REQUEST FOR STATEMENTS OF QUALIFICATIONS (RFSQ) No. 23-034

DATE:	**April 21, 2023**
Project Title:	**French Creek Pollution Control Centre Stage IV Expansion & Odour Control Upgrade: Collaborative Design and Construction – Contractor Team Selection**

The Regional District of Nanaimo (RDN) invites qualified and experienced Contractor Teams to submit Statements of Qualifications to join a collaborative effort to complete the detailed design and construction for the above-noted Project.

This RFSQ contains capitalised terms referring to Integrated Project Delivery (IPD) methods. The terms are defined in **Appendix A** which contains two documents:

1. "Exhibit A – Definitions" from the sample contract "Hanson Bridgett Integrated Project Delivery (IPD) Agreement", and;
2. A glossary taken from "Integrated Project Delivery: An Action Guide for Leaders", available on the Integrated Project Delivery Alliance's (IPDA) website at: https://www.ipda.ca/knowledge-competency/tools/integrated-project-delivery-an-action-guide-for-leaders/. The RDN does not represent or warrant the accuracy or completeness of any information contained within the above-referenced guide or the IPDA's website.

"Exhibit A – Definitions" shall take precedent where a term is defined in both above documents.

A. Intent

This Request for Statements of Qualifications (RFSQ) is issued to determine the most qualified and experienced team of service providers that can meet the RDN's requirements, expectations, and timeline using the Integrated Project Delivery (IPD) model. The Respondent Team is expected to include a General Contractor, a Mechanical Trade Contractor and an Electrical & Instrumentation Trade Contractor who would be selected as a team but who would engage with RDN as individual organizations and partners in the IPD process alongside the Consultant (AECOM). It is possible that the General Contractor may have the required mechanical and/or electrical and instrumentation capabilities in-house. In this case, the Respondent shall identify this in their proposal. Together, the Owner, Consultant and Contractor Team form the IPD Team.

Following approval of the Validation Report, the RDN intends to negotiate and enter into an IPD agreement using the Hanson Bridgett contract with the successful Respondents and Consultant. This would indicate the start of the Target Value Design (TVD) and construction phases of the project.

In any event, the RDN shall not be bound to enter into a contract with any Respondent to this RFSQ and, at its sole discretion, may elect to collapse this process.

RDN Board approval is required prior to entering into any agreements referenced in this document.

B. Background

The RDN operates four wastewater treatment facilities, 23 pump stations, and two septage receiving sites to transport and treat wastewater from more than 130,000 residents between Qualicum Beach and Duke Point.

The French Creek Pollution Control Centre (FCPCC) treats wastewater from approximately 29,000 residents and businesses. FCPCC serves the communities of: Qualicum Beach, Parksville, French Creek, Pacific Shores, Surfside, and Barclay Crescent. FCPCC also treats trucked waste from homes with septic systems and holding tanks. A significant upgrade and expansion to FCPCC is planned that will increase plant capacity by approximately 30%, replace aging infrastructure, improve odour control, and increase energy efficiency using solar panels and process heat recovery (the Project). Detailed design was originally completed in Spring 2021 but was delayed due to significant capital cost increases.

The RDN subsequently commissioned a value engineering study in the Fall of 2021 to determine if there were design alternatives that could deliver additional long-term value over the project life cycle and/or save capital costs. Two of the design alternatives were selected for further detailed study. The most impactful of those feasibility studies was recently completed and is included in **Appendix D**. The Project will proceed with the alternate design outlined in the appended feasibility study.

In general, the Project involves converting the existing plant to a primary treatment facility, repurposing the existing trickling filter to be a flow equalisation tank and adding the required secondary treatment capacity to the proposed expansion. Further description of the Project is included in the above-referenced feasibility study. This design alternative will require significant changes to the current design. Defining and completing the required design changes will be the focus of the IPD Team's efforts. However, the RDN may also wish to review the unaffected areas of the Project, such as the renovations to the existing treatment plant and administration building, for design completeness, optimisation, and constructability issues.

The IPD Team will review the Project and complete a Validation Report that will include a Base Target Cost for the project base program and scope. Once approved, the Project would then proceed through TVD and construction using the Hanson Bridgett Integrated Project Delivery (IPD) agreement. Reference **Appendix B** for a sample copy of the Hanson Bridgett IPD agreement.

This project will be the first IPD project for the RDN. To help ensure success of the project for all IPD Team members, the RDN has engaged a third-party coach (Colliers Project Leaders) to facilitate and guide the IPD Team process.

Integrated Project Delivery is not a business-as-usual arrangement. The process is highly collaborative and requires commitment from all IPD Team members to establish an open, trusting relationship and joint project management processes in order to be successful. For those not familiar with IPD and the governing agreement, it is advised to research the project delivery model and carefully review the sample Hanson Bridgett IPD agreement in **Appendix B** prior to submitting a response to this RFSQ. Some suggested resources for more information on IPD and Lean construction are:

- Home | The Integrated Project Delivery Alliance (IPDA)
- Integrated Project Delivery for Construction - IPD (leanipd.com)
- About | Lean Construction Institute
- Lean Construction Institute of Canada - Canadian Construction Association (cca-acc.com) currently in transition to newly organization About — Lean Design Construction Canada

The above website links are provided for general information purposes only. The RDN does not represent or warrant the accuracy or completeness of any information contained within the websites.

C. Contemplated Scope of Services

The general scope of services requested as part of this RFSQ includes the following:

1. Reliable in-person participation in Big Room activities using Lean IPD procedures, tools and techniques. The Big Room is planned to be located in Parksville, BC.

2. Provide a representative for the Senior Management Team (SMT) per organization.

3. Provide an experienced representative for the Project Management Team (PMT) per organization.

4. Provide experienced technical and other experts for Project Implementation Teams (PITS), to engage in the key discipline areas of civil / structural, mechanical / process piping and electrical / instrumentation and associated project management and cost modelling / estimation. The proposed team should also include members with expert knowledge and/or relative experience in Building Information Modelling (BIM), specifically the use of Autodesk Plant 3D, Revit, Navisworks, and Civil 3D, including other types where applicable, in planning and executing the related scope of work.

5. Engage collaboratively with the Consultant and RDN in the project design to provide innovative ideas that improve construction operations across all aspects of work execution, including supply chain considerations and labour productivity, to adapt plans and continual estimates accordingly. The Consultants, as registered professionals, will take overall responsibility for design but the Respondents would assume responsibility for execution of a constructable design.

6. Provide leadership in developing the Expected Cost, set the Base Target Cost, and set standards for the integration of Project financial information from all Project Participants. This will include an appropriate Project Contingency (Risk & Opportunities balanced) and Allowances (including Escalation). With other IPD Partners, jointly prepare the associated Business Terms Sheet in the Hanson Bridgett IPD Agreement.

7. Jointly develop the joint financial management processes for the project including development of the Incentive Program with other IPD Partners.

8. Provide leadership in the collaborative development of Baseline Milestone Schedule, engaging in adaptive, agile Lean planning processes.

9. Jointly develop and maintain a Responsibility Matrix collaboratively with other IPD Partners.

10. Jointly develop and deliver the Validation Report following the IPD team process.

11. Assuming Validation approval, and conditional upon IPD Agreement, engage in providing leadership within the IPD processes and framework for the remaining project execution including:
    a. Support for the completion of TVD, construction documentation and remaining procurement;
    b. Provide leadership for all logistics and supply chain planning and execution to prepare for construction operation;
    c. Provide field leadership for construction phase and the ongoing continuous improvement processes to meet or exceed performance expectations;
    d. Collaborate on an integrated commissioning plan.

D. Contemplated Schedule

The Validation phase is expected to take at least three months to complete. The IPD Team will determine the Validation phase schedule at the outset and the Project schedule in Validation. Below is an initial estimate of the Project timing, for guidance.

- Select design option – First Quarter (Q1) 2023 - **Complete**.
- Onboarding for IPD Team – Second Quarter (Q2) 2023
- Commence Validation phase – Q3 2023
- Complete Validation phase – Q4 2023
- **Proceeding beyond this point is dependent on outcome of the Validation Report, successful negotiation of an IPD agreement and Project approval by the RDN Board.**
- Negotiate IPD Agreement – Q4 2023
- RDN Board approval – Q4 2023
- Commence TVD – Q1 2024
- Complete initial TVD & construction preparations – Q2 2024
- Commence construction – Q2 2024

Timing of TVD and construction phases will be dependent upon the IPD Team defined approach captured in the Validation Report. Note that the IPD Team will be expected to integrate work structuring that supports design-to-construction flow efficiency with Lean Project Delivery.

E. Statement of Qualifications and Evaluation

The Statement of Qualifications submission (the SoQ) should include the information outlined in this section. To facilitate uniformity of presentation and ease of evaluation, the SoQ should be limited to a **maximum of 50 pages** (including appendices) and address the following items in order:

1. Executive Summary

i. One or two pages summarizing the SoQ and highlighting the Respondent Team's key attributes that addresses the qualifications and experience to successfully collaborate in this IPD project.

2. Project Methodology

i. Demonstrate understanding of Lean principles, tools and techniques and how they can be applied to the various stages of this project through completion.

ii. Discuss the Respondent Team's view regarding Big Room activities in the Validation, Design, Construction, Commissioning and Post-Commissioning phases of the project.

iii. Discuss the role of contractors and trades during design and discuss the role of consultants during construction with a focus on collaborative methodologies.

3. Resource Availability and Activities

i. Provide an organization chart representing the multiple companies and roles involved specific to the project using a typical IPD structure. Identify only the team members that will be actively and directly contributing to the project. At a minimum, this must include SMT and PMT roles plus the primary construction field leadership representing each of your organizations.

ii. Clearly identify each team member's role and include a Responsibility Matrix showing contributions at each phase of the IPD process.

iii. Describe methodology for crew planning during construction/commissioning. Include how your team will manage variation to respond to changes in labour reliability, work volumes or construction bottlenecks.

iv. Clearly identify current commitments (as a percentage) and availability for identified team members to be committed to this project.

4. Project Team Qualifications

i. For the team identified above, summarize how the team's technical and managerial experience on IPD projects, or other collaborative projects, will make them well suited to successfully complete this IPD project.

ii. For each of these key personnel, provide roles and responsibilities on three previous projects demonstrating experience related to their proposed role on this project.

iii. As a separate appendix, provide resumes including, but not limited to the following roles[1]:

- Senior Management Team Member (Must be Principal or President)
- Project Management Team Member (Proposed)

[1] Respondents should anticipate that any personnel listed with resumes may be requested by the RDN to participate in the interview process. At a minimum, the RDN will require the SMT and a PIT member for the interview.

- Project Implementation Team Members (May include estimator, project coordinator, site superintendent/foreman/contact, etc.)

5. Project Management

i. Demonstrate understanding of the role of the Senior Management Team, Project Management Team and Project Implementation Teams including field execution. Discuss how the team approach would maximize value to the project, reduce waste and improve efficiency.

ii. Demonstrate understanding of the IPD joint project management approach, particularly explaining the financial aspects including forecasting, open-book accounting, invoicing and change management processes.

iii. Discuss strategies for estimation including conceptual cost modelling, continuous estimation and risk/contingency integration practices that will support the IPD process.

iv. Provide methodology for civil / structural, mechanical / process piping and electrical / instrumentation design assistance. **Include any experience with the integration of technology and BIM.**

v. Demonstrate an understanding of pull planning and adaptive/agile systems and their use in collaborative projects.

6. Project Firm Qualifications

i. Identify each of the firms comprising the Respondent's team, (clearly identifying any joint ventures or partnerships) and provide a brief history of each of the Respondent's firms, specifying the role and interest each firm has in participating in an IPD project .

ii. Based on each of the Respondent firm's roles and responsibilities (as identified in section 3 and 4 above), describe how the Respondent firm's corporate culture supports collaboration, transparency, and willingness to perform as part of a multi-disciplinary team.

iii. For each of the Respondent firms, describe the corporate qualifications, resources and the ability of each firm to undertake this project. The response should include but not be limited to Respondent's ability to bond, provide labour force resources and perform work in the Province of BC.

