* (including calculations, assessments and Design Drawings), and be responsible for:

(i) conducting design checks to ensure that the Design of each element meets the Project Requirements set out in this Agreement and that such Design is carried out according to Good Industry Practice;

(ii) undertaking supplementary analyses to independently verify and confirm the Design methodologies and assumptions used;

(iii) identifying Deficiencies and other Nonconformities in the Design and analyses, and notifying Design-Builder and the City of unresolved Deficiencies and other Nonconformities; and

(iv) preparing and issuing reports and Checking Team Design Certificates.

(d) Design-Builder must cause the Checking Team to independently check the Design Data of the following Project elements:

(i) geotechnical and structural design of the 23 Avenue Underpass;

(ii) geotechnical and structural design of the Blackmud Creek LRT Bridge;

(iii) structural design for the 111 Street Roadway Bridge Widening;

(iv) geotechnical and structural design of the Anthony Henday Bridge; and

(v) derailment protection measures on Transportation Structures.

(e) The Design Team and the Checking Team must each satisfy themselves as to the applicability and accuracy of all computer programs used and must ensure the validity of the program for each application and each team must also be responsible for their own interpretation.

(f) For each applicable Interim and Final Design, Design-Builder must cause the relevant Checking Team member(s) to provide an authenticated report and a Checking Team Design Certificate in the form of the "Checking Team Design Certificate" as included in Appendix 4B *[Certificate Forms]*, indicating the results of the independent check.

(g) In addition to the checking procedures required above, Design-Builder must ensure that all checking procedures required by APEGA are completed. Documentation of such compliance must be included in the applicable Final Design submissions.

6.10 Final Designs

(a) Unless otherwise stated in Schedule 5 *[D&C Performance Requirements]*, Final Designs, including Design Data from all Design disciplines, for each Work Package must be submitted to the City in accordance with Schedule 2 *[Submittal Review Procedure]* and each Final Design must, at a minimum:

(i) include Design Certificates and all pertinent Design Data, including Design Drawings and copies of all Project Approvals and Design reports, and inspection and testing requirements sufficient to demonstrate conformance with the Project Requirements, along with such other supporting Design Data as requested by the City, acting reasonably;

(ii) include all information as listed in Appendix 4D *[Project Specific Submission Requirements]*, to the extent applicable to the Work Package;

(iii) include all applicable Design Data, authenticated in accordance with Applicable Law, and the policies and requirements of applicable Governmental Authorities and regulatory agencies, including APEGA, ASET, AAA, and AALA;

(iv) be comprised of designs that are Integrated appropriately, without conflicts, and presented in a consistent format;

(v) include Design Drawings that are complete, searchable, legible, scalable, accurate and provided in the formats and quantities described in Section 2.2.2(d) *[Drawing Submissions]* of Appendix 4E *[Project Drawing Standards]*. Any revisions to previously submitted Design Drawings must also be complete, searchable, legible, scalable, accurate and provided in the formats and quantities described in Section 2.2.2(e) *[Drawing Submissions]* of Appendix 4D *[Project Drawing Standards]*;

(vi) include all pertinent data from the system and safety assurance activities, the pertinent information recorded pursuant to the Requirements Management protocol and an Integration Register extract, for the applicable Final Design that demonstrates that the Final Design conforms to the Project Requirements and is Integrated with the other project disciplines;

(vii) include all applicable Road Safety Audit Certificates, in the form of the "Road Safety Audit Certificate" as included in Appendix 4B *[Certificate Forms]*, authenticated by the Independent Road Safety Auditor and the Designer;

(viii) include all models, mock-ups and studies applicable to the relevant Final Design or otherwise required to demonstrate compliance with the applicable Project Requirements;

(ix) include all plans and procedures applicable to implementation of the relevant Final Design;

(x) demonstrate, through comprehensive geotechnical and structural analyses and designs, that the Project Requirements and tolerances of the relevant Infrastructure and each component thereof must be met over the applicable Design Service Life;

(xi) detail how the High Floor Operations and Maintenance Parameters and any other operations and maintenance requirements in this Agreement have been incorporated into the applicable Final Design;

(xii) detail how SUI principles, goals and objectives have been incorporated into the applicable Final Design;

(xiii) detail how any comments of the City, and issues identified in the course of, any Interim Design reviews and any other comments and issues resulting from internal design reviews, quality control procedures and Checking Team reviews have been addressed in the Design;

(xiv) include a complete register of all Project Intellectual Property, including Third Party Intellectual Property, Third Party Licensed Software and Third Party Embedded Software, incorporated, embedded or otherwise included in or with, or required for the use of, the applicable Final Design and copies of all agreements (including confirmatory agreements) regarding the Project Intellectual Property and related Intellectual Property Rights required under this Agreement or otherwise requested by the City, including transfers or assignments to the City of Design-Builder's rights and licenses to use Project Intellectual Property and related Intellectual Property Rights;

(xv) contain all pertinent correspondence, arranged by subject matter in chronological order; and

(xvi) include a neat, bound and indexed set of applicable Design calculations authenticated by the responsible engineer, who must be a duly experienced Professional Engineer of the appropriate discipline. Calculations should be sufficiently detailed and state all required input information for owner to reproduce and check them if desired.

(b) Except as otherwise provided in the Agreement, specific content identified in the Final Designs that have been prepared and submitted to the City which have been accepted by the City in accordance with Schedule 2 *[Submittal Review Procedure]* subsequent to the submission of the Bid Extracts must replace the corresponding specific content contained in the Bid Extracts, provided that:

(i) Final Designs that contain information that is intended to replace information contained in the Bid Extracts are clearly marked up with a note which reads "REPLACES BID EXTRACT" for each individual deviation from the Bid Extracts; and

(ii) Final Designs in no circumstances result in lower levels of safety, reliability, durability, performance, quality and service than those described in the Bid Extracts.

6.11 Rejection of Final Design

If the City rejects a Final Design package, including any of the Design Data, in accordance with Schedule 2 *[Submittal Review Procedure]*, the City shall notify Design-Builder and Design-Builder must then:

(a) make any alterations and additions as necessary so that the Final Design is in accordance with the Project Requirements and all other requirements of this Agreement, all in accordance with Schedule 2 *[Submittal Review Procedure]*;

(b) subject to the other provisions of this Agreement, submit an Innovation Proposal, or

(c) dispute the rejection by the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

6.12 Adherence to Final Design

Design-Builder must not depart from Final Designs, including all Design Data, that have been the subject of a Design Certificate that has been submitted to the City in accordance with the Design and Certification Procedure unless Design-Builder:

(a) first revises and resubmits the applicable Final Design, together with:

(i) all applicable revised Design Data;

(ii) a revised Design Certificate(s); and

(iii) all other information required to be submitted with a Final Design pursuant to Section 6.10 *[Final Designs]*, to the City in accordance with Schedule 2 *[Submittal Review Procedure]*; or

(b) requests that the City consider a field-initiated change to the Final Design as a result of unforeseen construction conditions or urgent circumstances beyond Design-Builder's control. The City may accept or reject a request pursuant to this Section 6.12(b) *[Adherence to Final Design]* in its discretion and, if a request is accepted, the City may impose such conditions as it considers appropriate in the circumstances.

6.13 Designer Field Review during Construction

During Construction, Design-Builder must ensure that the Appropriate Person(s), in accordance with the procedures set out in the Design Management Plan, the relevant Quality Documentation and other Project Requirements, examine the Construction and satisfy themselves that the Infrastructure and every part thereof has been designed, fabricated, constructed, completed, commissioned, tested and maintained in all respects so as to accord with:

(a) the Design Data in respect of which accepted Design Certificates have been issued; and

(b) all applicable Project Requirements.

6.14 Temporary Works

(a) At a minimum, Final Designs must be provided for the following Temporary Works:

(i) all items intended for public use or potentially affecting public safety;

(ii) all Temporary Works within the boundaries of Bylaw 7188.

(b) Final Designs for the Temporary Works must be submitted to the City in accordance with Schedule 2 *[Submittal Review Procedure]:*

(c) Without limiting Section 6.9 *[Independent Checking]*, all Design Data relating to any Temporary Works requires an independent check by an Appropriate Person.

(d) In performing a check referred to in Section 6.14(c) *[Temporary Works]*, the Appropriate Person must be satisfied that:

(i) the Design Data meets the Project Requirements and otherwise complies with the requirements of this Agreement;

(ii) the Temporary Works (as a whole, as well as the constituent parts) are satisfactory for the safe and proper discharge of Design-Builder's relevant obligations; and

(iii) the Design Data complies with all Applicable Law and the requirements of the relevant Governmental Authorities.

(e) Must be subject to Designer field reviews.

6.15 No Construction without Accepted Endorsement

(a) Design-Builder must not commence or permit the commencement of Construction or any other construction activities on any Work Package, unless and until Design-Builder has:

(i) satisfied all applicable conditions precedent, as set out in this Agreement, including Schedule 10 *[Environmental Performance Requirements]*;

(ii) submitted all applicable Final Designs, including all Design Data and relevant Design Certificates required in respect of the relevant Work Package, in accordance with Schedule 2 *[Submittal Review Procedure]* and such Final Designs have been suitably endorsed by the City; and

(iii) obtained all necessary Project Approvals and fulfilled any other applicable requirements in respect of the relevant Work Package; and

(b) Notwithstanding Section 6.12(a) *[Adherence to Final Design]*, the City may grant certain exceptions for Temporary Works on a case by case basis, subject to the requirements of Section 6.14 *[Temporary Works]* being fulfilled in a manner deemed to be equivalent by the City, in its discretion.

7. CONSTRUCTION

7.1 Construction Management Plan

7.1.1 General

Within 90 days after the Effective Date, or at an alternate date Accepted by the City in the Submittal Schedule and Register, Design-Builder must prepare and submit a construction management plan, (the "**Construction Management Plan**"), which must:

(a) include an organizational chart identifying the entities responsible for performance of each major construction activity;

(b) include construction staging and site plans;

(c) include the documented processes, methods and procedures which will be employed in Construction work for critical subsystems, including the Traction Power System, Traffic Signals, Train Control System, fibre optic backbone and all supporting infrastructure including Wayside Equipment and Wayside Equipment Enclosures, Systems Duct Banks, and wire and cable. The processes, method and procedures employed on critical subsystems must be based on Good Industry Practice and minimising impact on Capital Line LRT operations.

(d) include procedures for ensuring coordination of all Construction performed by Subcontractors, including manufacturers of materials, plant or equipment;

(e) include procedures for ensuring coordination of all Other Works performed by Other Contractors;

(f) include procedures to regularly inform the Communications Manager to ensure that the requirements and activities of the communications plans and the engagement plans can be executed;

(g) describe the planned use of Field Review Monitors to execute quality control and quality assurance checks and describe in detail the field review process that will be implemented to ensure compliance of the constructed Infrastructure with the applicable Design Data in accordance with Section 5.5 *[Field Review Monitors]* of Schedule 9 *[Quality Management]* and Appendix 9C *[Construction Quality Management Plan]*;

(h) describe the procedures for accurately redlining on-site issued-for-construction Design Drawings and how revisions to the issued-for-construction Design Drawings will be managed;

(i) include a log of lessons learned from similar projects and plan for implementing mitigation measures to address similar issues;

(j) include procedures for identifying and correcting Deficiencies and other Nonconformities;

(k) include the following construction sub-plans, each as further described in Section 7.2 *[Construction Management Sub-Plans]*:

(i) Construction Noise Control Sub-Plan;

(ii) Construction Vibration Control Sub-Plan; and

(iii) Construction Soil Management Sub-Plan;

(l) describe the approach to managing the construction constraints described in Section 1-4.1 *[Construction Constraints]* of Schedule 5 *[D&C Performance Requirements]*; and

(m) include the requirements outlined for the Construction Quality Management Plan pursuant to Appendix 9C *[Construction Quality Management Plan]* in part or in whole, as practical, and as needed.

7.1.2 Updates to the Construction Management Plan

Prior to implementation of any amendments or updates to the Construction Management Plan, Design-Builder must submit the proposed amendments or updates to the City in accordance with Schedule 2 *[Submittal Review Procedure]*.

7.1.3 Compliance with the Construction Management Plan

Throughout the Construction Period, Design-Builder must implement and comply, and ensure that all Design-Builder Persons comply, with the Construction Management Plan and any amendments or updates which have been accepted by the City.

7.2 Construction Management Sub-Plans

7.2.1 Construction Noise Control Sub-Plan

The Construction Noise Control Sub-Plan must:

(a) describe the processes and procedures required to satisfy the requirements of Section 1-4.3 *[Construction Noise]* of Schedule 5 *[D&C Performance Requirements]*;

(b) describe the strategy to minimize Construction noise;

(c) describe the truck routes to be used for each Site;

(d) describe the truck movement restrictions within each Site, including limits on speed and reverse manoeuvres with back-up alarms;

(e) identify any special mitigation measures to be employed at noise-sensitive locations and/or noise-sensitive times of day and in the vicinity of festivals/events; and

(f) identify areas of Construction noise concerns that may require additional communications and engagement attention.

7.2.2 Construction Vibration Control Sub-Plan

The Construction Vibration Control Sub-Plan must:

(a) describe the processes and procedures required to satisfy the requirements of Section 1-4.4 *[Construction Vibration Control]* of Schedule 5 *[D&C Performance Requirements]*;

(b) describe the strategy to minimize vibration impacts;

(c) list all vibration-generating equipment and processes to be employed in the Construction;

(d) identify any special mitigation measures to be employed to mitigate vibration impacts at vibration-sensitive areas, and in the vicinity of festivals/events;

(e) identify minimum separation distances between operating vibration-generating equipment and buildings; and

(f) identify areas of Construction vibration concerns that may require additional communications and engagement attention.

7.2.3 Construction Maintenance Program

(a) Not less than 30 days before commencing any Construction activities within the Lands, Design-Builder must prepare and submit to the City a comprehensive Construction Maintenance program for the Construction Period (the "**Construction Maintenance Program**"), which must list the specific Construction Maintenance procedures in accordance with Section 1-4.5 *[Maintenance During Construction]* of Schedule 5 *[D&C Performance Requirements].*

(b) Design-Builder must review and amend the Construction Maintenance Program, not less than annually on the anniversary of the Effective Date throughout the Construction

Period, and more often as necessary, to ensure that the Construction Maintenance Program at all times:

(i) reflects the nature of the Project Work being performed at the applicable Sites; and

(ii) complies with the requirements set out in Section 1-4.5 *[Maintenance During Construction]* of Schedule 5 *[D&C Performance Requirements].*

(c) Any amendments to the Construction Maintenance Program must be submitted to the City pursuant to Schedule 2 *[Submittal Review Procedure].*

(d) The Construction Maintenance Program must terminate on the Construction Completion Date**.**

7.2.4 Construction Soil Management Sub-Plan

(a) The Construction Soil Management Sub-Plan must:

(i) describe how the Design-Builder will manage all soil excavation, handling, storage and reuse of soils;

(ii) describe how the Design-Builder will manage all Unsuitable Soil;

(iii) describe how the Design-Builder will manage all backfill that is required;

(iv) comply with the requirements in Schedule 10 *[Environmental Performance Requirements]* and the Beneficial Reuse and Soil Management Strategy;

(v) be submitted not less than 60 days before commencing any Construction on the Lands.

(b) Any testing and disposal of Unsuitable Soil undertaken by the Design-Builder shall be:

(i) composite samples from every 50 m3 of unsuitable materials. Each sample shall be comprised of a minimum of four spatially discrete samples. Discrete samples will not be accepted to define Unsuitable Soil; and

(ii) directed, monitored and documented by a geotechnical engineer who:

(A) is a Professional Engineer; and

(B) have a minimum of five years relevant experience in LRT or major civil construction in Alberta.

7.3 Construction Requirements

7.3.1 Skilled Workers

Design-Builder must employ or cause any entity performing Construction on the Project to employ a sufficient number of appropriately qualified and skilled workers to perform the Construction in compliance with this Agreement.

7.3.2 Control of the Construction

Design-Builder must have total control of the Construction and must effectively direct and supervise the Construction so that it is undertaken in compliance with the terms of this Agreement. Design-Builder must be responsible for all construction means, methods, techniques, sequences and procedures with respect to the Construction and for coordinating the various elements of the Construction and nothing in this Agreement (including this Schedule) must be interpreted as giving any responsibility for the above to the City, the City's Representative or any other representative or agent of the City.

7.3.3 Construction Drawings

(a) Design-Builder must have all issued-for-construction Design Drawings on-site and available for review throughout the Construction Period.

(b) All on-site issued-for-construction Design Drawings must be redlined, as required, to confirm As Built information, such that the actual state of Construction is accurately reflected on the on-site issued-for-construction Design Drawings at all times.

(c) Upon completion of the Construction and prior to issuance of the Construction Certificate for the applicable Work Package, the original copy of each final redlined issued-for-construction Design Drawing must be returned to the Designer for creation of the final Record Drawing.

(d) Copies of each final redlined issued-for-construction Design Drawing must be submitted to the City in accordance with Schedule 2 *[Submittal Review Procedure]* and retained as an As Built copy until superseded by the associated Record Drawing.

7.3.4 Emergency Measures

Design-Builder must, for purposes of managing Emergency and crisis incidents during Construction:

(a) develop a Crisis Communications and issues management protocol between the City, Design-Builder and Emergency Services to advise the City of any potential crisis on any site including, without limitation, a terrorist attack, infrastructure failing fatality or major injury. The Crisis Communications and issues management protocol must be consistent and integrated with the Emergency Response Plan;

(b) develop and communicate procedures for on-site fire response, including contact information for local fire and other Emergency Services, to all Site personnel;

(c) provide a 24-hour hotline, advertised for emergency use only (and Design-Builder must post the phone number in prominent locations at each Site) for notification of Construction related emergencies;

(d) support the City's lead role in addressing all Crisis Communications in accordance with Section 3.9 *[Crisis Communications]* of Schedule 12 *[Communications and Engagement]*; and

(e) maintain and provide access to the Lands, including maintenance of all overhead clearances for use by emergency response vehicles.

7.3.5 City's Access to Lands

(a) Without limiting, and in addition to, the access rights described elsewhere in this Agreement, Design-Builder must ensure that the City and its representatives, subject to complying with all reasonable safety procedures, including any relevant health and safety plans for the carrying out of the Construction and Design-Builder's reasonable site rules, have access to:

(i) attend the Lands and view and observe the Construction at any time;

(ii) attend and observe all aspects of the Testing and Commissioning Work;

(iii) attend the Lands to perform City Works in accordance with Section 1-1.3 *[City Works]* of Schedule 5 *[D&C Performance Requirements]*;

(iv) perform independent inspections/tests as described in Section 8.2 *[City Audits]* of Schedule 9 *[Quality Management]*;

(v) take photographs or video or install a device for taking photographs or video over a period of time for project monitoring, progress capture and communications purposes; and

(vi) during normal working hours, visit any site or workshop where materials, plant or equipment are being manufactured, prepared or stored for use in the Construction, for the purposes of general inspection and of attending any test, investigation or Testing and Commissioning Work being carried out in respect of the Design or Construction.

(b) The City and its representatives must have the right to attend all monthly progress meetings and site meetings, including meetings between Design-Builder and Subcontractors and Design-Builder must provide reasonable advance notice of the time and location of all such meetings to the City.

(c) Design-Builder must cooperate with the City to arrange for tours of the Lands at reasonable times during the Construction Period in a way that does not unreasonably interfere with the progress of the Construction and in compliance with Section 3.7 *[Special Events]* of Schedule 12 *[Communicating and Engagement]*.

7.3.6 Inspection

(a) Prior to the Final Completion Date, Design-Builder must, upon request by the City, which request must include detailed reasons for the request, open up for inspection by the City or its representatives any part of the Infrastructure which the City, acting reasonably, believes is defective;

(b) If the Parties agree, or if it is determined in accordance with the Dispute Resolution Procedure, that there are no Deficiencies in the relevant part of the Infrastructure, and Design-Builder complied with the requirements of Section 7.3.5 *[City's Access to Lands]*, then the exercise of such rights must be treated as a Relief Event and be subject to Section 10 *[Relief Events and Limited Relief Events]* of the Agreement;

(c) If the Parties agree, or if it is determined in accordance with the Dispute Resolution Procedure, that any relevant part of the Infrastructure contains Deficiencies:

(i) Design-Builder must rectify and correct such Deficiencies;

(ii) any consequence of such rectification or correcting Deficiencies must be carried out by Design-Builder at no cost to the City; and

(iii) Design-Builder must not be entitled to any extension of time to the Target Completion Date in relation to such rectification and Making Good of such Deficiencies; and

(d) If the Parties are unable to reach agreement in accordance with Sections (a) or (b) above, the matter must, at the request of either Party, be referred to the Dispute Resolution Procedure. If, in order to maintain compliance with the Construction Schedule, it is necessary to proceed in respect of the matter in Dispute, the Parties must proceed in accordance with the position of the City, provided that, if Design-Builder proceeds in accordance with the City's position and the Dispute is finally determined in favour of Design-Builder, Design-Builder must be entitled to claim a Relief Event subject to and in accordance with Section 10 *[Relief Events and Limited Relief Events]* of this Agreement.

7.3.7 City Project Meetings

At the City's request, Design-Builder Project Director must attend meetings to update the City on the progress of the Design and Construction and to discuss any issues that have arisen. These meetings must not be held more frequently than weekly unless mutually agreed otherwise.

7.4 Transportation Management Plan

7.4.1 Transportation Management Plan (TMP)

Within 90 days following the Effective Date Design-Builder must prepare and submit to the City a Transportation Management plan, (the "**Transportation Management Plan**"), which must be divided into the following chapters:

(a) Transportation Accommodation, in accordance with Section 7.4.2 *[Transportation Accommodation]*;

(b) public notification, in accordance with Section 7.4.3 *[Public Notification]*; and

(c) incident management, in accordance with Section 7.4.4 *[Incident Management]*.

7.4.2 Transportation Accommodation

The Transportation Accommodation chapter of the TMP must include:

(a) an overall strategy for provision of safe and continuous access to and passage for all impacted transportation modes, including pedestrians, bicycles and vehicles, through or around all Sites;

(b) an overall strategy for maintaining continuous, safe and efficient access to all impacted properties;

(c) a description of all safety Hazards associated with the Transportation Closures and the available mitigation measures;

(d) a description and drawings of the proposed Construction staging identifying:

(i) the location, anticipated duration and nature of each Transportation Closure; and

(ii) the traffic movements, pedestrian and bicycle routes including alternate routes where applicable;

(e) identification of all transit routes impacted by Transportation Closures;

(f) the approach to co-ordination of Transportation Accommodation with City Works, Other Works, other construction projects, festivals and events on or adjacent to the Lands and all of the Construction constraints described under Section 1-4.1 *[Construction Constraints]* of Schedule 5 *[D&C Performance Requirements]*;

7.4.3 Public Notification

The public notification chapter of the TMP must address the approach to compliance with the applicable requirements of Schedule 12 *[Communications and Engagement],* including but not limited to Section 3.2 *[Design and Construction Communications Services]* of Schedule 12 *[Communications and Engagement],* addressing all activities impacting all transportation modes throughout the Construction Period.

7.4.4 Incident Management

The incident management chapter of the TMP must address:

(a) procedures to deal with traffic incidents and emergencies within or adjacent to the Site;

(b) the approach to involving Emergency Services when developing the traffic incident management requirements of each TAR, TAP and TAS;

(c) identification of circumstances under which PCMSs will be used to provide incident information to the public; and

(d) a process for assessment, reaction, communication and staff training related to traffic incident reporting procedures.

7.4.5 Review and Amendment of the Transportation Management Plan

(a) Design-Builder must review and amend the Transportation Management Plan, at a minimum on every anniversary of the Effective Date throughout the Construction Period, based on monitoring of the Transportation Accommodation, as necessary to ensure that the Transportation Management Plan at all times:

(i) reflects the nature of the Project Work being performed, including any changes in the Sites, work methods, Construction staging or Construction Schedule;

(ii) complies with the requirements of Section 1-5 *[Transportation Management]* of Schedule 5 *[D&C Performance Requirements].*

(b) Any Transportation Management Plan amendments must be submitted to the City for review pursuant to Schedule 2 *[Submittal Review Procedure]*.

8. TRAINING

8.1 Training and Assessment Program

(a) Design-Builder must, in consultation with the City, develop a comprehensive Infrastructure training and assessment program, which must provide a description of the Infrastructure Training and Assessment Plan, and training program/process, including certification and re-certification, for each subsystem and associated training materials. The Infrastructure training and assessment program shall only include training not already available for the Capital Line LRT.

(b) Design-Builder must provide hands-on training to the City to ensure the City's competence in operating and maintaining the Infrastructure, the Equipment and systems.

(c) Design-Builder must ensure that qualified and skilled training and assessor personnel are available to adequately provide the City with the required quantity and quality of training in Edmonton unless otherwise Accepted by the City.

(d) Design-Builder must submit the CVs of the trainer and assessor six (6) months prior to the start of each course for approval. Each trainer and assessor should have at least ten years' experience delivering training and assessment programmes. They must have a recognized training and assessment qualification and have experience of delivering adult based learning programmes, ideally within an O&M rail environment.

(e) All training activities must be completed prior to the Integrated Testing and Commissioning Readiness Date, except operations training which is to be completed during Operational Testing.

(f) Design-Builder must develop the Infrastructure Training and Assessment Plan, and all training courses, including curriculum and materials, referenced in this Section 8 *[Training]* must submit such training courses and materials in accordance with Schedule 2 *[Submittal Review Procedure]* a minimum of six months prior to the Integrated Testing and Commissioning Readiness Date for all training courses listed in the Infrastructure Training and Assessment Plan. Changes to the training courses arising from review by the City must be incorporated prior to commencement of training. Training for equipment or programs that are vendor specific must be provided for by the vendor.

(g) Design-Builder must submit final training schedules not less than three months prior to the Integrated Testing and Commissioning Readiness Date for training activities described in the Infrastructure Training and Assessment Plan.

(h) Design-Builder must provide training sessions for the City personnel, in accordance with the Infrastructure Training and Assessment Plan, and the final training schedules and must ensure that all City personnel have the opportunity to receive training prior to the Integrated Testing and Commissioning Readiness Date. The City will be responsible for attendance of City personnel at the applicable training sessions held in accordance with the final Infrastructure Training and Assessment Plan and training schedules.

(i) The Infrastructure Training and Assessment Plan must use a 'train the trainer' format, so that the City, who will be trained by Design-Builder, will be enabled to deliver subsequent training to its staff. In the first session, a City Person trainer will be

members of the session. In the second training session, the City Person trainer will assist the instructor. In the third training session, the City representative trainer will deliver the training, assisted by the Design-Builder instructor.

(j) Sufficient time must be provided between training sessions to allow the City Person trainer to study the reference material in preparation for the next training session.

(k) At least one full training session, presented by Design-Builder's instructors, of each course must be completely recorded on video in 1080p. All video recordings will be provided to the City in a format agreed by the City.

(l) Each training course must include a testing component pursuant to which each student will be granted a pass or fail status according to his or her demonstration of competence. The assessment methodology and pass/fail criteria must be developed by Design-Builder and agreed with the appropriate City management personnel.

(m) Training and assessment materials and course content must be of high quality and follow Good Industry Practice for adult learning. Training and assessment materials, including instructor support documents, must be of sufficient quality and content to be used in continued in-house training by the City. Principal documents used for training must be tailored to reflect the specific course content and the target audience. At a minimum, Design-Builder must deliver:

(i) one complete set of student materials for each participant enrolled in any training led by Design-Builder;

(ii) one complete set of training materials for the City in a high-quality digital format so further copies can be made with no noticeable decrease in copy quality; and

(iii) one complete set of assessment materials for the City in a high-quality digital format so further copies can be made with no noticeable decrease in copy quality. The assessment documentation must include clear description of how to conduct practical assessment / simulated assessments as well as written assessments. Assessment materials should include model answer sheets and clearly outline the pass/fail criteria.

(n) Training schedules must reasonably account for trainee availability (notice period normal work shifts, days of rest and holidays) and must be conducted in a manner that does not impact the ongoing operation and maintenance of the Infrastructure.

(o) Training courses must be provided for the following personnel:

(i) OCC staff;

(ii) security staff, including ETS personnel;

(iii) City training staff and assessment supervisors, inspectors and managers;

(iv) City maintenance staff for all Infrastructures.

(v) Signals equipment maintainers, technicians' operations inspectors and engineering staff;

(vi) Track and wayside Equipment maintainers;

(vii) Traction Power System; and

(viii) IT and technical maintenance staff responsible for maintaining the Infrastructure, systems, networks, Data Centres and other communications systems.