7. References and Past Experience in Collaborative Projects

i. List and describe three collaborative (3) projects carried out by the Respondent Team; preference should be given to projects that showcase the Contractor Team working together. Projects should be within the last ten (10) years and clearly demonstrate relevant experience and qualifications to construct and commission projects similar in scope, value and challenges to this Project. Include:

a. Description of the projects demonstrating how they are similar to this Project and the collaborative tools and techniques used to complete them;

b. Identification of the Delivery Method that was used to deliver the project;

c. Date of completion, or if in progress, estimated date of completion and stage of construction;

d. Outline which of the Respondent firms and key personnel were part of the project, and their role(s);

e. A summary of lessons learned with respect to the collaborative delivery aspects; and

f. A reference for each project. Include name, title, organization, phone number and email address.

8. Equity and Sustainability

i. A statement of your firm's approach to advancing equity and sustainability in corporate operations and service provision, including mention of official policies, achievements or standards met.

9. Evaluation

Statements of Qualifications (SoQ's) will be evaluated by the RDN based on the above and assigned a qualitative score. The RDN will then conduct an interview with the highest rated Proponent. Based on the successful outcome of the interview, the RDN may then may proceed to negotiate with the highest ranked proponent with the intent of developing an agreement. If the parties after having bargained in good faith are unable to conclude a formal agreement, the RDN and the Proponent will be released without penalty or further obligations other than any surviving obligations regarding confidentiality and the RDN may, at its discretion, contact the Proponent of the next best rated submission and conduct an interview and attempt to conclude a formal agreement with them, and so on until a contract is concluded or the process is cancelled.

The RDN reserves the right to award the assignment in whole or in part or to add or delete any portion of the work. Throughout the evaluation process, the evaluation committee may seek additional clarification on any aspect of the submission to verify or clarify the information provided and conduct any background investigation and/or seek any additional information it considers necessary.

Any or all SoQ's will not necessarily be accepted.

E. Compensation

The successful Respondent Team firms will each be compensated for their Chargeable Costs (Ref. Exhibit 'E' in **Appendix C**) in the Validation Phase consistent with IPD pricing models; which separates and excludes profit. This will be negotiated with the highest rated Respondent.

Should the project be approved past Validation, this Profit-at-Risk pricing will go through final negotiation for all IPD parties per the Hanson Bridgett IPD Agreement.

F. Submission Date and Time

Statements of Qualifications should be received **BY EMAIL ONLY** on or before **3:00 p.m. pacific standard time on the 18th day of May 2023**. The RDN reserves the right to accept late submissions.

G. Questions and Submissions

Questions and submissions should be directed to:

Rob Wood
Project Engineer, Capital Projects, Regional and Community Utilities
Regional District of Nanaimo
Phone: 250-713-6356
Email: rwood@rdn.bc.ca

H. List of Appendices

- Appendix A – Definitions
- Appendix B – Sample Hanson Bridgett IPD Agreement (to be provided in an addendum)
- Appendix C – Exhibit 'E' – Builder Chargeable Costs
- Appendix D – AECOM Feasibility Study and Overall Site Plan

I. Additional Information

If the RDN determines that additional information is required, the RDN will post the additional information as an Addendum on the RDN (https://www.rdn.bc.ca/current-bid-opportunities) and the new BC Bid (https://new.bcbid.gov.bc.ca/) websites. It is the sole responsibility of interested vendors to check for additional information prior to submitting their response.

REGIONAL DISTRICT OF NANAIMO

Appendix A
Definitions

Integrated Project Delivery Agreement (Poly-Party)
Exhibit A – Definitions

1. **"Actual Net Recovery from Builder's Risk Insurance"** is the amount of actual funds received from the Builder's Risk insurance required by the Agreement, less any amount incurred to prosecute the Builder's Risk claim.

2. **"Adverse Weather"** is high wind or unusual precipitation that prevents or substantially impedes a Builder's ability to perform Construction Work resulting in a delay in the Contract Time beyond the number of lost days built into the Project schedule for adverse weather. Construction work is substantially impeded if the Builder loses more than half of a planned and otherwise available workday except to the extent the delay is also caused by any fault, neglect, act, or omission of the Designers, Builders, or their respective employees, consultants, subcontractors, or suppliers.

3. **"Affiliate"** means any firm, corporation, or other entity, however organized, that directly or indirectly, controls, is controlled by, or is under common control with another entity or shares common ownership that accounts for 20% or more of each entity.

4. **"Agreement"** is the Integrated Project Delivery Agreement executed by the Parties for this Project and all of the exhibits referenced in the Agreement.

5. **"Allowance"** is an estimated cost for a specific portion of the Work that is not at risk and does not contribute to shared savings. An Allowance is reconciled when it becomes an actual cost, or when the cost for the Allowance item can be reasonably estimated. If the reconciled amount is more or less than the estimated cost for the Allowance, then the Base Target Cost or Final Target Cost (depending on the phase) is increased or decreased by the difference between the reconciled amount and the estimated cost.

6. **"Allowed Claims"** are defined in Section 12.1.2 of the Agreement.

7. **"Amendment"** is a document executed by the Parties amending the terms and/or conditions of the Agreement.

8. **"Applicable Law"** includes all local, provincial, and federal laws, rules, regulations, ordinances, building code, or other codes, statutes, or regulations, or lawful orders of Governmental Authorities that are relevant to proper and safe performance of the Work. Applicable Laws include Anti-Corruption Laws.

9. **"Architect of Record"** (**"AOR"**) is the Designer with primary responsibility for reviewing and coordinating all Design Materials and Submittals. It will also sign and seal all architectural or engineering documents within its scope and in accordance with Applicable Law.

10. **"Builders"** are those Parties to this Agreement who are responsible for performing the Construction Work, among other things. The Contractor is a Builder.

11. **"Building Information Model"** (**"BIM"**) or **"Model"** is a parametric, computable representation of the Project design developed by the Designers, their consultants, and any Design-Build Trades, and will include construction details developed by the Parties and their respective

consultants and subcontractors. As used in this Agreement, references to Building Information Model, BIM, or the Model, include the primary design model or models and all linked, related, affiliated, or subsidiary models developed for design, estimating, detailing, fabrication, or construction of the Project, or any portion or element of the Project. The portions of the BIM prepared by the Designers, their consultants, and the Design-Build Trades, and those portions prepared by the Builders under the responsible control of a licensed design professional, are Implementation Documents. The portions of the BIM prepared by the Builders or subcontractors (other than Design-Build Trades) to illustrate means and methods for constructing, fabricating, or installing portions of the Construction Work are Submittals, which are not Contract Documents or Implementation Documents.

12. **"Business Day"** is any Calendar Day other than Saturdays, Sundays, and legally recognized holidays in the jurisdiction where the Project is located.

13. **"Business Terms Sheet"** are the page(s) under that heading prior to Article 1 of the Agreement that sets forth the key business terms among the Parties.

14. **"Calendar Day"** or **"day"** is any day whether a Business Day or not.

15. **"Change Order Request"** or **"COR"** is a written request for Change Order, which sets forth the nature of the change, the reason for the change, and the effect, if any, on the Base Target Cost or Final Target Cost, the Contract Time, or ICL.

16. **"Change Order"** is a mutually agreed written order between Parties adjusting the Base Target Cost, Final Target Cost, ICL, and/or Contract Time.

17. **"Chargeable Costs"** are cost categories that include the Designers' and Builders' costs incurred in the performance of the Work (excluding profit) as more specifically defined in Exhibits E and F, and are chargeable against the Base Target Cost and Final Target Cost.

18. **"Co-location Plan"** is a plan developed by the PMT or by a PIT under PMT direction that organizes the logistics, information systems, physical layout, scheduling and work flows for Project Participants to effectively work in the same physical location. The Co-location Plan, where appropriate, may include strategies for combining virtual co-location through use of communication technologies.

19. **"Commissioning Phase"** is described and defined in Section 6.7 of the Agreement.

20. **"Confidential Information"** means, with respect to a Party, any and all information and materials disclosed in furtherance of this Agreement or any Amendment hereto by or on behalf of the Party, its Affiliates, or any of their respective representatives to another Party or any of its representatives to the extent that the information:

a) is marked or otherwise identified as confidential or proprietary information, or

b) should, by its nature, or under the circumstances of its disclosure, reasonably be understood to be confidential or proprietary information of the Party.

Without limiting the foregoing, Confidential Information includes:

c) the Personal Information of any employee, officer, or director of a Party;

d) Owner's business, technical, and financial data, including Owner's intellectual property;

e) the trade secrets of a Party including existing and future products or service offerings, designs, business plans, business opportunities, finances, research, development, know-how, and other business, operational or technical information if the information satisfies the conditions of clause a or clause b, above, and

f) the existence, pricing, and terms and conditions of this Agreement are not Confidential Information as between the Parties but are Confidential Information as to persons or organizations not a party to this Agreement.

g) This Agreement does not affect ownership of Confidential Property, which remains a Party's sole and exclusive property.

21. **"Construction Work"** includes all labour, materials, equipment, appurtenances, and services necessary for proper construction and commissioning of the Project in accordance with the Contract Documents performed by Builders or subcontractors.

22. **"Contract Documents"** include the Agreement (inclusive of all exhibits), the Building Information Model, the Implementation Documents, and all other documents issued by the Designers, their consultants, and Design-Build Trades for construction of this Project, any PMT Bulletins, SMT Bulletins, and/or Owner's Directives, and any subsequent Amendments or Change Orders. The Contract Documents include Submittals prepared by Design-Build Trades and those Submittals incorporated into the Model. The documents included in the Contract Documents are complementary and what is required by one is required by all. If there are conflicting requirements within or between the various Contract Documents, the PMT will determine which requirements will better achieve the Project Objective and issue PMT Bulletins to that effect.

23. **"Contract Time"** is the date of Final Completion or, if Contract Time is stated as a duration, it is the number of Calendar Days between Notice to Proceed and Final Completion.

24. **"Contractor"** is the party identified as the Contractor in the Business Terms Sheet. The Contractor is a Builder that leads the other Builders, and has overall responsibility for supervising and coordinating the Work of the Builders; advising the Parties on construction matters; providing overall coordination, scheduling, logistics, site safety, cost modeling, constructability, and information and document management; and managing Builder participation in the Target Value Design and pre-construction efforts.

25. **"Deficiency List"** is a list of items that must be completed, repaired, or replaced prior to the Project or a Project Stage reaching Substantial Performance.

26. **"Design Consultants"** are specialty design or engineering that provide specialized Design Services, such as mechanical, electrical, structural, civil or other design or engineering specialties. Design Consultants may be Designers or subconsultants to a Party.

27. **"Design Materials"** are the latest issued construction drawings, including any changes made by RFI or Change Order, issued by the Architect, subsidiary drawings necessary for design and construction of the Project, and include the Model, Record Model, the subsidiary BIM models necessary for design and construction of the Project, all electronic design data for the Project, any related two dimensional drawings, calculations, schedules or specifications, and any other design materials, created for the Project.

28. **"Design Services"** are those professional architectural and engineering services rendered by the Designers, their consultants, and any Design-Build Trades necessary to develop and complete the Project design in accordance with the standard of care set forth in the Agreement and Applicable Law.

29. **"Design/Pre-Construction Phase"** is described and defined in Section 6.4 of the Agreement.

30. **"Design-Assist Trades"** are specialty contractors whose services include participation in the design effort but who are not Design-Build Trades. That participation includes provision of comments and recommendations on design elements and materials, preparation of cost opinions to inform design decisions, reviewing for constructability, trade coordination, and, where appropriate, execution of drafting efforts. Nothing in this Agreement requires the Design-Assist Trades to perform any Work outside their license or contrary to Applicable Laws. Design-Assist Trades may be Builders or subcontractors to a Party.

31. **"Design-Build Trades"** are specialty contractors that provide Design Services and Design Materials required for their respective portion of the Construction Work. Design-Build Trades have full architecture and engineering responsibility for their portion of the Work and will have their drawings and calculations signed and sealed by architects and/or registered professional engineers licensed in the jurisdiction where the Project is located in accordance with all Applicable Laws. Design-Build Trades may be Builders or subcontractors to a Party.

32. **"Designers"** are those Parties to this Agreement identified in the Business Terms Sheet who are responsible for performing the Design Services, among other things, but do not include Design-Build Trades. The Architect is a Designer. Designers are not responsible for providing Construction Work.

33. **"Engineer of Record"** (**"EOR"**) is the Designer with primary responsibility for reviewing and coordinating Design Materials with respect to its discipline and will coordinate Submittals with the Architect of Record. It will also sign and seal all architectural or engineering documents within its scope and in accordance with Applicable Law.