8.2 Training and Assessment Plan

(a) Design-Builder must develop and submit a draft training plan (the "**Infrastructure Training and Assessment Plan**") two years prior to the Integrated Testing and Commissioning Readiness Date that describes the procedures and courses that must be used to instruct the City on the recommended operation and maintenance practices for the Infrastructure, excluding the Llew Lawrence OMF, and that must include:

(i) the organizational structure and corresponding staff qualifications required to maintain the Infrastructure, excluding the Llew Lawrence OMF, and including the categorization of roles and the number of staff within each category, broken down as follows:

(A) supervisory staff;

(B) maintenance staff, divided into specialist areas (e.g. Track maintainers, Traction Power System maintainers);

(ii) a minimum list of courses which must be provided by Design-Builder and, as guidance, the number of sessions required;

(iii) proposed course structure;

(iv) overview of course material;

(v) overview of course content;

(vi) a list of any prerequisites;

(vii) duration of each course;

(viii) instructional technique to be used;

(ix) instructional aids which will be used;

(x) instructional materials which will be used;

(xi) assessment approach (practical, simulated and written) to be used;

(xii) the proposed pilot course and final course presentation schedules;

(xiii) training facilities and equipment to be used;

(xiv) instructor qualifications, including the following information:

(A) position in Design-Builder's organization, or in product supplier's organization;

(B) length of time employed in Design-Builder's organization, or in product supplier's organization;

(C) relevant training experience;

(D) education and reasons for Design-Builder selection of instructor; and

(E) demonstrated knowledge of the Equipment in respect of which training is provided; and

(xv) any special requirements beyond training facilities detailed in this Section.

(b) In delivering the Infrastructure Training and Assessment Plan, Design-Builder must be responsible to:

(i) provide all labour, equipment, tools, aids, products, services and supervision required to carry out the training as defined in the Accepted Infrastructure Training and Assessment Plan;

(ii) provide formal training for personnel identified by the City in the proper understanding, operation and maintenance of the Equipment;

(iii) assume the target trainees for technical equipment possess as a minimum the knowledge of an electrical journeyman, licensed in the Province of Alberta;

(iv) assume the target trainees for the City possess Operating Rule Book training;

(v) provide training materials sufficient to support continued training by the City;

(vi) provide updated training and training materials when, changes or modifications are made that affect the operation or maintenance;

(vii) provide the necessary qualified instructors, instructional material, reference information and equipment to carry out the Infrastructure Training and Assessment Plan;

(viii) provide sufficient classroom and on-the-job training and testing for City personnel to ensure their competence in understanding, operating and maintaining the Infrastructure, excluding the Llew Lawrence OMF, in accordance with the Maintenance Concept, and up to the standards required by the City and by any and all regulatory Governmental Authorities;

(ix) provide instructors who are competent and completely familiar with the subjects being taught and with the special tooling, test equipment, manuals and procedures to be employed by the City;

(x) make optimum use of the supplemental materials in the delivery of all training courses, such that formal instruction is augmented by effective hands-on experience; and

(xi) provide the training in Edmonton.

(c) The City may use, reproduce and modify any instructional materials (such as manuals, lesson plans, and audio-visual aids) as the City deems necessary for further instruction of City personnel.

8.3 Training Documentation

(a) Design-Builder must develop and submit an "Instructor's Guide" for each training course, which must contain, at a minimum:

(i) a system overview;

(ii) a statement of overall program goals;

(iii) lesson plans, a session by session outline containing the following:

(A) student learning objectives, stated in measurable terms;

(B) an overview of each lesson;

(C) the suggested instructional methods and learning activities;

(D) the required equipment and resources; and

(E) safety procedures and instructions, as appropriate; and

(iv) the assessment methods consisting of written and practical tests designed to measure the extent to which the student has met all learning objectives, with a model answer key for each of the tests developed.

(b) Design-Builder must develop and submit a "Student Manual" for each training course, which must contain, but not be limited to:

(i) a system overview and introduction;

(ii) a statement of overall program goals;

(iii) the student's learning objectives, stated in measurable terms that describe the desired behaviours or knowledge that will be taught;

(iv) a fully developed narrative, not outline format, of content presentation, developed in the same modular format as the instructor's guide;

(v) illustrations, tables, charts, or graphics, as needed to enhance content presentation;

(vi) problems and questions related to lesson content, as appropriate; and

(vii) safety procedures and instructions, as appropriate.

(c) Design-Builder must provide one copy of any Operating and Maintenance Manuals for each student in the session and incorporate them into the course instruction, provided that incorporation into, or reference to, Operating and Maintenance Manuals in the instructor's guide and the student manual must not compromise the ability of each manual to stand alone and function independently. The provided Operating and

Maintenance Manuals may be recovered at the end of each session and re-used in subsequent sessions.

(d) Final training and Operating and Maintenance Manuals must reflect the "As Built" Infrastructure. If errors or omissions in the Operating and Maintenance Manuals are found at any stage of training, all affected documentation contained in the instructor's guide, student manual, and Operating and Maintenance Manuals must be updated. Following correction and update, all corrected and updated training documentation must be distributed immediately to all participants who have completed the course. Similarly, any updated Operating and Maintenance Manuals must be resubmitted to the City in accordance with Section 9 *[Operating and Maintenance Manual]*.

(e) Design-Builder must deliver a complete set of instructors' guides, presentation materials, assessment guides and materials, and training aids to each training course session and a set of complete student materials for each participant enrolled in each training class.

8.4 Instructional Aids

Design-Builder must provide appropriate instructional aides to support the formal instruction carried out at each training session. The suitability of these aids will be assessed and agreed by the City following their use at a designated pilot course. The following instructional aids must be provided to support formal instruction:

(a) audio-visual aids such as handouts, transparencies, slides, videos, simulators;

(b) supplemental materials, which provide a functional mock-up or a functional representation. This will be required of any Equipment which requires theoretical discussion. This may be in the form of an animated schematic, a model of the equipment, an interactive video training device or the like. Any such mock-ups that are not actual items of supplied equipment will become the property of the City upon Construction Completion; and

(c) working Equipment. For the duration of the training period and until Final Completion, Design-Builder must provide, for the purposes of supporting formal instruction, a facility that contains a fully functional mock-up of the Equipment for which training is being provided.

8.5 Training Courses

(a) Design-Builder must ensure that the training courses meet the following requirements:

(i) Training courses must provide instruction in the theory, operation and Maintenance of the Infrastructure and related subsystems. This must include all of the hardware and software supplied as part of the Infrastructure. Separate training courses must be provided for both operations and Maintenance, although each course must include relevant overviews.

(ii) Design-Builder must provide separate training sessions, to enable the City personnel who work in shifts to participate in the courses. Design-Builder will be required to co-ordinate with the City in order to agree upon the exact number of each session.

(iii) Each training session must not train more than eight (8) persons and the duration of each course "day" must not exceed eight (8) hours.

(iv) Allowance must be made for sessions in each of the shift periods worked by City personnel.

(v) Each operations training course must include detailed reviews of product operating manuals and must include product operating demonstrations, all in sufficient detail to enable the City to operate the Infrastructure to its full potential.

(vi) Each Maintenance training course must include detailed reviews of product maintenance manuals and accompanying documentation and must cover materials in enough detail so that the City's Maintenance personnel can fully maintain the Infrastructure in all respects.

(vii) Maintenance training must provide City personnel with a full understanding of the function and operation, as well as maintenance requirements, of all components. It will include a review of the drawings and electrical schematics cover all scheduled inspection and lubrication requirements, adjustments and/or calibrations, detailed troubleshooting and diagnostic tools, component removal and installation.

(viii) Maintenance training must provide practical knowledge and must facilitate competence in the type of product being trained upon.

(ix) All training courses provided must use a combination of classroom and hands-on instruction. The instructors must tailor the course for the attending audience.

(x) All training courses must employ the use of actual assets or mock ups in order to facilitate hands-on instruction thereby ensuring that course participants further appreciate and build upon key concepts presented by formal instruction.

(xi) All Maintenance courses must cover Equipment installation, operation, interfaces and cabling/piping between Equipment, preventive Maintenance, diagnostics procedures, and corrective maintenance and expansion procedures. Course participants must operate actual Equipment, run all applicable diagnostic software and, perform hands-on diagnosis and repair of simulated failures on actual Equipment.

(xii) The communications network training must enable the City's operation and maintenance groups to be familiar with the communication network and have an in- depth working knowledge of all associated external interfaces, devices and alarms. Instruction will also include procedures to take in the event of radio frequency interference, fibre cable cut, Equipment failure, alarm, or the like.

(b) Design-Builder must provide one pilot course for each training course which must meet the following requirements:

(i) The pilot course must be presented at least ten Business Days prior to the first scheduled training course in that area of instruction.

(ii) The pilot course must be presented by the course instructor who will be teaching the actual course using full course materials and aids.

(iii) The pilot course will be attended by a small number of City personnel who will evaluate the course and recommend changes to be incorporated prior to providing further training.

(c) All training courses must include both written and practical tests, as appropriate, as a measuring device to determine adequate transfer of knowledge. Specifically:

(i) Tests must be appropriate for the intended audience and must have been validated in the corresponding pilot course or by some other means agreed to by the City.

(ii) Whenever possible, a practical hands-on test must be developed to demonstrate the successful transfer of operational and mechanical skills. Where appropriate, practical assignments may be employed for the purpose of testing that design concepts have been learned.

(iii) Records of test results must be kept and submitted to the City after each training session. These records must identify individual students and measure their success in meeting the training objectives for each course.

9. OPERATING AND MAINTENANCE MANUALS

9.1 General

(a) Design-Builder must develop and submit, in accordance with Schedule 2 *[Submittal Review Procedure]*, a comprehensive, and specific for the Project, installation, operation and maintenance manual (the "**Operating and Maintenance Manual**") for the Infrastructure, including each subsystem. Unless otherwise specified in this Agreement, the Operating and Maintenance Manual must be developed in accordance with the City's "Standard Record Documents Guideline for High Floor LRT Projects" (May 20, 2020), available as Disclosed Data and cover all Equipment supplied as part of the Project Work and, with the agreement of the City, may be split into manageable sized, logical multiple volumes where appropriate.

(b) The Operating and Maintenance Manual must be entirely in Canadian English using the Crystal Mark Accreditation standard, must give comprehensive descriptions and illustrations of each and every system's operating layouts and must include, without limitation, such items as operation, overhaul, adjustments, maintenance, recommended maintenance schedule, component removal and replacement, part numbers, operating voltage and other pertinent information.

(c) The Operating and Maintenance Manual must have sufficient detail in order that the City can fully maintain the Infrastructure, including all Equipment, in proper working order without the assistance of Design-Builder or any other external parties. The manual must include all pertinent software and hardware documentation.

(d) Design-Builder must submit drafts of the Operating and Maintenance Manual in accordance with all draft submission requirements set out in the City of Edmonton Standard Record Documents Guideline for High Floor LRT Projects.

(e) Design-Builder must incorporate revisions from training sessions into final copies of the Operating and Maintenance Manual already in the possession of the City. These revisions must be in the form of the requisite number of replacement pages and must be transmitted to the City.

(f) Separate sets of Operating and Maintenance Manuals must be provided for each of the following:

(i) The Llew Lawrence OMF; and

(ii) The mainline extension of the Capital Line included all structures, stations, utility complexes, track and systems.

(g) Five hard copies of the final Operating and Maintenance Manuals for each of the sets identified in Section 9.1 *[General]* must be provided by Design-Builder to the City, in addition to the electronic copies required in the the City's "Standard Record Documents Guideline for High Floor LRT Projects" (May 20, 2020), available as Disclosed Data.

(h) Design-Builder must develop and submit a Maintenance plan (the "**Maintenance Concept**") as part of the Operating and Maintenance Manual taking the following into consideration:

(i) It is assumed that troubleshooting and repair must be performed by an individual who possesses as a minimum the knowledge of a journeyman from the relevant discipline (e.g. electrical), licensed in the Province of Alberta.

(ii) Spare Parts recommended by Design-Builder as per the Spare Parts List defined in Section 5.5.10.4 *[Spare Parts]* of this Schedule, and Section 1-9 [*Spare Parts] of Schedule 5 [D &C Requirements]* will be available.

(iii) Maintenance will be performed at three discrete levels: on-line, off-line, and bench.

(A) on-line Maintenance is performed on an in-place and operational Equipment element. Test points or built-in indicators must facilitate identification of interfaces with other system elements. On-line maintenance must not disrupt service;

(B) off-line Maintenance is performed on in-place but out-of-service Equipment elements; and

(C) bench maintenance is performed on out-of-place and service Equipment elements. This Maintenance is to be performed in a shop area where standard test equipment and fixtures are available. Test equipment and procedures must allow maintenance to the lowest line replaceable unit part level.

(iv) The Maintenance Concept must define the repair, corrective, and preventive Maintenance program plans, policies, and support requirements for all Equipment supplied under this Project. It must:

(A) minimize each level of Maintenance consistent with the specification requirements and system RAM requirements defined in Section 5 *[System and Safety Assurance]*;

(B) include by design simple access arrangements to carry out maintenance safely without affecting service or causing inconvenience to passengers;

(C) recommend policies and practices which include a schedule of planned preventative maintenance inspections to determine the condition of any asset, carry out any adjustments required and replacement of any worn parts before failure. Where possible, maintenance practices must include recording of wear and/or cycles of use to assess the performance of line replaceable units against the specification requirements and system RAM requirements defined in Section 5 [*System and Safety Assurance*] and predict the actual life to allow for any changes in reliability arising as asset ages and due to differences in usage and environmental conditions; and

(D) recommend policies and practices which ensure that, at the time of a failure, qualified maintenance personnel will be promptly notified and will have the necessary documentation, tools, test equipment, and Spare Parts to affect the repair in a minimum of time and carry out diagnostics to determine how to avoid any future significant failures.

(v) The Maintenance Concept must develop recommendations for:

(A) depth and frequency of maintenance requirements at each level;

(B) facilities required;

(C) support Equipment and tools required;

(D) skill levels and numbers of personnel required;

(E) subsystem, component, and piece part repair policy; and

(F) detailed fault isolation and troubleshooting procedures, diagnostic equipment, and special test equipment.

9.2 Standard Operating Procedures and Operating Rule Book

Design-Builder acknowledges that the Project will adopt the Capital Line LRT's existing Standard Operating Procedures and Operating Rule Book (the "**Operating Rule Book**") included as Disclosed Data. Design-Builder must identify and communicate any proposed revisions to the Standard Operating Procedures or Operating Rule Book that are required due to different LRT technology to the City 180 days prior to the Integrated Testing and Commissioning Readiness Date.

10. NON-PERFORMANCE EVENTS

Failure by Design-Builder to comply with the obligations set forth in this Schedule 4 *[Design and Construction Protocols]* may constitute Non-Performance Events and may result in adjustments to the Payments, as more particularly provided in Schedule 16 *[Payment Mechanism]*.

Appendix 4A - WORK BREAKDOWN STRUCTURE

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 0	Construction			
Level 1	Utilities	Utilities		
Level 2	Utility Relocations & Protection	Utilities	N/A	
Level 2	New Utility Services (Water, Natural Gas, Power)	Utilities	N/A	
Level 3	New Utility Services - Twin Brooks Station		[15.00%]	%
Level 3	New Utility Services - Heritage Valley North Station		[15.00%]	%
Level 3	New Utility Services - Utility Complex Building #1 – Twin Brooks		[15.00%]	%
Level 3	New Utility Services - Utility Complex Building #2 – Heritage Valley North		[15.00%]	%
Level 3	New Utility Services - Utility Complex Building #3 – OMF		[15.00%]	%
Level 3	New Utility Services - Traction Power Substation – AHD TUC		[15.00%]	%
Level 3	New Utility Services - ROW		[10.00%]	%
Level 1	Roadworks	Roadworks		
Level 2	Civil Drainage	Drainage		
Level 3	Storm Drainage and Sanitary Sewer		[70.00%]	LM
Level 3	Manholes		[20.00%]	EA
Level 3	Catch Basins		[10.00%]	EA
Level 2	Roadworks	Roadworks		
Level 3	Removal of existing structures, stripping		[7.00%]	M2
Level 3	Excavation, Backfill and Subgrade Prep		[13.00%]	M2
Level 3	Granular Base		[11.00%]	M2
Level 3	Asphalt		[34.00%]	M2
Level 3	Concrete curb and gutter, sidewalk and bus pads		[23.00%]	M2
Level 3	Shared Use Path (SUP)		[9.00%]	M2
Level 3	Tree Removal		[1%]	%
Level 3	Traffic Signals Infrastructure		[2.00%]	%
Level 1	Heritage Valley Storm Pond Expansion	Heritage Valley Storm Pond Expansion		
Level 2	Heritage Valley Storm Pond Expansion	Heritage Valley Storm Pond Expansion		
Level 3	Earthworks		[50.00%]	%

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Outlet Relocation		[35.00%]	%
Level 3	Shared Use Path (SUP)		[5.00%]	%
Level 3	Landscaping		[9.00%]	%
Level 3	Site Furniture / Accessories		[1.00%]	%
Level 1	Street Lighting	Streetlighting		
Level 2	Street Lighting	Streetlighting		
Level 3	Street Lighting		[100.00%]	EA
Level 1	Structures	Structures		
Level 2	Retaining Walls	Structures #1		
Level 3	Retaining Walls		[100.00%]	M2
Level 2	23 Avenue Underpass	Structures #1		
Level 3	Removal of existing structures, pavement		[5.00%]	%
Level 3	Underpass Excavation		[15.00%]	M3
Level 3	Underpass Protection and Support		[15.00%]	%
Level 3	Reinforcing Steel Delivery		[0.80%]	%
Level 3	Reinforcing Steel Installation		[1.20%]	%
Level 3	Concrete - Retaining Wall (Portals)		[19.00%]	M3
Level 3	Concrete - Underpass		[19.00%]	M3
Level 3	Backfill - Underpass and Embankment		[10.00%]	M3
Level 3	Drilling and Grouting		[2.00%]	%
Level 3	Drainage		[5.00%]	%
Level 3	Asphalt Pavement		[7.5%]	M2
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%
Level 2	Blackmud Creek LRT Bridge	Structures #2		
Level 3	Piling		[10.00%]	M
Level 3	Reinforcing Steel Delivery		[1.20%]	%
Level 3	Reinforcing Steel Installation		[1.80%]	%
Level 3	Abutments		[11.00%]	M3
Level 3	Piers		[9.00%]	M3
Level 3	Deck		[13.00%]	M2
Level 3	Shared Use Path (SUP)		[2.00%]	M2

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Barriers and Parapets		[5.00%]	M3
Level 3	Transition Slabs		[5.00%]	M2
Level 3	Slope Paving		[3.00%]	M2
Level 3	Girders and Bracing Delivery		[16.90%]	%
Level 3	Girders and Bracing Installation		[9.10%]	%
Level 3	Railings		[7.50%]	M
Level 3	Expansion Joints		[2.00%]	M
Level 3	Bearings		[2.00%]	EA
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%
Level 2	111 Street Bridge Widening	Structures #1		
Level 3	Deck and Barrier Removal		[15.00%]	M2
Level 3	Approach and Roof Slab Removal		[20.00%]	M2
Level 3	Approach and Roof Slab Replacement		[30.00%]	M2
Level 3	Deck and Barrier Replacement		[25.00%]	M2
Level 3	Deck Surfacing		[9.50%]	M2
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%
Level 2	Anthony Henday Drive LRT Bridge	Structures #2		
Level 3	Earthworks		[1.30%]	M3
Level 3	Piling		[2.00%]	M
Level 3	Reinforcing Steel Delivery		[1.60%]	%
Level 3	Reinforcing Steel Installation		[2.40%]	%
Level 3	Abutments		[3.00%]	M3
Level 3	Piers		[3.00%]	M3
Level 3	Transition Slabs		[5.00%]	M2
Level 3	Deck - Jump Spans		[11.00%]	M3
Level 3	Deck - Arch Spans		[14.00%]	M3
Level 3	Slope Paving		[1.00%]	M2
Level 3	Girders and Bracing Delivery		[10.40%]	%
Level 3	Girders and Bracing Installation		[5.60%]	%
Level 3	Arches and Bracing Delivery		[19.80%]	%
Level 3	Arches and Bracing Installation		[16.20%]	%

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Railings		[1.50%]	M
Level 3	Expansion Joints		[0.50%]	M
Level 3	Bearings		[0.20%]	EA
Level 3	Bridge Deck Waterproofing		[1.00%]	M2
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%
Level 1	Stations	Stations		
Level 2	Twin Brooks Station	Twin Brooks Station		
Level 3	Earthworks		[5.00%]	%
Level 3	Piles		[10.00%]	%
Level 3	Reinforcing Steel Delivery		[0.40%]	%
Level 3	Reinforcing Steel Installation		[1.60%]	%
Level 3	GB / Foundations		[14.00%]	%
Level 3	Slabs / Platform		[14.00%]	%
Level 3	Structural / Misc. / Stainless Steel Delivery		[6.00%]	%
Level 3	Structural / Misc. / Stainless Steel Installation		[9.00%]	%
Level 3	Columns, Canopy Structural Delivery		[1.00%]	%
Level 3	Columns, Canopy Structural Installation		[4.00%]	%
Level 3	Shelters		[3.00%]	EA
Level 3	Canopy		[10.00%]	%
Level 3	Accessories / Benches		[1.00%]	%
Level 3	Wayfinding, Signage, and Visual Displays		[1.00%]	%
Level 3	Mechanical Plumbing / HVAC / Controls		[5.00%]	%
Level 3	Electrical / Communications / Security		[15.00%]	%
Level 2	Heritage Valley North Station	Heritage Valley North Station		
Level 3	Earthworks		[5.00%]	%
Level 3	Piles		[8.00%]	%
Level 3	Reinforcing Steel Delivery		[0.40%]	%
Level 3	Reinforcing Steel Installation		[1.60%]	%
Level 3	GB / Foundations		[11.00%]	%
Level 3	Slabs / Platform		[11.00%]	%

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Structural / Misc. / Stainless Steel Delivery		[4.80%]	%
Level 3	Structural / Misc. / Stainless Steel Installation		[7.20%]	%
Level 3	Columns, Canopy Structural Delivery		[1.00%]	%
Level 3	Columns, Canopy Structural Installation		[4.00%]	%
Level 3	Exterior Walls		[3.00%]	%
Level 3	Shelters		[3.00%]	EA
Level 3	Canopy		[10.00%]	%
Level 3	Windows / Entrances / Automatic Doors		[1.00%]	%
Level 3	Flooring		[1.00%]	%
Level 3	Painting / Coatings		[1.00%]	%
Level 3	Accessories / Benches		[1.00%]	%
Level 3	Wayfinding, Signage, and Visual Displays		[1.00%]	%
Level 3	Mechanical Plumbing / HVAC / Fire Protection / Controls		[10.00%]	%
Level 3	Electrical / Communications / Security / Fire Alarm		[15.00%]	%
Level 1	Landscaping	Landscaping		
Level 2	New Trees	Landscaping		
Level 3	New Trees		[100.00%]	EA
Level 2	Shrubs and beds	Landscaping		
Level 3	Shrubs and beds		[100.00%]	M2
Level 2	Topsoil, Sod or Seeding	Landscaping		
Level 3	Topsoil, Sod or Seeding		[100.00%]	M2
Level 2	Fencing	Landscaping		
Level 3	Fencing		[100.00%]	LM
Level 2	Blackmud Creek Naturalization	Landscaping		
Level 3	Blackmud Creek Naturalization		[100.00%]	M2
Level 1	System Structures	System Structures		
Level 2	Ductbanks	System Structures		
Level 3	Systems Ductbank		[30.00%]	LM
Level 3	Traction Power Ductbank		[30.00%]	LM
Level 3	Utility Power		[10.00%]	LM

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	LRT ROW Electrical		[30.00%]	LM
Level 2	Foundations - OCS	System Structures		
Level 3	Foundations - OCS		[100.00%]	EA
Level 2	Foundations - Signaling Equipment	System Structures		
Level 3	Foundations - Signaling Equipment		[100.00%]	EA
Level 2	Utility Complex Building #1 – Twin Brooks	Utility Complex Building		
Level 3	Clearing, Earthwork, Grading		[2.00%]	%
Level 3	Perimeter Wall Foundations		[16.00%]	%
Level 3	Perimeter Walls		[18.00%]	%
Level 3	Underground Ductbanks and Conduits		[15.00%]	%
Level 3	Interior Partition Walls		[2.00%]	%
Level 3	Roof Framing		[9.00%]	%
Level 3	Roofing		[2.00%]	%
Level 3	Flooring		[2.00%]	%
Level 3	Painting / Coatings		[1.00%]	%
Level 3	HMD / PSF / Hardware		[0.50%]	%
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%
Level 3	Mechanical Plumbing / HVAC / Fire Protection / Controls		[15.00%]	%
Level 3	Electrical / Communications / Security / Fire Alarm		[17.00%]	%
Level 2	Utility Complex Building #2 – Heritage Valley North	Utility Complex Building		
Level 3	Clearing, Earthwork, Grading		[2.00%]	%
Level 3	Perimeter Wall Foundations		[16.00%]	%
Level 3	Perimeter Walls		[18.00%]	%
Level 3	Underground Ductbanks and Conduits		[15.00%]	%
Level 3	Interior Partition Walls		[2.00%]	%
Level 3	Roof Framing		[9.00%]	%
Level 3	Roofing		[2.00%]	%
Level 3	Flooring		[2.00%]	%
Level 3	Painting / Coatings		[1.00%]	%
Level 3	HMD / PSF / Hardware		[0.50%]	%

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%
Level 3	Mechanical Plumbing / HVAC / Fire Protection / Controls		[15.00%]	%
Level 3	Electrical / Communications / Security / Fire Alarm		[17.00%]	%
Level 2	Utility Complex Building #3 - OMF	Utility Complex Building		
Level 3	Clearing, Earthwork, Grading		[2.00%]	%
Level 3	Perimeter Wall Foundations		[16.00%]	%
Level 3	Perimeter Walls		[18.00%]	%
Level 3	Underground Ductbanks and Conduits		[15.00%]	%
Level 3	Interior Partition Walls		[2.00%]	%
Level 3	Roof Framing		[9.00%]	%
Level 3	Roofing		[2.00%]	%
Level 3	Flooring		[2.00%]	%
Level 3	Painting / Coatings		[1.00%]	%
Level 3	HMD / PSF / Hardware		[0.50%]	%
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%
Level 3	Mechanical Plumbing / HVAC / Fire Protection / Controls		[15.00%]	%
Level 3	Electrical / Communications / Security / Fire Alarm		[17.00%]	%
Level 2	Traction Power Substation (TPSS) – AHD TUC	Traction Power Substation (TPSS)		
Level 3	Clearing, Earthwork, Grading		[2.00%]	%
Level 3	Perimeter Wall Foundations		[16.00%]	%
Level 3	Perimeter Walls		[18.00%]	%
Level 3	Underground Ductbanks and Conduits		[15.00%]	%
Level 3	Interior Partition Walls		[2.00%]	%
Level 3	Roof Framing		[9.00%]	%
Level 3	Roofing		[2.00%]	%
Level 3	Flooring		[2.00%]	%
Level 3	Painting / Coatings		[1.00%]	%
Level 3	HMD / PSF / Hardware		[0.50%]	%
Level 3	Wayfinding, Signage, and Visual Displays		[0.50%]	%

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Mechanical Plumbing / HVAC / Fire Protection / Controls		[15.00%]	%
Level 3	Electrical / Communications / Security / Fire Alarm		[17.00%]	%
Level 1	Mainline Trackwork	Mainline Trackwork		
Level 2	Track Drainage	Drainage		
Level 3	Subdrains		[100.00%]	LM
Level 2	Track Bed	Mainline Trackwork		
Level 3	Site Grading		[30.00%]	M3
Level 3	Subgrade Stabilization		[20.00%]	M2
Level 3	Ballast		[50.00%]	M3
Level 2	Tie-and-Ballast Track	Mainline Trackwork		
Level 3	Rail Delivery		[45.00%]	LM
Level 3	Rail Welding		[15.00%]	EA
Level 3	Tie-and-Ballast Track Installation		[50.00%]	LM
Level 2	Direct Fixation Track	Mainline Trackwork		
Level 3	Rail Delivery		[40.00%]	LM
Level 3	Rail Welding		[10.00%]	EA
Level 3	Direct Fixation Track Installation		[50.00%]	LM
Level 2	At Grade Crossings	Mainline Trackwork		
Level 3	At Grade Crossings		[100.00%]	LM
Level 2	Special Trackwork	Mainline Trackwork		
Level 3	Turnout Delivery		[35.00%]	EA
Level 3	Turnout Installation		[30.00%]	EA
Level 3	Diamond Delivery		[15.00%]	EA
Level 3	Diamond Installation		[10.00%]	EA
Level 3	Friction Bumper Delivery		[5.00%]	EA
Level 3	Friction Bumper Installation		[5.00%]	EA
Level 1	ROW Electrical	ROW Electrical		
Level 2	ROW Electrical	ROW Electrical		
Level 3	ROW Electrical		[100.00%]	%
Level 1	Mainline Power Supply and Distribution	Mainline Power Supply and Distribution		