34. **"Estimated Final Cost"** is the sum of incurred Chargeable Costs that have been actually incurred at the time the estimate is made plus the estimated Chargeable Costs that will be required to complete the Project.

35. **"Final Actual Cost"** is the sum of all incurred Chargeable Costs upon Final Completion of the Work.

36. **"Final Completion"**, **"Final Completion of the Project"**, or **"Project Final Completion"** is the Final Completion of all Project Stages and the completion of all requirements of the Agreement and occurs on the date when all of the following have occurred:

a. the Builders have completed the Construction Work in full compliance with the Implementation Documents; all Final Deficiency List items have been completed and accepted by the PMT;

b. all final unconditional waivers and releases complying with Applicable Laws covering the Construction Work have been received by Owner except that with respect to any Construction Work for which Final Payment is being sought, Owner shall have received final conditional waivers and releases complying with Applicable Laws covering the Construction Work; if applicable,

c. if applicable, all final unconditional waivers and releases complying with Applicable Laws covering the Design Services have been received by Owner except that with respect to any Design Services for which Final Payment is being sought, Owner shall have received final conditional waivers and releases complying with Applicable Laws covering the Design Services; the Project has been commissioned;

d. all close-out documentation required under the Contract Documents has been transmitted to Owner;

e. a final certificate of occupancy has been issued by the Governmental Authority having jurisdiction over occupancy of the Project;

f. and the PMT has issued a certificate of Final Completion.

A Project Stage may have its own final completion date, but all Project Stages must be complete before Final Completion of the Project.

37. **"Final Deficiency List"** is the Deficiency List prepared after Substantial Performance and final inspections documenting all Construction Work that needs to be corrected or completed to achieve Final Completion.

38. **"Final Payment"** is Owner's payment of all amounts due and owing to the other Parties, including any ICL due after Final Completion of the Project.

39. **"Final Target Cost"** will be established at or near the end of the Design/Preconstruction Phase and will include all Chargeable Costs to design and perform the Work described in the Implementation Documents, and the associated Builders' overhead to the extent allowed by Sections 8.1 and 8.5 of the Agreement. The Final Target Cost cannot exceed the Base Target Cost and must include all agreed Added Value Incentive Items. The Final Target Cost measures whether the Project meets the Owner's financial expectations and will be the threshold against which the Final Actual Cost is compared upon Final Completion of the Work to determine the final ICL amount earned, if any.

40. **"Force Majeure"** means natural disasters; named storms; labour strikes that cannot be resolved through a dual gate or other measures; disruptions in utility service and/or connections not

caused by the Builders or those for whom they are responsible; Governmental Authority actions other than permitting, design review or inspection of construction; and civil disobedience; an act of terror; unavoidable casualties or catastrophic events, provided the above events are beyond the control, and not due to any act or omission of, the Designers, Builders, or anyone for whom they are responsible.

41. **"Governmental Authority"** or **"Governmental Authorities"** means all crown, provincial, county, district or municipal boards, departments, courts, offices or agencies that have jurisdiction over the Project.

42. **"Hazardous Materials"** means any and all pollutants, wastes, flammables, explosives, radioactive materials, hazardous or toxic materials, hazardous or toxic wastes, hazardous or toxic substances or contaminants and all other materials governed by Applicable Law for environmental protection, occupational health and safety, or any substance or material that has been determined, or during the time of performance of the Construction Work is determined, to be capable of posing a risk of injury to health, safety, property or the environment by any Governmental Authority.

43. **"ICL Percentages"** are the Designers' and Builders', percentage shares in the ICL and will be used for distribution of any ICL.

44. **"Implementation Documents"** consist of the Model; plans, sections, and elevations extracted from the Model; and any ancillary drawings, specifications, and construction details together with dimensions and layouts for civil, architectural, structural, mechanical, electrical, plumbing systems, and landscape design. The Implementation Documents will describe in detail the requirements for the Construction Work and provide information necessary and appropriate to obtain all necessary permits for construction of the Project.

45. **"Implementation Phase"** commences on the effective date of the Notice to Proceed with construction and ends at Final Completion.

46. **"Implementation Phase"** is described and defined in Section 6.6 of the Agreement.

47. **"Incentive Compensation Layer"** (**"ICL"**) is an amount that is increased or decreased based on Project outcome during the Project and is distributed to the Non-Owner Parties in accordance with their ICL Percentages and the ICL Distribution Spreadsheet (Exhibit G). Payment of the ICL is contingent upon the Project phasing Milestone disbursement conditions set forth in the Agreement.

48. **"Joint Site Investigation"** is a site investigation attended by the Parties during the Validation Phase for the purpose of reviewing existing information and investigating the Project Site to identify deficiencies and discrepancies, and to determine the extent of any additional investigations or testing required for proper design and construction of the Project.

49. **"Justified Delay"** is a critical path delay meeting one of the categories described in Section 11.2 of the Agreement.

50. **"Key Employees"** are those employees of the Non-Owner Parties listed in Exhibit J that may not be removed from the Project without Owner approval. (See Section 4.9 of the Agreement.)

51. **"Lean Phase Plan"** is a plan for defining and integrating the necessary work, services, processes, and hand-offs among multiple firms and teams that are necessary to accomplish project Milestones while employing Lean objectives and values. The Lean Phase Plan is developed jointly by those that are responsible for carrying out the work or services referenced in the Lean Phase Plan.

52. **"Milestone"** or **"Milestones"** are events noted in the Milestones exhibit (Exhibit B-4), which when they occur, permit the PMT to evaluate the Project and, if pre-conditions are met, authorize the distribution of a portion of ICL to Non-Owner Parties in accordance with Exhibit G and subject to the clawback provisions of Section 8.4(c).

53. **"Notice to Proceed"** is a written document issued by the Owner or the PMT to set the date of commencement of the Construction Phase for the Project or for various Project Stages.

54. **"Owner-Elected Change"** is a material change directed by the Owner to the scope of the Work described in the Base Program or Implementation Documents that (i) impacts either the Base Target Cost or Final Target Cost; (ii) requires Work that is not reasonably inferred from the Project Objective; and (iii) requires Work that is not due to (a) the failure of the Construction Work to be executed in conformance with the Implementation Documents, (b) the negligent acts, errors, or omissions in the design of the Project or its component systems; or (c) the repair, modification, or replacement of Construction Work that does not meet the functional and performance requirements of the Project Objective or Implementation Documents.

55. **"Owner's Directive"** is a written directive from the Owner that overrides a decision by PMT or the SMT. An Owner's Directive may be construed as an Owner-Elected Change if it affects the Base Target Cost or Final Target Cost and/or Contract Time.

56. **"Owner's Separate Consultant"** or **"Separate Consultant"** is a design, technical, scientific, or other professional engaged directly by Owner to perform services that are related to the Project although not within the scope of the Agreement.

57. **"Owner's Separate Contractor"** or **"Separate Contractor"** is a contractor engaged directly by Owner to perform work that is related to the Project although not within the scope of the Agreement.

58. **"Party"** is the Owner, or any of the Designers and Builders, and **"Parties"** refers to all of them.

59. **"Phase"** is a functional segregation of Project Work into Validation, Design/Preconstruction, and Construction. Each Project Stage may have its own Phases.

60. **"PMT Bulletin"** is a written directive from the Project Management Team derived from a unanimous vote that affects design, cost, schedule, or allocation of the Work. A PMT Bulletin may affect the Project Objective.

61. **"Post Commissioning Phase"** is described and defined in Section 6.8 of the Agreement.

62. **"Post Permit Change"** is a substantive change to a permit by a Governmental Authority or made necessary as a result of changes to Applicable Laws that impacts the Construction

Work subsequent to the issuance of the affected permit provided that the changes are not due to (i) the failure of the Construction Work to be executed in conformance with the Implementation Documents, (ii) the negligent acts, errors or omissions in the design of the Project or its component systems; and (iii) the repair, modification, or replacement of Construction Work that does not meet the functional and performance requirements of the Project Objective or Implementation Documents and provided that the changes were not reasonably known or anticipated when the Target Cost was set.

63. **"Pre-Validation Phase"** is described and defined in Section 6.2 of the Agreement.

64. **"Product Data"** are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Builders, or a subcontractor, tier-subcontractor, manufacturer, vendors, supplier, or distributor to illustrate materials or equipment for some portion of the Construction Work.

65. **"Project Implementation Teams"** (**"PIT"** or **"PITs"**) are interdisciplinary groups of Project Participants organized by the PMT. PITs are part of the collaborative process to develop the Implementation Documents and other deliverables, and may be formed temporarily or for the duration of the Project.

66. **"Project Management Information System"** (**"PMIS"**) is a digital system or interrelated systems for communicating amongst Project Participants and managing, distributing, and storing digital documents, files, logs, and communications. The PMIS contains detail of the Project Objective, including cost, time, scope, and quality; identifies the Project Participants, the people organizations, and their roles; manages agreements, including contracts, permits, approvals, and commitments; manages project control documents; is used to create reports and dashboards for the Project; and guides collaboration and communicates best practices with policies, workflow diagrams, and document management.

67. **"Project Management Team"** (**"PMT"**) must include a representative of the Owner, a Designer, and a Builder, and may include additional members as jointly agreed by the Parties, who will act in a collaborative manner to provide management level leadership during the design and construction process in a concerted effort to achieve the Project Objective.

68. **"Project Objective"** includes all Owner requirements, goals, and limitations documented in Exhibit B.

69. **"Project Participant"** is any person or entity that is providing material, equipment, work, or services for the Project.

70. **"Project Stage"** is a portion of the Project that is geographically or otherwise distinct and may have separate Milestones and dates for Substantial and Final Performance.

71. **"Project"** is the Project described in Article 2 of the Agreement, and includes the Validation Phases, Design/Preconstruction Phases, Implementation Phases, Commissioning Phases, and Post Commissioning Phases for all Project Stages.

72. **"Record Model"** is the version of the BIM that will be updated throughout construction to reflect the as-built condition of the Project and is turned over to the Owner upon Final Completion.

73. **"Representatives"** means a Party's Affiliates and such Party's and its Affiliates' respective officers, board members, directors, partners, members, employees, agents and any other persons or entities (excluding the other Party or its Affiliates) who contribute to the performance of such Party's obligations under this Agreement. For purposes of this Agreement, Designers', CM/GC's, and Builders' Representatives will include any and all consultants and subcontractors and such consultants' and subcontractors' directors, officers, employees, and agents. Owner's Representatives will include its or its Affiliates' collaborators and licensees.

74. **"Samples"** are physical examples that illustrate materials, equipment, or workmanship and establish standards by which the Construction Work will be judged.

75. **"Senior Management Team"** (**"SMT"**) includes a senior executive member from each Party, who will act in a collaborative manner to resolve any matters referred to it by the PMT either through consensus or, if a consensus is not reached, by a majority vote, subject to an Owner's Directive.

76. **"Set Based Design"** is a design strategy that advances in parallel alternative design solutions that meet Project criteria and constraints until a decision is made to select one solution over the alternatives.

77. **"Shop Drawings"** are drawings, diagrams, schedules, and other data specially prepared for the Construction Work by a Builder, including the CM/GC if it performs any of the Construction Work, or a subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

78. **"SMT Bulletin"** is a written directive from the SMT derived from a majority vote of the SMT and is binding on all Project Participants unless vetoed or modified by an Owner's Directive.

79. **"Staging Schedule"** is used if the Project will be performed in stages. At a minimum, the Staging Schedule defines the dates for commencement of construction, Substantial Performance, and Final Completion of each Project Stage.

80. **"Standard Consultant"** is a consultant engaged by a Designer or a Design-Build Trade that has not placed profit at risk and therefore is not eligible to share in the Agreement's financial incentives, ICL, and mutual liability waivers. Standard Consultants are Project Participants, but are not Parties to this Agreement.

81. **"Standard Subcontractor"** is a subcontractor, supplier, or vendor engaged by CM/GC or a Builder that has not placed profit at risk and therefore is not eligible to share in the ICL and mutual liability waivers. Standard Consultants are Project Participants, but are not Parties to this Agreement.

82. **"Submittals"** include Shop Drawings, Product Data, and Samples, but are not Contract Documents unless they are produced and stamped by a Design-Build Trade. To the extent required by the Contract Documents, all Submittals that are not produced by a Design-Build Trade only demonstrate how the Builders, including the CM/GC if it performs any of the Construction Work, and subcontractors propose to execute the Construction Work shown by the Contract Documents.