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 2	Traction Power TPSS	Mainline Power Supply and Distribution		
Level 3	TPSS Equipment Delivery		[26.00%]	%
Level 3	TPSS Equipment Installation		[39.00%]	%
Level 3	TPSS DC Cable Delivery		[3.00%]	%
Level 3	TPSS DC Cable Installation		[12.00%]	%
Level 3	TPSS HV Cable Delivery		[2.40%]	%
Level 3	TPSS HV Cable Installation		[9.60%]	%
Level 3	TPSS LV Cable Delivery		[1.60%]	%
Level 3	TPSS LV Cable Installation		[6.40%]	%
Level 2	Traction Power SCADA	Mainline Power Supply and Distribution		
Level 3	Traction Power SCADA		[100.00%]	%
Level 2	TPSS Transfer Trip	Mainline Power Supply and Distribution		
Level 3	TPSS Transfer Trip		[100.00%]	%
Level 2	OCS	Mainline Power Supply and Distribution		
Level 3	Pole Delivery		[10.20%]	EA
Level 3	Pole Installation		[15.30%]	EA
Level 3	Hardware Delivery		[18.00%]	EA
Level 3	Hardware Installation		[27.00%]	EA
Level 3	Wiring Delivery		[10.90%]	EA
Level 3	Wiring Installation		[16.35%]	Tensioning Section
Level 3	Final setting		[2.25%]	Tensioning Section
Level 1	Mainline Signaling and Train Control	Mainline Signaling and Train Control		
Level 2	Mainline Signaling and Train Control	Mainline Signaling and Train Control		
Level 3	Signaling System		85.00%	%
Level 3	Centralized Train Control System		15.00%	%
Level 1	Communications Systems	Communications Systems		
Level 2	Communications Systems	Communications Systems		
Level 3	Communications Infrastructure		50.00%	%

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Telephony		3.00%	%
Level 3	Radio		3.00%	%
Level 3	CCTV		25.00%	%
Level 3	Public Address		4.00%	%
Level 3	Variable Message System		5.00%	%
Level 3	Fare Collection		1.00%	%
Level 3	WIFI		7.00%	%
Level 3	City TV Screens		1.00%	%
Level 3	Corporate Advertising Screens		1.00%	%
Level 1	Integrated Systems Testing and Commissioning	Integrated Systems Testing and Commissioning		
Level 2	Integrated Systems Testing and Commissioning	Integrated Systems Testing and Commissioning		
Level 3	Static SIT Testing		[50.00%]	%
Level 3	Dynamic SIT Testing		[30.00%]	%
Level 3	Integration Testing using LRVs		[20.00%]	%
Level 1	Llew Lawrence Operations and Maintenance Facility (OMF)	Operations and Maintenance Facility (OMF)		
Level 2	Track Structure	OMF – Site Track		
Level 3	Site Grading		[30.00%]	M3
Level 3	Subgrade Stabilization		[20.00%]	M2
Level 3	Ballast		[50.00%]	M3
Level 2	Yard and Track Works	OMF – Site Track		
Level 3	Rail Delivery		[45.00%]	LM
Level 3	Rail Welding		[10.00%]	EA
Level 3	Ballast Track Installation		[10.00%]	LM
Level 3	Direct Fixation Track Installation		[5.00%]	LM
Level 3	Embedded Track Installation		[5.00%]	LM
Level 3	Special Track Installation		[22.50%]	EA
Level 3	Other Track Installation		[2.50%]	LM
Level 2	OMF Building and Equipment	OMF – Building and Equipment		

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Earthworks		[1.86%]	%
Level 3	Piles		[2.25%]	%
Level 3	Reinforcing Steel Delivery		[0.40%]	%
Level 3	Reinforcing Steel Installation		[1.60%]	%
Level 3	GB / Foundations		[2.53%]	%
Level 3	Structural Slab		[10.89%]	%
Level 3	Masonry		[1.51%]	%
Level 3	Structural Steel Delivery		[5.18%]	%
Level 3	Structural Steel Installation		[7.78%]	%
Level 3	Millwork		[0.04%]	%
Level 3	Exterior Walls		[8.17%]	%
Level 3	Standing Seam Roof		[1.93%]	%
Level 3	TPO Roof		[2.37%]	%
Level 3	AV / Firestopping		[0.38%]	%
Level 3	HMD / PSF / Hardware		[0.45%]	%
Level 3	Folding Doors / Overhead Doors / Fire Shutters		[0.65%]	%
Level 3	Aluminum Windows / Entrances / Automatic Doors		[0.87%]	%
Level 3	Drywall / Ceilings / FRP Panels		[0.54%]	%
Level 3	Flooring		[0.21%]	%
Level 3	Painting / Coatings		[0.60%]	%
Level 3	Toilet Partitions / Washroom Accessories / Corner Guards		[0.09%]	%
Level 3	Elevator Delivery		[0.45%]	%
Level 3	Elevator Installation		[0.68%]	%
Level 3	Cranes and Dock Equipment		[0.36%]	%
Level 3	Wayfinding, Signage, and Visual Displays		[0.05%]	%
Level 3	Mechanical Plumbing / HVAC / Fire Protection / Controls		[18.06%]	%
Level 3	Electrical / Communications / Security / Fire Alarm		[17.40%]	%
Level 3	LRV Equipment		[11.70%]	%
Level 3	Facility Commissioning		[1.00%]	%
Level 2	Retaining Walls	OMF – Retaining Walls		

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Retaining Walls		[100.00%]	M2
Level 2	Roadways	OMF – Roadways		
Level 3	Removal of existing structures, stripping		[13.00%]	M2
Level 3	Excavation, Backfill and Subgrade Prep		[15.00%]	M2
Level 3	Granular Base		[18.00%]	M2
Level 3	Asphalt		[36.00%]	M2
Level 3	Concrete curb and gutter, sidewalk and bus pads		[17.00%]	M2
Level 3	Tree Removal		[1%]	%
Level 2	Civil Drainage	OMF – Drainage		
Level 3	Storm Drainage and Sanitary Sewer		[60.00%]	LM
Level 3	Manholes		[15.00%]	EA
Level 3	Catch Basins		[8.00%]	EA
Level 3	Lift Station for Sanitary		[17.00%]	%
Level 2	Utilities	OMF - Utilities		
Level 3	Water Mains and Service Connections		[10.00%]	LM
Level 3	Natural Gas Feeds		[15.00%]	EA
Level 3	Power Feeds		[75.00%]	EA
Level 2	Landscaping	OMF - Landscaping		
Level 3	New Trees		[35.00%]	EA
Level 3	Shrubs and beds (incl tree beds)		[20.00%]	M2
Level 3	Topsoil, Sod or Seeding		[30.00%]	M2
Level 3	Fencing		[15.00%]	LM
Level 2	OCS Foundations	OMF – OCS Foundations		
Level 3	OCS Foundations		[100.00%]	EA
Level 2	OCS	OMF - OCS		
Level 3	Pole Delivery		[10.20%]	EA
Level 3	Pole Installation		[15.30%]	EA
Level 3	Hardware Delivery		[18.00%]	EA
Level 3	Hardware Installation		[27.00%]	EA
Level 3	Wiring Delivery		[10.90%]	EA

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 3	Wiring Installation		[16.35%]	Tensioning Section
Level 3	Final setting		[2.25%]	Tensioning Section
Level 2	Duct Bank	OMF – Duct Bank		
Level 3	Systems Ductbank		[30.00%]	LM
Level 3	Traction Power Ductbank		[30.00%]	LM
Level 3	Utility Power		[10.00%]	LM
Level 3	LRT ROW Electrical		[30.00%]	LM
Level 2	Integrated Systems Testing and Commissioning	OMF – Integration Systems Testing and Commissioning		
Level 3	Static SIT Testing		[50.00%]	%
Level 3	Dynamic SIT Testing		[30.00%]	%
Level 3	Integration Testing using LRVs		[20.00%]	%
Level 1	Public Art	Public Art		
Level 2	Public Art Installation	Public Art		
Level 3	Public Art Installation		[100.00%]	%
Level 0	Design-Builder Management, Engineering, Overhead (Indirect Costs)		N/A	
Level 1	Project Management	Project Management	N/A	
Level 1	Design / Engineering	Design/Engineering	N/A	
Level 2	Utilities	Utilities	N/A	
Level 2	Roadworks	Roadworks	N/A	
Level 2	Drainage	Drainage	N/A	
Level 2	Heritage Valley Storm Pond Expansion	Heritage Valley Storm Pond Expansion	N/A	
Level 2	Streetlighting	Streetlighting	N/A	
Level 2	Structures #1	Structures #1	N/A	
Level 2	Structures #2	Structures #2	N/A	
Level 2	Twin Brooks Station	Twin Brooks Station	N/A	
Level 2	Heritage Valley North Station	Heritage Valley North Station	N/A	
Level 2	Landscaping	Landscaping	N/A	
Level 2	System Structures	System Structures	N/A	
Level 2	Utility Complex Building	Utility Complex Building	N/A	

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 2	Traction Power Substation (TPSS)	Traction Power Substation (TPSS)	N/A	
Level 2	Mainline Trackwork	Mainline Trackwork	N/A	
Level 2	ROW Electrical	ROW Electrical	N/A	
Level 2	Mainline Power Supply and Distribution	Mainline Power Supply and Distribution	N/A	
Level 2	Mainline Signaling and Train Control	Mainline Signaling and Train Control	N/A	
Level 2	Communications Systems	Communications Systems	N/A	
Level 2	Stray Current, EMI, Noise Vibration Mitigation	Stray Current, EMI, Noise, Vibration Mitigation	N/A	
Level 2	Integrated Systems Testing and Commissioning	Integrated Systems Testing and Commissioning	N/A	
Level 2	Operations and Maintenance Facility (OMF)	Operation and Maintenance Facility (OMF)	N/A	
Level 2	OMF - Integrated Systems Testing and Commissioning	OMF - Integrated Systems Testing and Commissioning	N/A	
Level 2	OMF - Site Track	OMF - Site Track	N/A	
Level 2	OMF - Building and Equipment	OMF - Building and Equipment	N/A	
Level 2	OMF - Retaining Walls	OMF - Retaining Walls	N/A	
Level 2	OMF - Roadways	OMF - Roadways	N/A	
Level 2	OMF - Drainage	OMF - Drainage	N/A	
Level 2	OMF - Utilities	OMF - Utilities	N/A	
Level 2	OMF - Landscaping	OMF - Landscaping	N/A	
Level 2	OMF - OCS Foundations	OMF - OCS Foundations	N/A	
Level 2	OMF - OCS	OMF - OCS	N/A	
Level 2	OMF - Duct Bank	OMF - Duct Bank	N/A	
Level 1	Construction Management	Construction Management	N/A	
Level 2	General Requirements and Supervision	Construction Management	N/A	
Level 2	Site Preparation, Mobilization and De-mobilization	Construction Management	N/A	
Level 2	Environmental Controls and Mitigations	Construction Management	N/A	
Level 2	Temporary Roadworks, Lighting, Signals	Construction Management	N/A	

Level	Name	WBS Discipline	% for Level 3	Indicative Unit of Measure
Level 2	Stray Current, EMI, Noise Vibration Mitigations	Construction Management	N/A	
Level 1	Public Art Coordination	Public Art Coordination	N/A	
Level 1	Communications and Public Engagement	Communications and Public Engagement	N/A	
Level 1	Offices	Offices	N/A	
Level 1	Proposal Phase Costs	Proposal Phase Costs	N/A	
Total	**Total Capital Cost Amount**			

Appendix 4B - CERTIFICATE FORMS

CONTENTS

Form of:

1. Road Safety Audit Certificate
2. Project Safety & Security Certificate
3. Certification for Design and Commitment for Field Review
4. Construction Certificate - Assurance Of Professional Review And Compliance
5. Checking Team Design Certificate
6. Commissioning Certificate
7. Assurance of Design Coordination Certificate

ROAD SAFETY AUDIT CERTIFICATE

GENERAL INFORMATION

Date: _____

To: The City of Edmonton

Re: [Detailed Design OR In-Service] Road Safety Audit Certificate for the following project:
Capital Line South LRT Extension

Form of Certificate for certifying that a [Detailed Design OR In-Service] Road Safety Audit has been carried out in accordance with the Project Requirements.

CERTIFICATE

In this Certificate, capitalized terms have the meaning set out in the Design-Build Agreement between The City of Edmonton and Capital Line Design-Build Ltd. dated May 31, 2024 (the "***Agreement***").

I certify that the Final Design of [_____]
insert applicable road segment(s)

has been the subject of a Road Safety Audit in accordance with Section 5.8 *[Road Safety Audits]* of Schedule 4 *[Design and Construction Protocols]*, the Design Management Plan, the Design Quality Management Plan and all other relevant provisions of the Agreement. The Independent Road Safety Auditor's report and statement certifying that the Detailed Design Road Safety Audit has been carried out are attached.

OR

I certify that all Roadways constructed as part of this project have been the subject of an In-Service Road Safety Audit in accordance with Section 5.8 [*Road Safety Audits*] of Schedule 4 [*Design and Construction Protocols*] and all other relevant provisions of the Agreement. The In-Service Road Safety Audit Report and statement certifying that the In-Service Road Safety Audit has been carried out are attached.]

Signed: _____
Independent Road Safety Auditor Name: _____
Title: _____
Date: _____
Address: _____

(Affix Professional Seal In Space Above)

PROJECT SAFETY & SECURITY CERTIFICATE

GENERAL INFORMATION

Date: _____

To: The City of Edmonton

Re: Project Safety & Security Certificate for the following project:
Capital Line South LRT Extension

CERTIFICATE

In this Certificate, capitalized terms have the meaning set out in the Design-Build Agreement between The City of Edmonton and Capital Line Design-Build Ltd. dated May 31, 2024 (the "***Agreement***").

The undersigned hereby gives assurance that all safety and security requirements have been successfully completed in accordance with the Safety and Security Certification Program and that the Infrastructure is certified for revenue service, subject only to the following noted restrictions:

RESTRICTIONS

Restrictions (List restrictions if any):

PROFESSIONAL ENGINEER

I certify that I am a registered professional engineer, and

I am a member of the firm _____ and I sign this Certificate on behalf of the firm

_____ _____
Print Name Date

_____ _____
Signature Initials Sample

_____
Address

_____
Address

_____
Phone (Affix Professional Seal in Space Above)

_____

CERTIFICATION FOR DESIGN AND COMMITMENT FOR FIELD REVIEW

GENERAL INFORMATION

Date: _____

To: The City of Edmonton

Re: Certification for Design and Commitment for Field Review for the following project:
Capital Line South LRT Extension

DESIGN SUBMISSION

Submission Number: _____

Submission Name: _____

Work Package: _____

Contents of Design Submission: _____

(See document / drawing list attached)

In this Certificate, capitalized terms have the meaning set out in the Design-Build Agreement between The City of Edmonton and Capital Line Design-Build Ltd. dated May 31, 2024 (the "***Agreement***").
I hereby give assurance that the Final Design of the:

- ☐ ARCHITECTURAL
- ☐ CIVIL
  - ☐ Road ☐ Drainage ☐ Utilities ☐Track
- ☐ ELECTRICAL
- ☐ GEOTECHNICAL
  - ☐ Temporary Work ☐ Permanent Work
- ☐ LANDSCAPING, NATIVE FOREST RESTORATION, AND NATURALIZATION
- ☐ MECHANICAL
- ☐ OTHER STRUCTURE
- ☐ SYSTEM INTEGRATION
- ☐ SYSTEMS
- ☐ TRACTION POWER
- ☐ TRAFFIC SIGNAL
- ☐ TRANSPORTATION STRUCTURE
- ☐ OTHER (SPECIFY): _____

components of the plans and supporting documents prepared by this registered professional for the Work Package _____, comply with the Project Requirements and the Applicable Laws.

Initials _____

The undersigned hereby undertakes to be responsible for field reviews of the above referenced components during Construction.

Initials _____

The undersigned also undertakes to notify the City in writing as soon as practical if the undersigned's contract for field reviews is terminated at any time prior to the Construction Completion Date.

REGISTERED PROFESSIONAL

I certify that I am a registered professional, and

I am a member of the firm _____ and I sign this Certificate on behalf of the firm

Print Name	Date
Signature	Initials Sample
Address	
Address	
Phone	(Affix Professional Seal in Space Above)

Note: The above letter must be signed by a registered professional, where a registered professional means a person who is registered or licensed to practice as a Professional Engineer under the Alberta Engineering and Geoscience Professions Act or as an architect under the Alberta Architects Act.

CONSTRUCTION CERTIFICATE

GENERAL INFORMATION

Date: _____

To: The City of Edmonton

Re: Construction Certificate for the following project:
Capital Line South LRT Extension

Submission Number: _____

Submission Name: _____

Work Package: _____

DESIGN / BUILD CERTIFICATION

In this Certificate, capitalized terms have the meaning set out in the Design-Build Agreement between The City of Edmonton and Capital Line Design-Build Ltd. dated May 31, 2024 (the "***Agreement***").
I hereby give assurance that the Construction of the:

☐ ARCHITECTURAL

☐ CIVIL

☐ Road ☐ Drainage ☐ Utilities ☐Track

☐ ELECTRICAL

☐ GEOTECHNICAL

☐ Temporary Work ☐ Permanent Work

☐ LANDSCAPING AND NATURALIZATION

☐ MECHANICAL

☐ OTHER STRUCTURE

☐ SYSTEM INTEGRATION

☐ SYSTEMS

☐ TRACTION POWER

☐ TRAFFIC SIGNAL

☐ TRANSPORTATION STRUCTURE

☐ OTHER (SPECIFY): _____

components of Work Package _____ have been:

(i) constructed in accordance with the applicable Final Design; and

(ii) completed in accordance with the applicable Project Requirements.

CONSTRUCTION CERTIFICATE

I certify that I am a registered professional, and I am a member of the firm _____ and I sign this Certificate on behalf of the firm.

Print Name	Date
Signature	Initials Sample
Address	
Address	
Phone	

(Affix Professional Seal in Space Above)

Note: The above must be signed by a registered professional, where a registered professional means a person who is registered or licensed to practice as a Professional Engineer under the Alberta Engineering and Geoscience Professions Act or as an architect under the Alberta Architects Act.

CHECKING TEAM DESIGN CERTIFICATE

GENERAL INFORMATION

Date: _____

To: The City of Edmonton

Re: Checking Team Design Certificate for the following project:
Capital Line South LRT Extension

Form of certificate to be used by the Checking Team for certifying the design of infrastructure forming part of, or to be incorporated into, the Infrastructure and requiring an independent check, in accordance with Schedule 4 *[Design and Construction Protocols]* to the Agreement.

CERTIFICATE

In this Certificate, capitalized terms have the meaning set out in the Design-Build Agreement between The City of Edmonton and Capital Line Design-Build Ltd. dated May 31, 2024 (the "***Agreement***").

I certify that the Checking Team has the requisite professional qualifications, skill and experience to perform an independent check of the Design Data referred to herein in accordance with the requirements of the Agreement.

I certify that the Checking Team has performed an independent check of the Design Data for Work Package _____ for *[Name of the design component and list all elements of the component included in the Design Data]* listed in the Schedule hereto *[and annexed]* and utilizing the standards of care, skill and diligence that, in accordance with the standards of our profession, are required of experienced professionals undertaking such an independent check, and that in our professional opinion the:

a) design, methodologies and assumptions are consistent with Good Industry Practice; and
b) said Design Data meets performance expectations outlined in the Agreement, including Design Submittal No. _____ dated _____, as amended by the following:

_____

_____

_____

Independent Checking Engineer

I certify that I am a registered professional engineer, and

I am a member of the firm _____ and I sign this Certificate on behalf of the firm and on behalf of the Checking Team

_____ _____
Print Name Date

_____ _____
Signature Initials Sample

_____
Address

_____
Address

_____
Phone

(Affix Professional Seal in Space Above)

COMMISSIONING CERTIFICATE

GENERAL INFORMATION

Date: _____

To: The City of Edmonton

Re: Commissioning Certificate for the following project:
Capital Line South LRT Extension

Submission Number: _____

Submission Name: _____

Indicate Work Package, or CLSE: _____

TESTING AND COMMISSIONING MANAGER CERTIFICATION

In this Certificate, capitalized terms have the meaning set out in the Design-Build Agreement between The City of Edmonton and Capital Line Design-Build Ltd. dated May 31, 2024 (the "***Agreement***").

I hereby give assurance that:

I have fulfilled my obligations for Testing and Commissioning as outlined in Section 2.2 *[Testing and Commissioning Manager]* of Schedule 6 *[Testing and Commissioning]* for:

☐ Work Package _____ Commissioning Certificate, certifying that all applicable equipment, components, systems and sub-systems, of the Work Package operate in accordance with the Project Requirements and are ready for, and have met the Commissioning requirements for, application for Commissioning Certificate in accordance with Section 2 *[Testing and Commissioning]* of Schedule 6 *[Testing and Commissioning]*; or

☐ Final Commissioning Certificate, certifying that all applicable equipment, components, systems and sub-systems, of the CLSE have met the Commissioning requirements in accordance with Section 2 [*Testing and Commissioning*] of Schedule 6 [*Testing and Commissioning*], and operate in accordance with the Project Requirements and are ready for application for Construction Completion.

I certify that I am a registered professional, and I am a member of the firm _____ and I sign this Certificate on behalf of the firm.

Print Name	Date
Signature	Initials Sample
Address	
Address	
Phone	

(Affix Professional Seal in Space Above))

ASSURANCE OF DESIGN COORDINATION CERTIFICATE

GENERAL INFORMATION

Date: _____

To: The City of Edmonton

Re: Assurance of Design Coordination for the following project:
Capital Line South LRT Extension

CERTIFICATE

In this Certificate, capitalized terms have the meaning set out in the Design-Build Agreement between The City of Edmonton and Capital Line Design-Build Ltd. dated May 31, 2024 (the "***Agreement***").

The undersigned hereby gives assurance that

- the Final Design of the Infrastructure has been appropriately coordinated;
- design of each element and Work Package has been effectively coordinated with every other element and Work Package; and
- sufficient inter-disciplinary review meetings have taken place;

in accordance with the Agreement the Design Management Plan, and the attached authenticated Integration Manager's final report.

PROFESSIONAL ENGINEER

I certify that I am a registered professional engineer

Print Name	Date
Signature	Initials Sample
Address	
Address	
Phone	(Affix Professional Seal in Space Above)

APPENDIX 4C - CONSTRUCTION JOINT COMMITTEE TERMS OF REFERENCE

MANDATE

The Construction Joint Committee (CJC) is established in accordance with the Design-Build Agreement.

The CJC provides a forum for the City Representative and its delegates (the "City"), and, Design-Builder Representative and its delegates ("Design-Builder") to consult and cooperate in all matters relating to the Capital Line South Extension, during the Construction Period. The CJC is the central point of communication between the City and Design-Builder and is the forum to which other sub-committees report.

The CJC is a joint committee and has no authority to amend the Design-Build Agreement.

MEETING SCHEDULE

The CJC must meet at least once monthly throughout the Construction Period and at other times as determined by the CJC.

DUTIES OF COMMITTEE

- Consult and cooperate in matters relating to the Project during the Construction Period;
- Appoint or delegate representatives to attend the Communications Working Group meetings to align project management, Design, and Construction and operations transition with public and stakeholder communications;
- Report on current status of Design (including Interim Design submissions), Environmental compliance, Quality, Construction, Safety, Testing and Commissioning, Relief Event, Limited Relief Event or Force Majeure Event status, Changes, Payments, Communications and Stakeholder Engagement, and other administrative issues;
- Review key points on the 90-day look-ahead schedule;
- Develop subcommittees as required, including the establishment of terms of reference, delegate authority in alignment with the Design-Build Agreement, and appoint members based on required experience and qualifications to achieve the objectives laid out in the Design-Build Agreement.

OUTCOMES/OUTPUTS

- To align the project management team comprised of City and Design-Builder key leadership staff, who will work collaboratively in the interests of the Project to execute a successful Project;
- A clear understanding of the activities, opportunities and impacts related to those activities and those accountable for the compliant execution;

- Identification and discussion of important risks and opportunities, as well as issues that may impact the Project and action plans to mitigate them;

- Record meeting minutes to document issues, key discussions and decisions made over the course of the Construction Period;

- Action items that guide implementation and measure progress of important tasks and activities arising from the meetings; and

- Create team relationship built on trust, healthy conflict, commitment, accountability and attention to results through open communication and mutual respect.

ORGANIZATION, ACCOUNTABILITY AND RESPONSIBILITIES

- **City Representation:**

  - City Representative - City Project Director (Chair)

  - City Technical Manager

  - City Commercial Manager

  - Owner's Engineer Project Manager

  - Management Support Team Lead/Project Controls Manager

- **Design-Builder Controls Manager (Co-Chair):**

  - Responsible for facilitating meeting, scheduling meeting, location and invites, development and issuance of agenda:

  - City Communications

  - Subject Matter Experts (as required)

- **Design-Builder Representation:**

  - Design-Builder Representative

  - Design Manager

  - Construction Manager

  - Communications Manager

  - Quality Manager

  - Integration Manager

  - SUI Leader

  - Utilities Manager

  - Other Key Individuals and Subject Matter Experts (as required)

- **Administration, as required or invited by the Committee:**

    - Responsible for meeting minutes and distribution of meeting discussion documents prior to the meeting (note: meeting minutes are the responsibility of the City unless otherwise agreed)

Appendix 4D - PROJECT SPECIFIC SUBMISSION REQUIREMENTS

1. INTERIM DESIGN REQUIREMENTS

The contents of the Interim Designs must contain an appropriate amount of information to allow for a multidisciplinary review of the Work Packages at the applicable level of design. Interim Designs for the same Work Package must be submitted at two distinct, reasonable levels of design (e.g. 50% and 75%). The requirements identified below for the Interim Designs are not meant to form an exhaustive list.

(a) for all Roadway Interim Designs:

(i) first Interim Design to be in accordance with the City Design & Construction Standards and include:

(A) roll plans with profiles drawn to scale of 1:500 horizontal and 1:100 vertical containing:

(I) Design criteria/standards/considerations (for example, design and posted speed, design vehicle and e-rate) for the existing and ultimate stages;

(II) Proposed access locations (including width and curve radii);

(III) Proposed turn bay locations and requirements (taper and bay lengths);

(IV) Horizontal and vertical alignment;

(V) Pedestrian and cyclist accessibility, curb ramps, and bus stop requirements;

(VI) Typical and non-typical road cross-sections showing lane width, sidewalks, shared-use path, streetlights, trees, utilities alignments, ditch, berms, noise attenuation, super elevation;

(VII) Pavement marking that indicates lane width and turn bay/taper requirements; and

(VIII) Existing accesses and infrastructure.

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design; and

(B) plans and profiles drawn to a scale of 1:500 horizontal and 1:100 vertical organized into:

(I) Alignment drawings (“A” plans) containing:

1) road, alley, shared-use path and sidewalk alignments;

2) trackway;

3) bus stop pads and walk connections;

4) alignments of immediately adjacent existing or proposed streets, walks, alleys, roads and ditches, interim access connections and alignment data; and

5) any other elements listed in City Design & Construction Standards.

(II) Grading drawings ("G" plans) containing:

1) existing ground profile;

2) intersection grades, including PI and 1/4pt elevations;

3) profiles of proposed lip of gutters, alley grades and cross elevations for all intersecting roadways;

4) grade of proposed and field-established elevations of existing local improvements affecting proposed design;

5) gutter elevations of catch basins;

6) curb elevations at beginning and end of corner radii, horizontal and vertical curves and locations where a break in grade takes place;

7) centreline grades on profiles; and

8) any other elements listed in City Design & Construction Standards.

(III) Details drawings ("D" plans) containing:

1) Pavement structures;

2) Concrete medians, sidewalks, and infill;

3) Shared-use paths;

4) Structures such as retaining walls and guardrails;

5) Grind and overlay limits at tie-ins to existing roads; and

6) Any other elements listed in the City Design & Construction Standards.

(IV) Cross-section drawings showing typical and non-typical road cross-sections cross-referenced to relevant plans containing:

1) trackway

2) lane widths;

3) sidewalks;

4) shared-use paths;

5) streetlights;

6) property lines;

7) trees;

8) above and underground utilities;

9) ditches;

10) berms;

11) fences;

12) retaining walls

13) super elevation;

14) pavement structures for roadway construction; and

15) any other elements listed the City Design & Construction Standards.

(V) Pavement marking, signage drawings ("P" plans) containing:

1) sign locations and numbers;

2) pavement marking line types and extents;

3) pavement marking symbol types and locations; and

4) any other elements listed in the City Design & Construction Standards.

(VI) Any additional drawings as required such as for guardrails and delineators within the TUC.