83. **"Substantial Performance" or "Substantial Completion:** occurs on the date when the Project is sufficiently complete to allow the Owner to legally occupy or utilize the Project for its intended purpose, all systems are operational as designed or required, all inspections and tests required under the Contract Documents have been completed successfully, the Governmental Authority with jurisdiction over Project occupancy has issued approval for legal occupancy, all Deficiency List items have been corrected or resolved, unless otherwise agreed by the PMT in writing, and the PMT has issued a certificate of Substantial Performance. A Project Stage may have its own Substantial Performance or Substantial Completion date.

84. **"Target Value Design"** is a design discipline that requires project values, cost, schedule, and constructability to be basic components of the design criteria, and uses cost targets to drive innovation in designing a project to provide optimum value to an owner. Target Value Design uses constructability and cost information from the Designers and Builders before design decisions are made to allow the design to progress within the Base Target Cost, Final Target Cost, and Contract Time.

85. **"Unforeseen and Differing Site Conditions"** is the discovery of an unknown, subsurface or otherwise concealed physical condition at the Project Site that differs materially from those indicated in the Implementation Documents or the information obtained from the Joint Site Investigation; an unknown physical condition of an unusual nature at the Project Site that differs materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character and nature provided for in the Implementation Documents; or an unknown, pre-existing hazardous substance or condition at the Project Site that requires removal or remediation.

86. **"Unusual Material Escalation"** is an increase in the cost of materials that exceeds 5% per annum that could not reasonably have been anticipated when the Base Target Cost or Final Target Cost was set and which is caused by extreme and unusual fluctuation in the market cost of the material or materials.

87. **"Validation Phase"** is described and defined in Section 6.3 of the Agreement.

88. **"Validation Phase"** is the first phase of the Project where the Parties document the Base Program and establish the Base Target Cost and the Added Value Incentive Items.

89. **"Work"** includes all labour, materials, equipment, appurtenances, and services required to design, construct, and commission the Project in accordance with the Contract Documents. It includes Design Services and Construction Work.

90. **"Anti-Corruption Laws"** means Applicable Laws, rules, or regulations concerning or relating to public or commercial bribery or corruption.

91. **"Non-Owner Party"** is a Party to this Agreement that is not the Owner. **"Non-Owner Parties"** are the Parties to this Agreement, except the Owner.

92. **"Owner Data"** means data or information, including without limitation any Owner information and Personal Information of a confidential, proprietary or private nature, provided to a Designer, CM/GC, a Builder, or any of their representatives by or on behalf of Owner or its Representatives or otherwise obtained in connection with this Agreement.

93. **"Owner"** is the entity identified as the Owner on the signature page at the end of the Agreement.

94. **"Personal Information"** means any information from which an individual may be identified, by direct or indirect means, that is provided to a Party by the Owner, or processed by a Party for or on behalf of the Owner, including without limitation an individual's name, address, telephone number, social security number, driver's license number, passwords, personal identification numbers (PIN), account numbers, account balances, account histories, and "personal information", "nonpublic personal information", "protected health information" (and other similar information, however described) as defined in any Applicable Laws protecting the Personal Information of a person.

95. **"Pre-Existing Work"** means any proprietary intellectual property, including inventions, processes, know-how, trade secrets, computer technical expertise and software and other intellectual property, standard drawing details and standard system, subsystem, or component designs that were independently developed by a Party other than Owner before execution of the Agreement and without reference to Owner's specific business practices, designs or processes, or any Confidential Information and for which reasonable documentary evidence of such pre-existence and independent development exists

96. "**Project Site"** is the physical location where the Project is being constructed and any adjacent laydown or storage areas dedicated to staging or storing material or equipment to be incorporated into the Project. In addition, the Project Site may include non-adjacent physical locations that are identified in writing if these locations are dedicated to providing or preparing for Project Construction Work.

97. **"Willful Default"** is any one of the following events:

a. actual or constructive abandonment of the Project;

b. persistent and repeated failure, after written notification, to correct Construction Work that significantly and materially deviates from the Implementation Documents or Applicable Law;

c. fraud, reckless disregard, or willful injury to the persons or property of another, or violation of the law, whether willful or negligent; or

d. willful and wanton misconduct.

Actual abandonment occurs if the Party, without justification, ceases performing Work for a period of 21 consecutive days or notifies one of the Parties that it is ceasing to perform Work on the Project.

Constructive abandonment occurs if the Party, without justification, expends so little effort on the Project that there is no meaningful progress on its scope of work for 21 consecutive days. The good faith exercise of any contractual suspension rights granted the Designers, CM/GC, and Builders under this Agreement or under an applicable subcontract or consulting agreement is not an intentional or constructive abandonment.

[END OF EXHIBIT]

GLOSSARY

A3

A one-page report on a single 11 x 17 sheet of paper, which uses PDCA thinking as it applies to collaborative problem solving, strategy development, or reporting. An A3 includes a problem statement, data and background information, analysis, proposed options, recommendations and agreements, actions, expected results, and follow-through. (*See Appendix 12 for an example of an A3.*)

A3 Thinking

A3 Thinking refers to the structured process of documenting a problem, solution, and action plan. The A3 Thinking process is undertaken collaboratively, with input from all stakeholders on the topic. It begins with consensus on the problem statement and arrives at consensus on a solution and path forward.

Actual Cost

The sum of the total cost of the work actually incurred by the project participants in connection with the performance of all phases of the project. Does not include owner expenses, such as fees for permit, inspection, or equipment. Depending on the contract form used, actual cost may be direct costs plus overhead or may be direct cost plus overhead plus profit.

Allowable Cost

The owner's absolute maximum project cost, based on the project business case, which is the subject of the validation study. The allowable cost includes all elements: direct costs, overhead, and profit (also called ICL).

Big Room

A space where all stakeholders in the team can come together and work, typically with visual documentation posted. Shared space can support communication and dialogue, resulting in greater efficiency and work product that is updated in real time, as well as less reworking and revising. Big Room setup, duration, and usage varies.

Building Information Model(ing) (BIM)

The product (model) and process (modeling) of generating and managing building data during the life cycle of a building. BIM uses three-dimensional building modeling software. BIM includes building geometry, spatial relationships, geographic information, and quantities and properties of building components.

Blended Rate

An average hourly rate that can be used for financial tracking when precise amounts are not needed. Typically used for trade partners when a range of hourly rates based on person-hours can be averaged to project costs. (See Appendix 23 for an example of how a blended rate was used to calculate costs based on hours.) Can also be used in situations when design partners may not wish to highlight differences in salaries for personnel who share the same job title. Averaging multiple people at the same title creates one rate that can be openly shared without revealing sensitive information.

Burn Rate

The rate at which project funds are expended. Typically tracked in a spreadsheet with budgeted versus actual cost for labor and materials, focusing on rate of expenditure over time. (*See Appendix 24 for an example of how the burn rate can be tracked.*)

Choosing by Advantages (CBA)

A structured decision-making system that compares the advantages of alternatives based on objective facts and transparently evaluated subjective preferences.

Co-location

Physically locating personnel in a single area, often referred to as the Big Room, to enable constant communication and integrated thinking, build relationships, and increase productivity. Co-location may be face-to-face 100% of the time or part-time. Virtual co-location, the commitment of the team to collaborate at specific dates and times through use of web-based collaboration technology, is another method of co-location.

Conditions of Satisfaction (CoS)

An explicit description by an owner and/or other members of the IPD team, stating all requirements that must be satisfied to deem the outcomes as successful. Distinct from a project charter, which typically focuses on team-behavioral goals. (*See Appendix 2 and Appendix 4 for examples of CoS.*)

Dashboard

Visual management system to track data and metrics important to the team, which highlights whether the project is on track and also prompts actions. (*See Appendix 14 for examples of dashboards and their use in the Big Room.*)

Design Assist

Builders providing design assist services offer suggestions, insight, costing, and constructability review, but do not take responsibility for design, which remains with a design professional unaffiliated with the builder. All builders that are within the IPD group typically provide design assist or design/build services. In some instances, trade contractors who are not in the IPD group may provide design assist services under their subcontracts.

Design/Build

Design/build can refer to a project delivery method or a method for delivering an element of a project, such as a mechanical system. As a project delivery method, the design/builder is responsible for the design and construction of the project. As a method for delivering an element of a project, the design/builder has the design and the construction responsibility for that element. Fire protection systems, for example, are often delivered as a design/build element within an IPD project.

Design Management

Design management brings order and structure to the development of the design through defining outcomes and decision-making processes and by identifying and optimizing information flow and pull planning.

Guaranteed Maximum Price (GMP)

A cost-type contract that compensates the contractor for actual costs incurred plus a fee subject to a ceiling price.

Huddle

Huddle (or "daily huddle") is a very short daily stand-up meeting that addresses the day's work. Huddles are a part of scrum but are also frequently used in lean construction. (*See also Scrum.*)

Incentive Compensation Layer (ICL)

The team's collective, at-risk profit. The ICL can increase or decrease based on the project outcome. An adjusted ICL is the ICL after adjustment based on project outcome.

IPD Agreement or Integrated Form of Agreement (IFoA)

In this guide, we use IPD agreement to reference the multiparty or poly-party agreement that includes, at minimum, the owner, design professional, and constructor as signatories to the same construction contract. Examples include custom agreements (such as those by the law firm Hanson Bridgett) and templates (such as CCDC-30, ConsensusDocs 300, and AIA-C191 or C195). An IPD agreement is synonymous with IFoA. An IFoA or IPD agreement may be a multiparty (three-party agreement) or a poly-party agreement that can have more than three parties. (*See also Multiparty Agreement and Poly-party Agreement.*)

Integrated Project Delivery (IPD)

IPD is a contractually based approach, which creates an environment that enhances collaboration, innovation, and value. IPD is characterized by early involvement of IPD team members, shared risk and reward based on project outcome, joint project management, liability reduction among IPD team members, and joint validation of project goals.

IPD Team

The IPD team is made up of the participants who have placed their profit at risk and have the opportunity for increased profitability, based on project outcome. Under a multiparty agreement, IPD team members who are not signatory to the multiparty agreement are engaged through appropriate subcontracts or subconsulting agreements that reflect the terms of the multiparty IPD agreement. Sometimes called the risk/reward team, parties, or the ICP participants.

Last Planner System (LPS)

The collaborative, commitment-based planning system that integrates pull planning, make-ready look-ahead planning with constraint analysis, weekly work planning based on reliable promises, and learning based upon analysis of PPC and reasons for variance. (*See Appendix 15 for an example of LPS statistics.*)

Lean

A culture based on a set of principles focused on creating more value for the customer through elimination of waste, streamlined processes, and continuous improvement (*See More Resources for more information on lean.*)

Level of Development (LOD)

The LOD specification is a product of the BIMForum. Based on the basic LOD definitions developed by AIA, it is used to clearly define and communicate to what level of completion work will be done in a BIM and by whom: who will be responsible for modeling which building elements to a specific level of detail at a particular point in time. (*See Appendix 13 for an example of a LOD matrix.*)

Likert Scale

A common means of psychological measurement used to gauge a person's opinions, values, and/or attitude along a range of responses. The range of responses usually consists of five to seven possible answers—for example, ranging from strongly disagree to strongly agree—with a number value corresponding to each response.

Logs/Registers

This family of tools includes constraint logs and risk and opportunity registers. These have multiple functions. They are used to track and mitigate risks and issues. The development and consistent usage of them builds team consensus and can drive accountability. (*For examples of logs and registers, please see Appendix 10 and Appendix 11.*)

MEP

Mechanical, electrical, and plumbing systems. These are often inclusive of fire protection and data cabling as well.

Milestone

An item on a master schedule that defines the end or beginning of a phase or a contractually required event.

Multiparty Agreement

Referencing a three-party IPD agreement between owner, designer, and builder. Though the prefix multi does not imply a specific number, it is industry standard that multi-party is a three-party agreement due to the history of the development of IPD agreements. (*See also IPD Agreement and Poly-party Agreement.*)

Non-Signatory

A company that is participating in the project that is not part of the IPD team. That is, they are not included in the IPD agreement with the shared risk/reward and other terms.

Off-Boarding

The deliberately planned process for removing team members or firms.

On-Boarding

The deliberately planned process for bringing new players onto the team. In IPD, there is a need to on-board and align the initial team and to have a process for on-boarding new players added later to the team.

One-Piece-Flow

A methodology used to address a process from end to end with all parties involved in order to identify which step(s) must be completed for the next step to occur without waiting or waste.

Overhead (Home Office Overhead)

The amount, which may be expressed as a percentage applied to costs or a fixed amount, to compensate a firm for items such as rent, executive salaries, and other non-project-specific costs. (*To see an example of how overhead can be calculated, see Appendix 27 for trade partners and Appendix 28 for designers*.)

Owner Controlled Insurance Program (OCIP)

An OCIP is an insurance program in which the owner obtains a policy to cover loss and liability during the project, reducing the coverages provided by other parties, such as the construction manager/general contractor and trade partners. An OCIP program has requirements for safety management, reporting, and the like, which must be incorporated into the IPD team's plan.

Owner's Project Requirements (OPR)

Developed by the owner, this is a project narrative defining the owner's requirements. The OPR is often used as a basis for the team to develop the CoS. In the context of a high-performance certification, this can include quantitative measures, such as meeting LEED or Petal standards. (*See Appendix 3 for an example of OPR.*)

Percent Plan Complete (PPC)

A basic measure of how well the planning system is working, calculated as the number of commitments completed by the time stated divided by the total number of commitments made for the time stated. It measures the percentage of assignments that are 100% completed as planned. (*For examples of how PPC is visually tracked, see Appendix 14 and Appendix 15.*)

Plan-Do-Check-Act (PDCA; also sometimes Plan-Do-Check-Adjust)

A four-step process intended to support continuous improvement in a product or process: plan, do, check, act. This is conceived of as a repeating and never-ending cycle, which creates a feedback loop for teams to assess their ability to achieve and improve outcomes.

Plus/Delta

Performed at the end of an activity, such as a meeting or a decision process. This review is used to evaluate the activity. Two questions are asked and discussed. Plus: what produced value during the session? Delta: what could we change to improve the process or outcome?

Poly-party Agreement

An IFoA that has more than three parties and generally includes, as parties, all members of the IPD team. The distinction between a multiparty (three party) and poly-party agreement is relevant to contract structure, governance, and insurance.

Project Charter

(*See also Conditions of Satisfaction.*)

Project Implementation Team (PIT)

PITs are nimble, multidisciplinary groups of project participants assigned by the PMT to conduct deep dives into specific project needs (e.g., building envelope, mechanical systems). PITs typically have an initial mission, a time frame in order to perform their work and report back, and the authority to incorporate the right people to perform the work. These are sometimes called clusters or cluster groups. PITs can include all members of the team—PMT, signatories, non-signatories, owners, architects, contractor, trades, and suppliers. Common PITs include structure, mechanical, electrical, envelope, etc. The specific number of PITs needed will be determined by the team. (*See also Project Management Team.*)

Project Management Team (PMT)

A team composed of representatives from each IPD contract party, with membership as defined by the specific IPD contract and subsequently others as jointly agreed by the parties. The PMT is charged to act in a collaborative manner to provide project management leadership during the design and construction process in a concerted effort to achieve the project's objectives. The PMT is the project's administrative workhorse, making the tough decisions and monitoring financials. Sometimes called the core group or core team. Interfaces with the SMT and PIT. (*See also Senior Management Team and Project Implementation Team.*)

Project Team

The totality of all firms participating in the project, regardless of their status in the risk/reward structure. For the purposes of this guide, the firms participating in risk/reward make up the IPD team. There may be firms working on the project that are not part of the risk/reward structure. These are referenced as non-signatory or the project team. The totality of all the individuals on the team is referenced as project participants. (*See also IPD Team and Non-Signatory Agreement*).

Pull

A method of advancing work when the next-in-line partner is ready to use it. A request from the partner signals that the work is needed and is pulled from the performer. In the pull method, work is released when the other members of the team are ready to use it.

Push

The opposite of pull. During push, an order is made from a central authority based on a schedule and advancing work based on a central schedule. Releasing materials, information, or directives possibly according to a plan but independent from whether or not the downstream process is ready to process them.

Request for Information (RFI)

A formal question asked by one party of the contract to another party. Typically, a request from the contractor to the designer.

Request for Proposals (RFP)

Owner's call for teams to submit proposals. In IPD this often includes how the team is going to handle collaboration and integration. (*See Appendix 1 for an RFP example.*)

Request for Qualifications (RFQ)

Typically includes relevant previous work, key personnel, and approach to work. In IPD this often includes demonstrations of lean and IPD experience.

Risk/Reward

A collectively agreed upon amount or percentage of final cost that will be distributed among the members of the IPD team (sometimes called risk/reward pool) if project goals are met. Sometimes called ICL or profit pool.

Rough Order of Magnitude (ROM)

Estimate of time or cost before details are known. A way to describe the impact and likelihood of an occurrence that could impact the project budget, positively or negatively. Calculated by taking possible cost or savings multiplied by the probability of occurrence. Typically used with risk logs or opportunity logs, sometimes combined into one format, sometimes weighted with probabilities and costs so that it can be managed in conjunction with contingency funds.

Scrum

Scrum is a term borrowed from agile project management, often used in software development, referring to a process involving small teams engaging in short, repeatable, sustainable "sprints," the outcome of which is a chunk of delivered value.

Senior Management Team (SMT)

A team composed of representatives from each IPD team member, typically the project executive of the firm. The SMT always handles dispute resolution and backs up the PMT as required. In many cases they also conduct contract negotiations and resolve questions of scope change, but this can alternatively be done by the PMT. The SMT is composed of one C-level executive from every party who signs the IPD agreement.

Target Cost (TC)

The cost goal established by the project team as the target for its design and delivery efforts, typically determined after the validation process. In some projects, there is only TC, which can be adjusted by the owner in the rare situations when that is appropriate. Other times, TC is broken into two measures:

- Base Target Cost: The TC amount that matches the base program in the project objective.
- Final Target Cost: The TC amount that matches the base program, plus any value added Items. Because the value added Items are funded from savings off of the base TC, the final TC must be less than or equal to the base TC (unless there are change orders).

Target Value Design (TVD)

A disciplined approach to design that requires project values, cost, schedule, and constructability to be basic components of the design criteria, and uses cost targets to drive innovation in designing a project to provide optimum value to an owner. TVD uses constructability and cost information from the owner and IPD team before design decisions are made to allow the design to progress within the base TC, final TC, and schedule. (*To see an example of PIT tracking during TVD, see Appendix 26.*)

Trade Partners

Trade partners are the IPD team members (signatories to the IFoA) who are the specialty contractors engaged to put the construction work in place. Trade partners typically include mechanical contractor, electrical contractor, structural steel contractor, and the like. Not to be confused with trade contractors, subcontractors, and trades, which are ambiguous terms that do not imply membership on the IPD team.

Validation

Validation is a process through which the IPD team establishes certainty for the project. It proves or disproves whether the team can meet the full range of the owner's CoS within the owner's constraints (including cost and schedule). Validation is not compressed schematic design. The project is developed only to the degree necessary to achieve certainty. Validation is a go/no-go gate, undertaken at the beginning of the project, and often has its own budget, schedule, prerequisites, and approvals. (*For an example of a validation checklist, see Appendix 8.*)

Virtual Design and Construction (VDC)

The use of BIM and other tools to optimize and coordinate design, virtually rehearse and manage construction, and/or operations.

Visual Management

Placing tools, parts, plans, schedules, measures, and performance indicators in plain view for transparency, allowing the system to be understood at a glance by everyone involved and actions taken locally in support of system objectives. (*For examples of dashboards and visual management in the Big Room, see Appendix 14.*)

Weekly Work Plan (WWP)

The commitment-level step of LPS, identifying the promised task completions agreed on by the project team. The WWP is used to determine the success of the planning effort and to determine what factors limit performance and is the basis of measuring PPC. (*See Appendix 16 for examples of WWPs.*)

REGIONAL DISTRICT OF NANAIMO

Appendix B
Sample Hanson Bridgett IPD Agreement
(To be issued via addendum)

REGIONAL DISTRICT OF NANAIMO

Appendix C
Sample Exhibit 'E' – Builder Chargeable Costs

Integrated Form of Agreement
Exhibit E – Builder Chargeable Costs

1. DEFINITIONS

1.1 Billable Rates. Billable rates are the hourly rates that a Builder may charge for its Hourly Employees and Salaried Employees, as applicable, consistent with this Exhibit E and listed in the Builder's individual Exhibit E-1.

1.2 Stipulated Overhead Rate. A rate agreed to between Builder and Owner that compensates Builder for all of its Indirect Costs (except for Indirect Costs related to its shop or fabrication facilities, if any) and that is, depending on the option specified in the Business Terms Sheet, either included in Builder's Billable Rates, or applied to the Builder's Chargeable Costs.

1.3 Shop Overhead Rate. A rate agreed between Builder and Owner that compensates Builder for all of its Indirect Costs related to its shop or fabrication facilities and, if used, is included in the Billable Rates for Builder's shop personnel.

1.4 Direct Salary Expense ("DSE"). DSE is the amount actually paid by the Builder to an employee, exclusive of bonuses and profit sharing, and before any federal income tax, employment insurance, Canada Pension Plan withholdings or equivalent provincial taxes or withholdings.

1.5 Base Hourly Wage Rate ("BHWR").

1.5.1 For Hourly Employees. The Base Hourly Wage Rate for Hourly Employees is the amount of DSE paid to the employee per working hour for non-overtime work.

1.5.2 For Salaried Employees. The Base Hourly Wage Rate for Salaried Employees is the amount of the employee's annual DSE divided by 2,080 hours.

1.6 Direct Personnel Expense ("DPE"). DPE is the Builder's contribution to the mandatory benefits provided to its Hourly Employees and Salaried Employees.

1.6.1 For employees who are subject to a collective bargaining agreement, DPE shall only include those benefits the Builder is required to pay on behalf of the employees pursuant to the collective bargaining agreement.

1.6.2 For employees who are not subject to a collective bargaining agreement, DPE shall only include employment taxes, statutory employee benefits including workers' compensation insurance (net of premium discounts, dividends or rebates), and group insurance, (including health, dental, term life and accidental death and dismemberment insurance, all net of employee contributions), sick pay, holidays, vacation actually earned and accrued, employer contributions to employee savings plans, and pension and profit sharing plans that are nondiscretionary, requiring equal distribution of benefits.

1.6.3 DPE does not include any charge for severance pay, tuition reimbursement, employee training, employee morale programs, employee bonuses, executive bonuses, provision of, or reimbursement for automobiles, computers, software, cellular phones and internet or telephone charges, liability insurance of any kind, or any non-mandatory employer contribution to employee compensation.

1.7 Direct Personnel Expense Multiplier ("DPEM"). DPEM is a multiplier, that when multiplied by an employee's BHWR, calculates the amount of DPE allocated to an hour of the employee's work.

Example				
BHWR	*	DPEM	=	DPE
$60	*	0.25	=	$15

1.8 Direct Costs. As defined in Section 2.1, below.

1.9 Indirect Costs. As defined in Section 2.2, below.

1.10 Chargeable Costs. As calculated in Article 2, below.

1.11 Hourly Employees. A Builder's employees that are directly engaged in the performance of Work on the Project that are non-salaried and whose compensation is paid on an hourly basis.

1.12 Salaried Employees. A Builder's employees that are directly engaged in the performance of Work on the Project that are paid a salary and whose compensation is not paid on an hourly basis.

2. CHARGEABLE COSTS. Builders' Chargeable Costs only include Builder's Direct Costs and Indirect Costs directly related to performing Work for the Project, but do not include profit. All Builder Chargeable Costs are actual costs, without markup and are net of any credits, including input tax discounts or rebates.

2.1 Direct Costs. Builder's Direct Costs are the following:

2.1.1 Labor Cost. The cost of Builder's employees directly performing work on the Project calculated for each employee as follows:

Example				
BHWR	+	(BHWR * DPEM)	=	Labor Cost
$60	+	($60 * 0.25)	=	$75

2.1.2 Materials and Equipment Incorporated into the Project.

(a) Materials and Equipment. Costs, including transportation and storage, of materials and equipment incorporated or to be incorporated into the Project that are either delivered to the Project Site or suitably stored off-site at a mutually acceptable location, if pre-approved by the PMT and fully insured against loss or damage. Purchases or costs from any Builder affiliated entities, divisions, groups, etc. for materials, equipment, and other costs will be billed at the actual and auditable cost incurred by those affiliated entities, divisions, groups, etc., except as pre-approved by the PMT.