(b) for all Civil Drainage Interim Designs:

(i) first Interim Design to include:

(A) sewer removal/abandonment plans;

(B) sewer relocation plan/profile drawings drawn at 1:500h / 1:100v;

(C) proposed drainage system plan and profile drawings drawn at 1:500h / 1:100v containing the minimum information requirements outlined in Volume 3, Drainage, Vol. 3-05 Drawing Requirements, Approvals, and Asset Acceptance/Transfer;

(D) track drainage plans and profiles;

(E) sections, details, specifications, and general notes for storm sewers, manholes, ditches, sub drain pipes, and clean outs;

(F) specifications for pipe bedding and surround materials and geotextiles;

(G) storm pond/storage units' plans, sections, and details including flow control units;

(H) outfall structures' sections and details including erosion control systems; and

(I) calculations supporting sizing storm ponds and drainage pipes/ditches.

(ii) second Interim Design to include an update to the information provided in the first Interim Design and additional details showing further progression of the design;

(c) for all Landscaping and Landscaping/Streetscaping Interim Designs (excluding Utility Complexes, Llew Lawrence OMF and SWMF):

(i) first Interim Design to include:

(A) soil and material plans;

(B) plant lists, planting plans and details for Character Zones, Opportunity Areas, and Pedestrian Priority Zones;

(C) furnishing plans (excluding Station furnishings);

(ii) second Interim Design to include update to the information provided in the first Interim Design and additional details showing further progression of the design;

(d) for all Street Lighting Interim Designs:

(i) first Interim Design to include:

(A) pole types;

(B) photometric result drawings; and

(C) pole location plans.

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design; and

(B) street lighting drawings ("L" plans) containing:

(I) the location and type of lighting davit;

(II) pole base;

(III) underground cable alignment;

(IV) offsets to new pole locations;

(V) new cabinet locations; and

(VI) any other elements listed in the City Design & Construction Standards.

(e) for all 23 Avenue Underpass, Blackmud Creek LRT Bridge, 111 Street Roadway Bridge Widening, and Anthony Henday Bridge Interim Designs:

(i) first Interim Design to include:

(A) general arrangement showing the overall plan, elevation, and typical sections;

(B) bridge girder, and arch cross-sections;

(C) horizontal and vertical clearances;

(D) pier elevations;

(E) structural design loading (vertical and lateral) and material criteria;

(F) foundation designs;

(G) Initial typical reinforcement and prestressing details for major elements

(H) MEP integration;

(I) overall plans and elevations;

(J) tunnel and portal construction methodology including plan, elevations and sections; and

(K) safety barriers and Protection Railings;

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design and additional details showing further progression of the Design;

(B) bearing and expansion joint details;

(C) expanded reinforcement and prestressing details for major elements;

(D) plans, sections and elevations of any required slope stabilization;

(E) plans, sections, and elevations of tunnel and portal excavations;

(F) tunnel and portal waterproofing; and

(G) finishes, including textures and colours.

(f) for all Retaining Walls Interim Designs:

(i) first Interim Design to include:

(A) finishes, including textures and colours; and

(B) structural design loading (vertical and lateral) criteria, structural material criteria, structural layout, structural plans, elevations and cross-sections;

(ii) second Interim Design to include update to the information provided in the first Interim Design and additional details showing further progression of the design;

(g) For all Sign Structure Interim Designs:

(i) first Interim Design to include:

(A) roll plans identifying the locations of any sign structures:

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design; and

(B) Overhead signage drawings ("F" plans) containing

(I) sign cross sections;

(II) sign boards;

(III) pile specifications; and

(IV) any other elements listed in the City Design & Construction Standards.

(h) for all LRT Station Interim Designs:

(i) first Interim Design to include:

(A) branding;

(B) architectural design;

(C) exterior finishes, including textures and colours;

(D) structural design;

(E) mechanical design;

(F) electrical design;

(G) site servicing plan and drainage design;

(H) locations of furnishings;

(I) accessibility treatments, including the locations of all tactile attention indicators and tactile direction indicator surfaces;

(J) locations and types of all signage;

(K) locations of Passenger Interface Equipment;

(L) locations and types of vertical circulation;

(M) room layouts; and

(N) energy model outputs.

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design; and

(B) types of furnishings.

(i) for all Utility Complex Interim Designs:

(i) first Interim Design to include:

(A) site layout, including driveways and parking stalls;

(B) plan layout, including all systems components and clearances;

(C) wall elevations, including location of doors;

(D) exterior finishes, including textures and colours;

(E) structural design;

(F) electrical design;

(G) mechanical design;

(H) site servicing plan and drainage design; and

(I) site landscaping design, including soil and material plans, plant lists, planting plans and details.

(j) for Llew Lawrence OMF Yard Interim Design:

(i) first Interim Design to include:

(A) site layout, including the OMF building footprint, locations of outdoor storage as defined in Section 1.a.i *[Interim Design Requirements for all Roadway Interim Designs first Interim Design]* of this Appendix, and internal access roads;

(B) OMF track design per (point) Track Interim Design;

(C) OCS yard wiring plans, yard sectioning details and schedules per (point s) all OCS and OCS Line Wide Interim Designs;

(D) yard Utility Complex submissions as defined in Section 1.r.i. [*Interim Design Requirements for all Utility Complex and Traction Power Substation Supply and Distribution Interim Designs first Interim Design*] of this Appendix;

(E) site servicing plan and drainage design;

(F) site landscaping design including soil and material plans, plant lists, planting plans, fencing and details;

(ii) second Interim Design to include update to the information provided in the first Interim Design and additional details showing further progression of the design;

(k) for Llew Lawrence OMF Building Interim Design:

(i) first Interim Design to include:

(A) branding;

(B) architectural design;

(C) exterior finishes, including textures and colours;

(D) structural design loading (vertical and lateral), structural material criteria, structural layout, structural design, including foundation design;

(E) electrical design;

(F) mechanical design;

(G) interior design;

(H) locations and types of vertical circulation;

(I) room layouts for each floor;

(J) energy model outputs; and

(K) locations and types of all signage.

(ii) second Interim Design to include update to the information provided in the first Interim Design and additional details showing further progression of the design;

(l) for Stormwater Management Facility Interim Design:

(i) first Interim Design to include:

(A) storm water management pond layout:

(B) cross sections;

(C) linear design;

(D) inlet and outlet details;

(E) 1:5 year, 1:25 year, 1:100 year, and design event water levels;

(F) plan and profile for outlet pipe;

(G) signage;

(H) storm pond sizing calculation;

(I) site landscaping design, including soil and material plans, plant lists, planting plans; and

(J) any other requirements listed in the City Design & Construction Standards.

(ii) second Interim Design to include update to the information provided in the first Interim Design and additional details showing further progression of the design;

(m) for all Track Interim Designs:

(i) first Interim Design to include:

(A) roll plans with profiles drawn to scale of 1:500 horizontal and 1:100 vertical containing:

(I) Design criteria/standards/considerations (for example, design and operating speed);

(II) special trackwork type and location;

(III) locations of embedded, direct fixation, pit track, and ballasted track;

(IV) track drainage;

(V) vehicle arrestors, including colours, wraps and other treatments;

(VI) geometric points indicating beginning and end of tangents, spirals and curves; and

(VII) curve radii, Actual Super elevation (Ea), Unbalance Super elevation (Eu);

(VIII) horizontal geometry track chart; and

(IX) track centreline spacing throughout Trackway

(B) Typical Cross Sections and details of each track type with Dynamic Envelope

(C) Connection and transition details for embedded track tie-in to Capital Line LRT embedded track

(D) Track Design Criteria Report for all trackwork and track alignment requirements including material requirements, rail neutral temperature and other elements which the design will follow.

(E) Track Optimization Study as described in Section 3-1.2.2.1E *[Track Alignment]* of Schedule 5 *[D&C Performance Requirements]*;

(ii) second Interim Design to include:

(A) Update to the information provided in the first interim design; and

(B) Plans and details including the following:

(I) All Special Trackwork details including turnout and crossover layout geometry, details of switch points, frogs, switch blower or heating and connection details (for all track types),

(II) Track fastening details, including reinforcement and product materials for all track types

(III) Typical sections for all track conditions with clearance envelopes and dimensions including adjacent road, platforms, structures and grading

(IV) Layout details in plan for all track types (including direct fixation rail fastening structures/plinths)

(V) Typical plan and sections of track drains for each track type

(VI) Plan and section of Track transition zones

(VII) Layout and fastening details of vehicle overrun protection

(C) Swept path analysis report including figures for all track conditions (i.e. track spacing change, tight radius curves, etc.)

(D) Rail/Structure interaction report including rail gap analysis for all track types and rail deflection with respect to fastener spacing including a rain/wheel interface analysis

(E) Track construction specifications for all track types

(F) Material procurement specifications for all rail materials including rail, special trackwork, fastening systems, and Other Trackwork Materials (OTM).

(n) for all systems integration and Testing and Commissioning Interim Design:

(i) first Interim Design to include:

(A) a narrative description of the overall approach and technical details for each signalling system, including how Design-Builder will conform to the requirements set out in Part 6 [*Systems*] of Schedule 5 [*D&C Performance Requirements*] and Sections 5.6 *[Integration Management]* and 5.7 *[Interface Management]* of Schedule 4 *[Design and Construction Protocols]*;

(B) integration management plan to control functional requirements and interfaces;

(C) interface management plan to control interfaces;

(D) Interface Matrix

(E) Interface Log

(F) interface control documents for each interface;

(G) interface specifications, including derived requirements;

(H) design drawings, including:

(I) single line diagrams;

(II) concept of operations and riser diagrams;

(III) layout plans and schedules;

(IV) electro-mechanical interface requirements to support system functionality; and

(V) heat dissipation

(I) cable and fibre routing;

(J) site locations and site plans;

(I) try distribution;

(II) cabinet distribution;

(III) evacuation route;

(IV) HVAC ducts;

(V) distribution of lights and switches; and

(VI) distribution of telecommunications equipment

(K) equipment layout drawings;

(L) conduit continuity diagrams;

(M) conduit fill calculations;

(N) identification of major raceway routes;

(O) fibre optic cable allocation tables;

(P) fibre optic backbone routing and termination details;

(Q) peripheral device space requirements; and

(R) wayside equipment enclosure wrap designs.

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design;

(B) OCC Interface Control Documents for each system;

(C) local control panel HMI interface layouts for each individual system;

(D) wiring plans and schedules;

(E) local control panel layouts;

(F) system elements mounting details;

(G) bandwidth calculations for ETS Network elements;

(H) optical power and loss budgets for ETS Network elements;

(I) network security analysis;

(J) IP addressing details;

(K) obsolescence management plan; and

(L) integrated plans:

(I) cross sections with

(1) equipment of the systems;

(2) train gauge;

(3) evacuation space;

(4) conduits and trays;

(5) OCS poles; and

(6) Platforms.

(II) duct transition, from the track to the technical rooms;

(III) turnouts and track circuit links;

(IV) track and negative returns; and

(V) OCS and feeders.

(o) for all Signal System Interim Design:

(i) first Interim Design to include:

(A) a narrative description of the overall approach and technical details for each signalling system, including how Design-Builder will conform to the requirements set out in Section 6-3 *[Signals]* of Schedule 5 *[D&C Performance Requirements*], including an explanation of how the Design will eliminate the possibility of negatively impacting the Capital Line LRT during Construction, testing and commissioning of the Project;

(B) interface control documents for each system;

(C) system requirements specifications, including derived requirements;

(D) design drawings, including:

(I) single line diagrams;

(II) concept of operations and riser diagrams;

(III) layout plans and schedules; and

(IV) electro-mechanical interface requirements to support system functionality;

(E) conduit fill calculations;

(F) identification of major raceway routes;

(G) fibre optic cable allocation tables;

(H) fibre optic backbone routing and termination details;

(I) network diagram;

(J) fibre splice schedule; and

(K) peripheral device space requirements for each signalling system;

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design;

(B) OCC Interface Control Documents for each system;

(C) wiring plans and schedules;

(D) local control panel layouts;

(E) system elements mounting details; and

(F) obsolescence management plan;

(p) for all CTS Interim Designs:

(i) first Interim Design to include:

(A) a narrative description of the overall approach and technical details for each communications subsystem, including how Design-Builder will conform to the requirements set out in Section

6 of Schedule 5 [*D&C performance Requirements*], including an explanation of how the Design will eliminate the possibility of negatively impacting the Capital Line LRT during Construction, testing and commissioning of the Project;

(B) a narrative description and diagrams of the overall approach and technical details for the tie-in at Century Park station;

(C) interface control documents for each communications subsystem;

(D) system requirements specifications, including derived requirements;

(E) cable and conduit schedules with field level cable and conduit labels identified;

(F) site plan and analysis of field of view and obstructions for camera placement and sight lines;

(G) site plan showing and device locations, cable distance for copper and fibre cables;

(H) equipment rack layouts and bills of material;

(I) floor plans layouts for equipment locations and rack locations;

(J) overall block diagrams and detailed block diagrams showing device names; and

(K) mounting details for end-devices.

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design;

(B) OCC Interface Control Documents for each subsystem;

(C) VLAN and IP address assignments of all devices on device schedules;

(D) Fibre patch panel layout and labels;

(E) power bar layout and power system diagrams;

(F) cable schedules with cable type, cable lengths, colour code and connector type

(G) equipment schedules with equipment types, models, power budget and dimensions

(H) port assignments for network equipment;

(I) end-device drawings showing typical media converter installations;

(J) optical power and loss budgets;

(K) bandwidth calculations; and

(L) obsolescence management plan.

(q) for all Systems Duct Bank Interim Designs:

(i) first Interim Design to include:

(A) a narrative description of the overall approach and technical details of the Systems Duct Bank, including an explanation of how the Design will eliminate the possibility of negatively impacting the Capital Line LRT during Construction, testing and commissioning of the Project;

(B) conduit fill calculations;

(C) identification of major raceway routes;

(D) fibre optic cable allocation tables;

(E) fibre optic backbone routing and termination details;

(F) drainage design from maintenance holes and embedded pullboxes; and

(G) duct bank configuration, maintenance holes, access points, termination boxes and duct bank capacity allocations;

(ii) second Interim Design to include;

(A) update to the information provided in the first Interim Design; and

(B) conduit and Systems Duct Bank drawings.