(b) Waste and Spoilage. Costs of materials described in Section 2.1.2(a) in excess of those actually incorporated into the Project to allow for reasonable waste and spoilage. Unused excess materials, if any, will become Owner's property at Final Completion or, at Owner's option, will be sold by the Builder and credited against the final cost of the Project.

2.1.3 Subcontracted Work and Services. The actual cost, net of any credits, discounts or rebates, paid by Builder to a subcontractor, subconsultant, supplier, vendor, inspector or permitting agency, that is not owned by or affiliated with Builder, for performance of Work necessary for the Project.

2.1.4 General Requirements.

(a) On-Site Temporary Facilities & Services. Costs for Builder's on-site office or big room and temporary facilities (including trailers, power, water, sanitary, utilities, telephone, internet), on-site security, on-site temporary protection and barricades (including fences, signage and traffic control), on-site temporary office furniture and equipment (including cost of computers and software purchased specifically for this Project with the concurrence of the PMT and inclusive of all variable software, applications, systems, and support costs directly related to this Project); postage and parcel delivery charges; and on-site devices, servers, printers, copiers, plotters, facsimile transmissions and long-distance telephone calls, including costs of transportation, installation, minor repairs and replacements, dismantling and removal thereof. Any equipment or materials purchased and charged to the Project will remain the property of Owner at the end of its usage.

(b) Temporary Materials and Equipment. Costs, including transportation and storage, installation, maintenance, dismantling and removal of construction materials, supplies, machinery, equipment, and small tools over $500 not customarily owned by the construction workers, that are provided by the Builder at the site (but not incorporated into the Project) and fully consumed in the performance of the construction work. If items are not fully consumed, the cost less salvage value, whether sold to others or retained by the Builder, will be included. Salvage value will be the fair market value or actual value received. The cost of small tools under $500 will not be reimbursable as part of Builder's Direct Cost, but should be included in the Builder's Indirect Costs.

(c) Third Party Rental Expenses. Rental charges for non-affiliated third-party equipment will be considered reimbursable and will be reimbursed at actual costs, as long as rental rates are consistent with those prevailing in the locality. Such equipment will be exclusive of small tools, and limited to the direct costs of transportation, delivery, installation, dismantling, removal, and maintenance. Rental charges will be equitably prorated if the foregoing equipment is not exclusively devoted to the Project.

(d) Builder Owned Rental Expenses. For rental charges for items described in Section 2.1.4(c) that are rented from the Builder or an affiliate of the Builder, the aggregate rental amounts (exclusive of all installation, maintenance, dismantling, removal, transportation, and delivery costs) for any one piece of equipment cannot exceed 80% of the purchase price (at the time it is placed in service) during the rental period of the equipment used for this Project. Agreed rates for equipment that is owned by the Builder or an affiliate and rented to the Project are subject to these same terms and must be scheduled in Exhibit F-2. Upon Owner's request, the Builder will present an analysis of an opportunity to purchase rather than rent the item. All purchased items will be a Chargeable Cost and title to the property will vest to Owner upon Final Completion.

2.1.5 Miscellaneous Costs

(a) Taxes. The Goods and Services Tax, imposed under Part IX of the *Excise Tax Act* (Canada) ("GST") imposed by a Governmental Authority, on the Owner, provided that the Builder provides the Owner with the information prescribed by the *Excise Tax Act* (Canada) to allow Owner to claim an input tax credit but for greater certainty, excluding all GST, provincial sales tax, franchise or income based tax or any similar taxes imposed by a Governmental Authority on the Builder.

(b) Insurance. Insurance expenses specifically required of Builder by the Agreement and allocable to this Project. Deductibles are a Chargeable Cost only to the extent specifically provided in Exhibit L-2 and Article 15 of the Agreement.

(c) Permits, Fees, and Assessments. Fees and assessments for the building permit for the Project and for other permits, licenses and inspections that Builder is required to pay under the Agreement. Major permits may be paid by Owner directly.

(d) Testing. Fees of laboratories for tests required by the Agreement.

(e) Fees. License fees paid for the use of a particular design or process required by the Agreement and approved by the PMT.

(f) Recycle & Waste. Costs of removal and disposal of debris from the site and recycle costs not offset by recycle fees or rebates.

(g) Document Reproduction. Costs for blueprinting and other document reproduction necessary for constructing and administrating the Project.

(h) Travel Expenses. All reasonably and actually incurred direct, non-salary, travel-related reimbursable expenses will be billed to Owner at actual cost without markup. Unless otherwise stated in Owner's travel guidelines, all air travel, regardless of domestic or international destination, will be at unrestricted coach class fare or other class, whichever is lowest. Mileage will be reimbursed at the Canada Revenue Agency's published automobile allowance rates for travel by Designer in its own vehicles.

(i) Emergencies & Repairs. Subject to the Agreement, costs incurred in taking action to prevent threatened damage, injury, or loss in case of an emergency that threatens the safety of persons.

2.1.6 Trade Discounts and Surplus. Trade discounts and refunds for Builder purchased material and equipment will be credited against the incurred Chargeable Cost. Sales of surplus materials and equipment will likewise be credited against the Chargeable Costs.

2.1.7 Cost of Repair/Correction. Cost of repairing or correcting Construction Work that is deficiently designed, or damaged or non-conforming Construction Work executed by a Builder , provided that (1) the costs are incurred prior to Final Completion and (2) the damaged or non-conforming work was not intentional or caused by Willful Default. Correction or repair of deficient or non-conforming work that was performed or installed by a Standard Consultant or Standard Subcontractor will be remedied at the a Standard Consultant's or Standard Subcontractor's own expense and is not a Chargeable Cost.

2.1.8 Other Incurred Costs. Other costs incurred by Builder that are necessary for the Project, if approved by the PMT in writing prior to being incurred.

2.2 Indirect Costs or Overhead. Builder's Indirect Costs are the following:

2.2.1 Defined. Builder's Indirect Costs are costs, of any kind, other than Direct Costs and Excluded Costs. Builder's Indirect Costs customarily include the cost of personnel not working directly in connection with the Work; executive salaries; association dues and fees; depreciation on all property, equipment or other assets; payroll processing costs; corporate taxes or fees; business development costs; employee training; all home office infrastructure costs; general administrative personnel costs; risk management costs; interest expense; perquisites such as car allowances, home office expenses (including without limitation rent, utilities, telephones, faxes, postal charges, and reprographics); software and computer hardware costs; accounting personnel; legal personnel; recruiting costs; field office; cellular telephones and pagers; severance pay, and employee morale programs.

2.2.2 Overhead Rate. If Indirect Costs are paid under option 2.2.3(b) below, the Overhead Rate is a factor only included in the Hourly Employees' or Salaried Employees' Billable Rate (as applicable). If Indirect Costs are paid under option 2.2.3(c)

below, the Overhead Rate is a factor applied to the sum of Builder's Chargeable Costs, and not included in the employee's Billable Rate.

2.2.3 Payment. Indirect Costs are paid as Chargeable Costs using one of the following methods selected when the Agreement is executed and indicated on the Business Terms Sheet:

(a) A fixed amount paid in equal monthly installments from execution of the Agreement until Final Completion;

(b) Included with the Builder's Hourly Employees' and Salaried Employees' Billable Rates calculated as (BHWR + (BHWR * DPEM)) * Overhead Rate; or

(c) Applied as an Overhead Rate multiplied by the Builder's Direct Costs incurred during a payment period.

2.2.4 Shop Indirect Costs. Builders that use pre-fabrication or shop facilities to perform portions of the Work may, with the written approval of Owner, have a separate Shop Overhead Rate that applies only to the hourly rate of Builder's employees that directly perform Work in the shop or pre-fabrication facility ("Shop Personnel") such that the Billable Rate of Shop Personnel is calculated as (BHWR + (BHWR * DPEM)) * Shop Overhead Rate.

3. EXCLUDED COSTS

3.1 Direct Costs. The following costs are excluded from Builder's Direct Costs.

3.1.1 Offsite Personnel. Salaries and other compensation of personnel stationed at any office or offices other than the Project Site office or the Contractor's principal office identified in the Notices provision of the Business Terms Sheet, unless otherwise agreed in writing by the PMT.

3.1.2 Offsite Expenses**.** Expenses related to a firm's principal office and offices other than the Project Site office.

3.1.3 Business Licenses, Permits, and Taxes**.** All costs of business and/or operating permits, licenses, fees, and taxes required by any local, provincial, or federal Governmental Authorities to enable Builders or their subcontractors of any tier to be qualified to do business and/or perform their respective portions of the Work.

3.1.4 Costs Not Included In Direct Costs. Any cost not explicitly included as a Direct Cost in Section 2.1.

3.2 Chargeable Costs. The following costs are excluded from Chargeable Costs, and will not be paid by Owner.

3.2.1 Financing or Cost of Use of Money. Financing costs, cost of use of money, or other capital expenses, including interest on capital employed for the Construction Work.

3.2.2 Bonuses and Incentive Programs. Employee bonuses or incentive program payments regardless of whether personnel are specifically assigned to this Project because these costs are carried in Contractor's Indirect Costs.

3.2.3 Fraud and Willful Default**.** Any cost resulting from fraud, Willful Default, or willful misconduct.

3.2.4 Stale Invoices**.** Work performed 75 days or more before the submittal date of the invoice to Owner, unless prior written approval is obtained from the PMT.

3.2.5 Costs incurred after Project Final Completion. Costs incurred for the Work after Project Final Completion.

[END OF EXHIBIT]

REGIONAL DISTRICT OF NANAIMO

Appendix D
AECOM Feasibility Study and Overall Site Plan

AECOM

FCPCC Secondary Treatment Process Feasibility Study

FCPCC Stage 4 & Stage 5 Expansion Project

Regional District of Nanaimo

Project number: 60590631

March 2023

Delivering a better world

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time..

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AECOM: 2015-04-13

Quality information

Prepared by		Checked by	Verified by
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Revision History

Revision	Revision date	Details	Name
00	January 23, 2023	Draft for Client Review	L. Locke
01	March 6, 2023	Final Report	L. Locke

Prepared for:

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Executive Summary

The French Creek Pollution Control Centre is a secondary wastewater treatment plant owned and operated by the Regional District of Nanaimo (RDN) in Parksville, BC. The facility is nearing its operating capacity (12 ML/d average annual flow) and is scheduled to be expanded to meet growth in the service area to 36,200 people in the year 2035 (Stage 4 Expansion) and 44,900 people in the future (Stage 5 Expansion).

AECOM completed the detailed design of a Stage 4 Expansion in 2021 which provided a capacity expansion to supplement the existing Stage 3 secondary treatment plant. The proposed expansion included modification of the screened raw sewage channel to either divert flows directly to a new equalization tank, to new Stage 4 bioreactors, or to the existing wastewater treatment infrastructure. The expansion did not include additional primary treatment upstream of the new bioreactors. The proposed expansion uses combined treatment units that consist of an activated sludge bioreactor and secondary clarifier within a single concrete structure. Two units were proposed for the Stage 4 Expansion with an additional two units added during the Stage 5 Expansion.

After receiving the Detailed Design and Construction Cost Estimate (AECOM, 2021), the RDN expressed concerns regarding the cost growth of the project and initiated a value engineering study to identify potential alternatives to the initial design from a planning and optimization perspective. A key concern resulted from the costs incurred to maintain existing trickling filter infrastructure and significant odour control costs that were required to address the continued use of the process. Subsequently, the RDN developed a new concept that repurposes the existing secondary clarifiers for use as primary clarifiers, abandons the aging and problematic tricking filter/solids contact process, and conveys primary effluent to new combined treatment units for secondary treatment. A portion of the trickling filter infrastructure would then be repurposed as peak flow storage/equalization. Key advantages of this concept include:

- Providing additional primary treatment capacity at minimal cost
- Consolidating the secondary treatment process into one technology (conventional activated sludge)
- Reducing odour control infrastructure requirements
- Diverting capital expenditures to improving infrastructure rather than fixing aging infrastructure and operational challenges that are inherent in the existing technology.

The RDN retained AECOM to assess the feasibility of this modified approach, including identifying any fatal flaws that could prevent modifications to be made within the existing plant as well as updating the design basis for the new “full-flow” secondary treatment infrastructure. This report outlines AECOM’s assessment of the modified Stage 4 and 5 Expansion concept and provides a recommendation for a design approach that will best fit the RDN’s objectives.

The feasibility study determined the following key conclusions:

- By applying minor modifications to the existing plant, it is feasible to repurpose the existing secondary clarifiers into primary clarifiers and increase the primary treatment capacity of the existing plant. AECOM concluded that the expanded primary clarification capacity would be sufficient to operate under the Stage 4 and Stage 5 flows and loads.
- The tricking filter/solids contact process will not be part of Stage 4 and 5 Expansions and will be abandoned. It is feasible to repurpose the structures for flow equalization. The modification would include removing the spray headers, the filter media, the feed pumps, the recirculation pumps, and the structure above the 10.5 m floor elevation.
- The application of a new equalization basin, retrofitted from the tricking filter/solids contact structure, may mitigate the current odour issues originating from the primary clarifiers due to the wastewater becoming septic during low flows. This is achieved by transferring the collected wastewater in the equalization basin to the head of the plant overnight.

- The secondary treatment process must meet the redundancy requirements of the Municipal Wastewater Regulation and is proposed to include four new combined treatment units, which are sized based on Stage 5 flows and loads. According to preliminary sizing done in this study, each combined treatment unit will have an overall diameter of 27.6 meters.
- Effluent flow from the modified Stage 4 and 5 Expansion is proposed to be measured by a Parshall flume and then disinfected through open-flow channel ultraviolet reactors before discharging to the secondary effluent pump station wet well.
- A new reclaimed water treatment system is proposed to be installed at the new secondary treatment process location since the existing reclaimed water infrastructure is not in a suitable location to service the reconfigured plant.
- The final effluent water supply for the Morningstar Golf Course will be relocated to the new secondary treatment process location.
- To mitigate the odour issue within the primary treatment area, it is proposed to separate and enclose the headworks building and install covers on open-top areas that contain primary influent. Foul air will be extracted from these spaces and treated through a new synthetic media biofilter. The new odour control system for the new primary treatment area requires approximately a third of the capacity of the trickling filter odour control system.

An estimate of AECOM's opinion of probable cost for the Modified Stage 4 & 5 Expansion concept, assuming a construction start of April 2024, was determined to be $81,180,000. The cost estimate has an expected range of accuracy between ±20%.

AECOM is of the opinion that the modified approach to the future development of the FCPCC is very feasible, will eliminate long term odour sources at the plant, and will result in a more effective facility for the existing community and future population growth.

Table of Contents

Figures

Tables

1. Introduction

1.1 Background

The French Creek Pollution Control Centre (FCPCC) is a secondary wastewater treatment plant owned and operated by the Regional District of Nanaimo (RDN) in Parksville, BC. The FCPCC treats wastewater produced by approximately 27,000 people in the communities of French Creek, Parksville, Qualicum Beach, and the surrounding areas. FCPCC receives wastewater from seven pump stations, interceptor lines and forcemains, and has a septage receiving facility on site. The existing plant provides primary treatment followed by secondary treatment using a trickling filter/solids contact (TF/SC) process to remove the remaining solids and organic pollutants from the wastewater. The RDN has authorization under Environmental Management Permit No. PE-4200 to discharge treated effluent from FCPCC to the Strait of Georgia 2,440 m offshore at a depth of 61 m. FCPCC produces Class A biosolids, which are beneficially managed through a soil fabrication program. From May to September, up to 1,370 m^3/d of reclaimed water is pumped to ponds at the Morningstar Golf Course where it is stored for irrigation.

The plant was originally constructed in 1977 and has undergone many upgrades and expansions. Recent upgrades include:

- Stage 2 Expansion: Trickling filters and solids contact tanks were constructed to replace activated sludge with the TF/SC process in 1996.
- Stage 2B Expansion: The fourth Autothermal Thermophilic Aerobic Digester (ATAD) was commissioned in 2004.
- Stage 3 Expansion: Modifications to the solids contact tanks, headworks, turborators, and solids handling processes from 2006 to 2010.

The FCPCC is nearing its operating capacity (12 megalitres per day [MLD] annual average flow [AAF]) and the plant is scheduled to be expanded to meet growth in the service area to 36,200 people in the year 2035[1] (Stage 4 Expansion) and 44,900 people in the future (Stage 5 Expansion). The secondary treatment process selection for the Stage 4 Expansion was performed in 2011 and a conventional activated sludge process was recommended. The objectives of the Stage 4 Expansion project include:

- Provide additional wastewater treatment capacity to meet provincial and federal regulations.
- Reduce odours in the surrounding neighbourhoods.
- Be expandable for future growth.
- Replace ageing infrastructure.
- Contribute to sustainability and greenhouse gas reduction goals.

In 2021, AECOM completed the FCPCC Stage 4 Expansion Detailed Design, which includes:

- New secondary treatment infrastructure based on a conventional activated sludge process.
- Maintenance building and storage area adjacent to secondary treatment infrastructure.
- Effluent pump station replacement with a new facility for all flows.
- Odour control for the existing TF/SC process.
- New secondary sludge thickening penthouse with expanded capacity.

[1] The expansion years presented in this report are estimates based on population growth rates provided by the RDN at the start of the work in 2018. Recent data indicates that the actual population growth in the tributary area is lower than originally projected so requirements for future expansions are likely delayed.

- Replacement of much of the existing, aging trickling filter infrastructure and renovations to the enclosure to mitigate odour escape.
- New odour control system for the dewatering building.
- New dewatered sludge bin loading conveyors and relocated truck scale.
- New flow measurement infrastructure and provision for future ultraviolet (UV) disinfection.
- Improved forklift access to digester pump room roof structure area.
- Major renovations and upgrades to the existing administration building.
- Upgrades to the Morningstar Creek crossing.
- New site access from the Island Highway complete with vehicle gate.
- New security gate at the main entrance to the plant.
- New electrical service and power distribution.
- Relocate existing motor control centres above the hydraulic grade line where needed to mitigate flood risk.
- New generator and fuel tank adjacent to new Stage 4 secondary treatment infrastructure.
- Equalization (EQ) tank to attenuate peak diurnal flows and improve wet weather management.

Following the Detailed Design and Construction Cost Estimate (AECOM, 2021), the RDN expressed concerns regarding the cost growth of the project and whether the project was still addressing the challenges with the most appropriate solution. A value engineering study was initiated in 2021 to identify viable alternatives to the proposed design from a planning and optimization perspective.

Subsequent to the value engineering efforts, the RDN developed a modified concept that repurposes the existing secondary clarifiers (SCs) as primary clarifiers (PCs) and directs primary effluent to new combined treatment units (CTUs) that consist of a bioreactor and secondary clarifier in a single circular structure. The existing SCs would need a retrofit to function as primary clarifiers. A summary of the modified approach is described below:

- Use the existing PCs as primary treatment for the CTUs.
- Upsize the CTUs and add additional units to treat all flow during normal operation and meet *Municipal Wastewater Regulation* (MWR) reliability requirements.
- Repurpose the TF/SC tanks as equalization storage for peak flows.
- Convert the existing SCs into PCs.
- Do not construct the previously proposed EQ tank or odour control upgrades for the trickling filter.
- Reduce the capacity requirements for odour control within the existing plant.

The RDN retained AECOM to assess the feasibility of the modified approach for the FCPCC Stage 4 Expansion and determine the feasibility of designing the plant for Stage 5 design flows. Considerations for this approach include, but are not limited to:

- Details of flow routing and distribution from existing PCs through converted SCs to CTUs.
- Consideration of strategies for mitigating PCs going septic overnight.
- Consideration of options to mitigate odour and corrosion concerns in waste biological sludge (WBS) building if primary effluent flow is directed through the existing final effluent channel to the CTUs.
- Evaluation of opportunities to re-purpose existing, decommissioned infrastructure for flow equalization or other purposes.

This report describes the feasibility assessment of implementing the modified approach, along with other required modifications for the Stage 4 and Stage 5 Expansions.

Table 1-1 provides a more detailed description of the differences between the two options.

Table 1-1. Description of Original Design versus Full Secondary Treatment Replacement Options

Descriptions	AECOM 2021 Design	Full New Secondary Treatment Feasibility Study
Treatment Plant Capacity Expansion	• Expand plant from an average annual flow from 10.5 ML/d to 14.1 ML/d (3.5 ML/d) by adding 2 combined treatment units (CTUs) each at 1.75 ML/d capacity for Stage 4 flows.	• Expand plant from an average annual flow from 12 ML/d to 17.5 ML/d (7.0 ML/d) by adding 4 combined treatment units each at 4.375 ML/d capacity for Stage 5 flows.
Overall scope of work Impacted by Treatment Changes	• New secondary treatment for 3.5 ML/d of the screened primary influent. Combined treatment units (CTUs) built for this flow. Remaining flow to existing treatment facility.	• New secondary treatment for all primary effluent. Existing liquid stream treatment infrastructure converted to primary clarifiers and flow equalization. • Demolition and modifications needed.
Existing Plant Demolition	• Removal of 50% of old sludge drying beds (now used for storage.) • Replace walls on upper level (elevation 14.15 m) of trickling filters with translucent panels (see discussion below)	• Removal of 50% of old sludge drying beds (now used for storage). • Removal of existing primary clarifier roof and support structure. • Removal of trickling filter roof and all components above elevation 10.5 m. • Decommission all trickling filter mechanical, HVAC, and electrical infrastructure.
Influent distribution	• New splitter box after the screening step to transfer flows to either existing plant, new CTUs, or new flow equalization tank. • Inclusion of a new manually raked by-pass screen and channel	• Inclusion of a new manually raked by-pass screen and channel • Flows to new CTUs and new equalization tankage relocated to existing effluent pump station (see discussion on flow equalization below)
Existing Primary Sedimentation Tanks	• No changes to existing infrastructure.	• Remove roof and add low profile covers for odour containment.
Trickling filters	• Replace distribution piping • Replace existing walls with translucent panels • Replace existing ventilation system with odour control system (see discussion below)	• Re-purpose trickling filter structure as an equalization tank (see discussion below)
Solids Contact Tank	• No change to existing infrastructure.	• Re-purpose solids contact tank for flow equalization (see discussion below) • Modify effluent launder box and use to direct primary influent to secondary clarifiers 2 and 3.

Descriptions	AECOM 2021 Design	Full New Secondary Treatment Feasibility Study
Existing Secondary Clarifiers	• No changes to existing infrastructure.	• Convert secondary clarifiers 2 and 3 to primary sedimentation tanks and add low profile covers for odour containment. Secondary Clarifier 1 could be converted in the future if needed.
Equalization tank	• New tank (24.5m L X 11.5m W X 7.5m D) • Odour control covers • Mixers • Tank Washing System • Transfer Pumps	• Repurposing the TF/SCs to EQ basins • New walkways at elevation 10.5 m • Odour control covers • Mixers • Tank Washing System • Transfer Pumps
CTUs Distribution Box	• New box	• New box (4 times larger than original 2021 Design box) to accommodate higher flows
Combined Treatment Units	• 2 units – 12.3 m radius	• 4 units – 13.6 m radius
Operations building	• Addition and renovation	• No change to the AECOM 2021 Design
Waste biological sludge thickener	• Two new units and new 2nd floor structure	• No change to the AECOM 2021 Design
Trickling Filter Odour Control	• New collection system and biofilter	• Reduce odour treatment capital cost by 50% compared to the updated AECOM 2021 Design cost
Dewatering building odour control biofilter	• New biofilter	• No change to the AECOM 2021 Design
Tertiary filtration	• Not discussed	• Space allowance for future installation – no cost incurred at this time.
Parshall Flumes	• Two new flumes for the new secondary treatment plant	• Only 1 flume for the new secondary treatment plant
UV disinfection	• Space allowance for future installation – Concrete channel only	• Add UV equipment for Stage 4 expansion
Morningstar Creek Golf Club – water irrigation supply	• No change from the Stage 2 design	• New pumping system at the new secondary treatment plant area
Reclaimed Water Supply	• No change from the Stage 2 design	• New filtration and storage system at the new secondary treatment plant area
Dewatering Building	• Install new sludge cake distribution conveyor	• No change to the AECOM 2021 Design
Civil works	• Site works	• Double the cost for site works.
Morningstar Creek bridge replacement	• New bridge.	• No change to the AECOM 2021 Design
CTU Building	• New building	• AECOM 2021 Design – plus 10% larger footprint

Descriptions	AECOM 2021 Design	Full New Secondary Treatment Feasibility Study
Electrical Infrastructure	• New incoming power from BC Hydro • New main electrical room/primary distribution equipment • New emergency generator • Relocate electrical infrastructure above hydraulic grade line to eliminate flooding risk	• Same as the AECOM 2021 Design and … • Larger electrical room in the CTU Building • More electrical infrastructure related to additional tankage.
Building Mechanical – CTU Building	• New HVAC in new building	• HVAC capacity increased by 10% to accommodate larger building.