(r) for all Utility Complex and Traction Power Substation supply and distribution Interim Designs:

(i) first Interim Design to include:

(A) a narrative description of the overall approach and technical details of the Traction Power System, including how Design-Builder will conform to the requirements set out in Section 6-2 *[Traction Power (TP)]* of Schedule 5 *[D&C Performance Requirements]*;

(B) the Load Flow Study as described in Section 6-2.1.4 *[Load Flow Study]* of Schedule 5 *[D&C Performance Requirements]*;

(C) conduit and duct bank routing to all TPSS locations;

(D) TPSS internal conduit and cable trays routing layouts;

(E) TPSS building below grade grounding drawings;

(F) TPSS lighting and 110V services drawings;

(G) TPSS equipment layout;

(H) maintenance holes and pullbox locations;

(I) tie-breaker room layout;

(J) negative tie provisions;

(K) HVAC ducts and cable trays routing layouts;

(L) auxiliary and emergency trip systems concept of operations;

(M) fire and smoke detection concept of operations;

(N) security and intrusion detection concept of operations;

(O) network diagram;

(P) fibre splice schedule;

(Q) peripheral device space requirements;

(R) Emergency Alarm Station locations and conduit stub-ups;

(S) a description of the Traction Power supply design, failure modes and mitigations;

(T) a description of the Traction Power grounding and corrosion control strategy; and

(U) switchgears, transformers, and other TPSS equipment and identification.

(ii) second Interim Design to include:

(A) update to the information provided in the first Interim Design;

(B) protective relaying and transfer trip concept of operation;

(C) AC and DC circuit breaker control schematic diagrams;

(D) ground grid design calculations;

(E) studies and calculation notes;

(F) detailed design for each TPSS;

(G) TPSS conduit and cable tray layout;

(H) auxiliary and emergency trip systems riser diagrams;

(I) fire and smoke detection riser diagrams;

(J) security and intrusion detection riser diagrams;

(K) protective relaying schedules; and

(L) traction feeder and negative return schedules.

(s) for all OCS and OCS Line Wide Interim Designs:

(i) first Interim Design to include:

(A) a narrative description of the overall approach and technical details of the OCS system, including how Design-Builder will conform to the requirements set out in Section 6-2.3 *[Overhead Traction Power System]* of Schedule 5 *[D&C Performance Requirements],* including an explanation of how the Design will eliminate the possibility of negatively impacting the Capital Line LRT during Construction, testing and commissioning of the Project;

(B) a description of the OCS grounding and corrosion control strategy;

(C) typical OCS arrangements within mixed-use sections, confined sections, character zones and areas with height restrictions;

(D) OCS overlap charts and tension lengths;

(E) typical loading tables;

(F) wind, ice and radial loads and calculations;

(G) along track movement, stagger change and effect, auto tension catenary diagrams;

(H) feeder and jumper details;

(I) section isolator design;

(J) catenary hangers and suspension assemblies;

(K) negative return details;

(L) pole types, including finishes; and

(M) pole locations;

(t) second Interim Design to include update to the information provided in the first Interim Design and additional details showing further progression of the design.

2. FINAL DESIGN DRAWING CONTENTS

The contents of the Final Designs for each discipline must contain the appropriate amount of information to demonstrate compliance with the Project Requirements, and where applicable must include final versions of the drawings and documents provided in the second Interim Design, including any updated information. The contents of the Final Designs for certain disciplines must also include:

(a) for all System Integration and Commissioning Final Designs:

(i) final versions of all previous submittals;

(ii) detailed configuration information, including a network administration guide and a system administration guide; and

(iii) shop drawings and cutsheets;

(b) for all Signal System Final Designs:

(i) final versions of all previous submittals;

(ii) detailed configuration information, including a network administration guide and a system administration guide; and

(iii) shop drawings and cutsheets;

(c) for all CTS Final Designs:

(i) final versions of all previous submittals;

(ii) drawings showing all devices connected to head end with details such as network switch ports, cable names and what conduits cables go through;

(iii) drawings showing conduit runes and boxes and names for all;

(iv) drawings showing and splice boxes, terminal block and similar devices;

(v) drawings for each communication subsystem;

(vi) fibre splice diagrams;

(vii) field cabling layouts;

(viii) serial cable layouts; and

(ix) BMS and control system I/O drawings.

(d) for all Traction Power Substation supply and distribution Final Designs:

(i) final versions of all previous submittals;

(ii) TPSS civil and structural drawings;

(iii) relaying and coordination study;

(iv) system start-up plan;

(v) TPSS shop drawings;

(vi) Traction Power System shop drawings; and

(vii) description of the Traction Power System, including normal and abnormal operation modes.

(e) for all OCS and OCS Line Wide Final Designs:

(i) final versions of all previous submittals;

(ii) section isolator hardware; and

(iii) OCS shop drawings

(f) Landscape and roadway drawings snow storage / stockpile areas.

.

Appendix 4E - PROJECT DRAWING STANDARDS

1. DRAFTING GUIDELINES AND INSTRUCTIONS

1.1 General

(a) This Appendix 4E *[Project Drawing Standards]* applies to all hard copy and electronic drawing submissions.

(b) All electronic drawings must be submitted in a DWG format compatible with Autodesk 2018 native file format.

(c) All electronic files submitted must be scanned with anti-virus software and certified virus free prior to submitting.

(d) The Design-Builder ordinate system is NAD83 - 3TM referenced to the 114° meridian.

(e) All drawings must be legible and scalable.

(f) Drawings must be in accordance with the City Design & Construction Standards and the Edmonton Facility Consultant Manual where indicated.

1.2 Drawing Layout

(a) All drawings must be completed in metric units.

(b) Drawing files must be drawn at 1:1.

(c) The scanning of hard copy drawings to produce the required drawing files is not acceptable. Only vector based (CAD) drawings are to be used.

(d) The file name must be the same as the drawing number.

(e) The scale selected for a particular drawing will depend on the information to be shown on the drawing. The scales are based on full-sized, nominally A1, drawings. The preferred scales to be used on all drawings are as in Table 4E-1.2:

Table 4E-1.2: Preferred Drawing Scales

Type of Drawing		Preferred
Overall Plans		1:500/1:1000
Plan / Profiles	Horizontal	1:500
	Vertical	1:100
Cross Sections	Horizontal	1:100/1:50
	Vertical	1:20
Architectural / Structural Plans		1:100
Details		1:20/Varies

1.3 Drafting

The following is a list of drafting guidelines and instructions for the Project:

(a) all line work must be accurate and all intersections must be trimmed;

(b) all drawing files must be purged of and audited for redundant and unnecessary information;

(c) all lettering must be in capitals except metric SI unit symbols which are to follow SI practice (e.g. mm, m, km, kN, MPa);

(d) when associated with a number, symbols must always be used (e.g. 16 m, not 16 metre). However, in text the unit must be spelled out in full;

(e) when a decimal fraction is used, a leading zero must be placed in front of the decimal point;

(f) do not abbreviate unless required to save space. Do not abbreviate in notes;

(g) when abbreviating, use only standard abbreviations, and use without periods;

(h) place annotations as close as possible to the relevant item to eliminate or reduce the length of leaders;

(i) river and stream names must follow the shape of the feature;

(j) use a space between numbers and units (e.g. 100 mm);

(k) cross references to other drawings in notes must refer to the other drawing number;

(l) all dimensions must be ground dimensions. Stations may be given in either grid or ground coordinates. The chosen system must be specified in the general notes and used uniformly across all drawings sets;

(m) skew angles must be given to the nearest minute;

(n) all drawing sets must have consistent presentation. Design teams must be coordinated so that all like drawings are presented in a uniform manner;

(o) each drawing package must include legends for all line types and symbols; and

(p) design drawings must illustrate what is to be constructed and must not show multiple options.

1.4 Drawing Content

(a) For all design within the Road Right of Way, design drawings sets must be organized in accordance with the City Design & Construction Standards.

(b) For all other disciplines, design drawings sets must be organized in accordance with current best practice and the Edmonton Facility Consultant Manual.

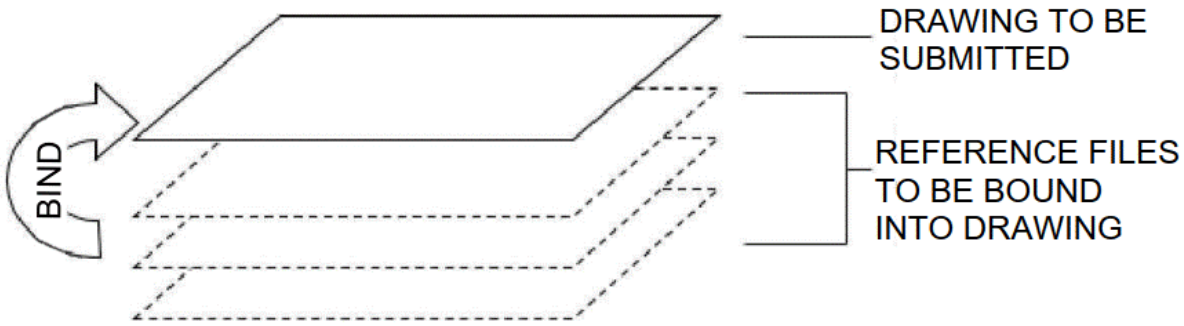
1.5 Layer Naming Conventions

(a) A system of CAD layer naming conventions must be developed and used in accordance with the level structure set out in the City Design & Construction Standards.

2. DRAWING MANAGEMENT

2.1 Drawing Organization

(a) For all CAD submissions all referenced files must be bound together into one file.



2.2 Submissions

2.2.1 General

(a) An index listing of all drawings included in the drawing set must be shown on the first sheet of the set.

(b) All drawings must be drawn at a scale of 1:1.

(c) Confirm that any externally referenced files are correctly attached.

2.2.2 Drawing Submissions

(a) Presentation drawings for providing information to Stakeholders must be provided upon request. These are usually larger drawings, images, and charts that may be mounted on foamcore for display, and are intended to be used at open houses, Stakeholder meetings, council presentations, internal meetings, or other gatherings. These drawings must be submitted:

(i) in hard copy and mounted, if requested; and

(ii) electronically, in the following formats:

(A) PDF;

(B) a DWG format compatible with Autodesk 2018 native file format; and

(C) scanned to TIFF at minimum 300dpi resolution (if hand drawn or coloured).

(b) Report drawings & figures, if requested, must be either 8½" x 11" or 11" x 17" in sheet size, and must be submitted:

(i) in hard copy as part of a report; and

(ii) electronically as part of the report, in the following formats:

(A) PDF;

(B) a DWG format compatible with Autodesk 2018 native file format; and

(C) scanned to TIFF (if hand drawn).

(c) Where sketches are required for clarification of any design, they must be either 8½" x 11" or 11" x 17" in sheet size, and must be submitted:

(i) in hard copy for distribution to Stakeholders; and

(ii) submitted in the following electronic formats:

(A) PDF; and

(B) a DWG format compatible with Autodesk 2018 native file format.

(d) Final Design Drawings must:

(i) be issue no "0", dated and initialed in the "issue data" portion of the title block for Design Drawings that have had no revisions or addenda changes;

(ii) have a note in the CAD files indicating when the original Design Drawings were authenticated, and by whom;

(iii) be submitted electronically on Aconex in the following formats:

(A) 11" x 17" Design Drawings, scaled half size, in PDF; and

(B) native Design Drawings in a DWG format compatible with Autodesk 2018 native file format;

(e) If required, revisions made to Final Design Drawings must:

(i) include the next sequential revision number as the revision number with a description of the revision in the revision block. The revision must be

clouded on the Design Drawing, and noted with the revision number shown adjacent to the cloud in a triangle;

(ii) include a note indicating when the original Design Drawing was authenticated, and by whom on the AutoCAD versions of the drawing; and

(iii) be submitted in the following electronic formats:

(A) PDF; and

(B) a DWG format compatible with Autodesk 2018 native file format.

(f) All Record Drawings must:

(i) include the note “Record” and initials in the “issue data” portion of the revision block;

(ii) be clean of revision notes and clouding from previous revisions;

(iii) have the revision number reset to 0;

(iv) include the typed name of the reviewer in the “reviewed by” title block;

(v) be submitted electronically on Aconex in the following formats:

(A) 11” x 17” Record Drawings, scaled half size, in PDF; and

(B) native Record Drawings in CAD DGN format compatible with Microstation Select Series 10 or newer products;

(vi) be submitted in hard copy in the following format:

(A) authenticated full sized set of Record Drawings; and

(vii) include all record shop drawings submitted on Aconex.

2.2.3 City of Edmonton CARDEX Naming Format

(a) All Roadways, drainage and landscaping Final Design drawings must include a secondary drawing numbering format that conforms to the standard City of Edmonton CARDEX system.

(b) Design-Builder must provide a drawing list for all Roadways, drainage and landscaping drawings in advance of the Final Design submission in order for the City to assign CARDEX numbers for the drawings. The City will need 10 Business Days to review the drawings lists and provide the requested numbers. Design-Builder must accommodate this requirement in scheduling the submission of all applicable Final Designs.

(c) For reference, “S085 131 A01”, is the file name format for all Roadways, drainage and landscaping drawings.

2.2.4 Final Roadways Base Drawing Layer Format

(a) Notwithstanding the electronic filing requirements of Section 2.2.2 *[Drawing Submissions]* of this Appendix 4C *[Project Drawing Standards]*, the final Roadways base drawing file(s) must be submitted in DGN format compatible with Microstation Select Series 10 or newer products, with the following levels:

(i) Curb Line:

(A) Level Name: RD_DETL_CURB, color=9, weight=3, linestyle=0;

(ii) Lip Line:

(A) Level Name: RD_DETL_LIPG, color=8, weight=2, linestyle=0;

(iii) Walk/Curb Ramps:

(A) Level Name: RD_DETL_WALK, color=13, weight=2, linestyle=0; and

(iv) Shared Use Paths:

(A) Level Name: RD_DETL_WALK, color=8, weight=2, linestyle=0.

Appendix 4F - POISSON DISTRIBUTION METHODOLOGY

Poisson Distribution Formula:
$$C.L \leq \sum_{k=0}^{S} \frac{(n * \lambda * t)^k * exp^{(-n*\lambda*t)}}{k!}$$
Where:
n = The number of LRUs in service in the system.
λ = Failure rate per hour (fph).
t = Total exposure time in hours during turnaround period.
C.L = Confidence level
k = The number of spares required.
S = Number of spares required to meet the confidence level
The confidence level can be calculated in Excel, using function POISSON, DIST and specific RAM parameters:
POISSON, DIST (k, mean, cumulative = true) = CL
Where k= Number of spares and
Mean= $n * \lambda * t$

For the use of Poisson Distribution, the following parameters can be used to determine the number of Spare Parts required.

Parameter	**Parameter targets for Poisson Distribution Sparing Analysis**
RCIL, SCIL sparing	Confidence Level: 99%
LRU and other sparable items	Confidence Level: 95%
Maintenance Level 1 Turnaround Period	Design-Builder to confirm for City consideration
Maintenance Level 2 Turnaround Period	Design-Builder to confirm for City consideration