1.2 Report Objectives

The objectives of this report include:

- Update the previous review of regulatory requirements.
- Confirm Stage 4 and Stage 5 Expansion flows and loads.
- Assess the feasibility of retrofitting primary treatment in the existing plant with secondary treatment implemented in a new plant.

1.3 Site Location

It is proposed that the new secondary treatment infrastructure will be constructed on the lower portion of the site to the northwest of the existing plant, on the opposite side of Morningstar Creek. The dewatering building is currently located in this area along with old sludge drying beds (now equipment storage) and a small pre-engineered building that will be replaced with dry, heated storage space as part of the new project. The existing plant is located on the upper portion of the site on the southwest side of the property, near the intersection of Island Highway and Lee Road.

1.4 Feasibility Study Scope

The scope items of the Feasibility Study are listed below:

- Feasibility of using and expanding the existing PCs' capacity by re-purposing existing SCs to operate as primary treatment for the new CTUs.
- Feasibility of converting the existing SCs into PCs.
- Providing details of flow routing and distribution from the primary influent channel upstream of the existing PCs through the converted SCs to the CTUs.
- Considerations for abandoning the TF/SC process.
- Evaluating opportunities to re-purpose and decommission the existing TF/SC infrastructure for flow equalization or other purposes.
- Proposing strategies for mitigating PCs going septic overnight.
- Proposing options to mitigate odour and corrosion concerns in the WBS building if the primary effluent flow is directed through the existing final effluent channel to the CTUs.
- Confirming the number and size of the new CTUs.
- Adding ultraviolet (UV) disinfection as part of the modified Stage 4 and 5 Expansion.

- Allocating space for tertiary filtration if needed in the future.
- Cost comparison of AECOM's 2021 Stage 4 Design with the modified Stage 4 and 5 Expansion concept (BF-14 Value Alternative).

1.5 Definitions and Abbreviations

Defined terms, abbreviations and acronyms used in this report are summarized in Table 1-1.

Table 1-2. Terms, Abbreviations and Acronyms

Acronym	Description
AAF	Average Annual Flow
ADWF	Average Dry Weather Flow
ATAD	Autothermal Thermophilic Aerobic Digester
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
BOD_5	Five-day Biochemical Oxygen Demand
$cBOD_5$	Five-day Carbonaceous Biochemical Oxygen Demand
CMDF	Cloth-media disk filter
COD	Chemical Oxygen Demand
CTU	Combined Treatment Unit
$d.BOD_5$	Dissolved Five-day Biochemical Oxygen Demand
d.COD	Dissolved Chemical Oxygen Demand
EMA	BC Environmental Management Act
EQ	Equalization
ff.COD	Flocculated Filtered Chemical Oxygen Demand
FCPCC	French Creek Pollution Control Centre
LWMP	Liquid Waste Management Plan
MLD	Mega-litres per day
MWR	BC Municipal Wastewater Regulation
PC	Primary Clarifier
PF	Peaking Factor
RDN	Regional District of Nanaimo
SC	Secondary Clarifier
SLR	Solids Loading Rate
SOR	Solids Overflow Rate
TF/SC	Trickling Filter / Solids Contact
TSS	Total Suspended Solids
UV	Ultraviolet
WAS	Waste Activated Sludge
WBS	Waste Biological Sludge (older acronym, equivalent to WAS)
WSER	Wastewater Systems Effluent Regulations

2. Regulatory Requirements for Effluent Criteria

2.1 Federal Requirements

The *Fisheries Act* was promulgated by the federal government to protect fish that are part of or support a commercial, recreational, or First Nations' fishery. The *Fisheries Act* prohibits the discharge of deleterious substances into fish-bearing waters. According to the *Fisheries Act*, a deleterious substance means:

- any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water, or
- any water that contains a substance in such quantity or concentration, or that has been so treated, processed or changed, by heat or other means, from a natural state that it would, if added to any other water, degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water.

The Wastewater Systems Effluent Regulations (WSER) was enacted by the federal government in 2012 under the *Fisheries Act* and amended in 2015. WSER establishes that a wastewater effluent is not considered a deleterious substance if it meets minimum discharge limits for carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), total residual chlorine (TRC), and unionized ammonia, which are summarized in Table 2-1. Furthermore, to not be considered a deleterious substance under WSER, wastewater effluent must meet acute lethality requirements.

Table 2-1. WSER Effluent Discharge Requirements

Parameters	Criteria
$cBOD_5$	≤ 25 mg/L (quarterly average)
TSS	≤ 25 mg/L (quarterly average)
TRC	≤ 0.02 mg/L (only if used in treatment)
Un-ionized ammonia	< 1.25 mg/L (calculated as N at 15°C ± 1°C and the effluent pH per WSER) (maximum) using the following equation: $(\text{total ammonia})/(1+10^{9.56 - \text{pH}})$ *Where:* *total ammonia = the sum of unionized and ionized ammonia* *pH = the initial pH of the effluent at 15°C ± 1°C* *9.56 = the logarithmic dissociation constant of ammonia at 15°C* *The concentration of total ammonia in the effluent is determined using an aliquot of the effluent from which the pH of the effluent is determined.*
Acute lethality	Effluent at 100% concentration does not kill more than 50% of the rainbow trout (RBT) subjected to it during a 96-hour test period.

2.2 Provincial Requirements

The BC *Environmental Management Act* (EMA) is the primary provincial legislation relating to environmental matters and gives the Minister broad powers and functions pertaining to the management, protection, and enhancement of the environment. The MWR, as a regulation under EMA, regulates discharges of wastewater effluent. The MWR effluent quality requirements are summarized in Table 2-2.

Table 2-2. MWR Effluent Quality Requirements

Parameters	Discharge Limit
$cBOD_5$ (24-hour composite) Daily flow < 2x ADWF: Daily flow ≥ 2x ADWF:	 45 mg/L 130 mg/L
TSS (24-hour composite) Daily flow < 2x ADWF: Daily flow ≥ 2x ADWF:	 45 mg/L 130 mg/L
pH	6-9

All the above effluent discharge limits would apply to the expanded FCPCC, and the plant will be designed to meet these effluent quality requirements.

2.2.1 Disinfection Requirements

The MWR states the following discharge requirements for fecal coliform (not including reclaimed water):

a) if discharging to shellfish-bearing waters at the edge of the initial dilution zone, the median or geometric mean most probable number of fecal coliform organisms must be less than 14/100 mL, with not more than 10% of the samples exceeding 43/100 mL;

b) if discharging to recreational use waters, the geometric mean number of fecal coliform organisms at the edge of the initial dilution zone must be less than or equal to 200/100 mL.

Fecal coliform is removed from wastewater by disinfection, typically by chlorination or UV disinfection. The requirement for disinfection at FCPCC will be confirmed by the environmental impact study that is currently underway. As part of the modified Stage 4 & 5 Expansion concept, the installation of a UV disinfection reactor is included in the design. This process is further described later in this report.

2.2.2 Monitoring Requirements

Monitoring and reporting requirements are stated in the MWR and are based on the maximum day flow range. The FCPCC falls within the range of 5,000 to 50,000 m^3/d and therefore monitoring requirements are:

Table 2-3. MWR Monitoring Requirements

Parameters	Frequency and Type
Flow	Daily
BOD, TSS	Weekly grab samples
NH_4-N, PO_4-P, total P	6 times/year grab samples
Fecal Coliform	Monthly grab samples

The above data must be submitted to a director twice per year. The WSER also has specific monitoring and reporting requirements. These include:

- A continuous measure of the volume of influent or effluent.
- Composite samples are taken every two weeks and analyzed for BOD and TSS.
- Quarterly sampling and analysis for acute lethality.
- Quarterly reporting.

The frequency of lethality testing increases to twice per month if the effluent is found to be acutely lethal; the frequency returns to quarterly once there are three consecutive samples determined not to be acutely lethal. Further, if the effluent is found not to be acutely lethal for four consecutive quarters, then the sampling frequency is reduced to yearly.

2.2.3 Reliability Requirements

The MWR reliability category of a wastewater facility is determined based on the environmental impact study, which is prepared by a qualified professional. As previously mentioned, the FCPCC environmental impact study is in progress but has not been finalized or published at the time of writing this report. However, based on facilities of similar scope, size and receiving environments it is assumed that the plant will fall under Category I, which is defined as a facility:

1. that discharges to ground or water, and
2. in respect of which short term effluent degradation could cause permanent or unacceptable damage to the receiving environment, including discharges near drinking water sources, shellfish waters or recreational waters in which direct human contact occurs.

The general component and reliability requirements of a Reliability Category I facility are summarized in Table 2-4.

Table 2-4. Component and Reliability Requirements of Category I Facility

Wastewater Facility Component	Reliability Requirement
Primary Sedimentation Tanks	Multiple units, 50% of design flow when one tank is out of service.
Biological Reactors	Multiple units, 75% of design flow when one tank is out of service.
Secondary Clarifiers	Multiple units, 75% of design flow when one tank is out of service.
Anaerobic Digesters	2 digesters minimum, 50% of design flow when one digester is out of service.

Source: Table 1, BC Municipal Wastewater Regulation (BC ENV, 2012)

2.2.4 Effluent Discharge Authorization

A waste discharge authorization is written permission under the EMA to release waste into the environment. An approved authorization must be obtained before discharging any waste and the application to discharge waste is specific to the waste activity. In BC, municipal effluent or use of reclaimed water requires compliance with the MWR to authorize the discharge. The RDN currently has authorization under Environmental Management Permit No. PE-4200 to discharge a maximum daily flow of 16,000 m^3/d of treated effluent from FCPCC to the Salish Sea.

Liquid waste management plans (LWMP), authorized under the provincial EMA, allow municipalities to develop community-specific solutions for wastewater management that meet or exceed existing regulations. Under a LWMP, the BC Ministry of Environment and Climate Change Strategy (BC ENV) can issue operational certificates to specify monitoring, reporting, and general requirements for authorized municipal wastewater discharges. Operational certificates will eventually replace the legacy waste discharge permits. Permit updates can be triggered by changes to the authorized treatment works or when the maximum effluent flow is increased by a minimum of 10%.

The MWR, Division 2, Section 16 (2) states that re-registration of a municipal wastewater facility is required if the volume of discharge increases by 10%. The proposed upgrades will increase the FCPCC capacity by more than 10%, so it is expected that an operational certificate or registration under the MWR will be required.

The RDN has initiated the process to amend its LWMP to better reflect the status of its capital project list and timelines and streamline future action items. It has been proposed to transition the FCPCC discharge authorization to operational certificates, as an amendment to the LWMP is in progress.

As part of this process, the existing reclaimed water system may need to be reviewed and registered under the MWR. This can be a lengthy process as reclaimed water consumers within the plant, such as utility stations used by operators and process water uses, must be included in the registration. During detailed design, all the current reclaimed water consumers within the plant will need to be identified to register these uses with the ministry.

2.3 Existing Treatment Plant Performance

The authorized treatment works of the existing FCPCC include a septage receiving facility, mechanical screens, grit tanks, PCs, biological reactors, SCs, trickling filters, thermophilic aerobic digesters, biosolids thickening and dewatering facilities, odour control facilities, and outfall extending approximately 2 km from shore to a depth of 61 m below mean low water, and effluent pumping station and pipeline to convey effluent to the storage ponds at the Morningstar Golf Course, standby power, and related appurtenances (RDN, 2016). It is noted that the effluent reuse program to Morningstar Golf Course was discontinued between 2015 to 2019.

The FCPCC is currently designed to treat an AAF of 12.0 ML/day. As shown in Figure 2-1, the plant is nearing its capacity.

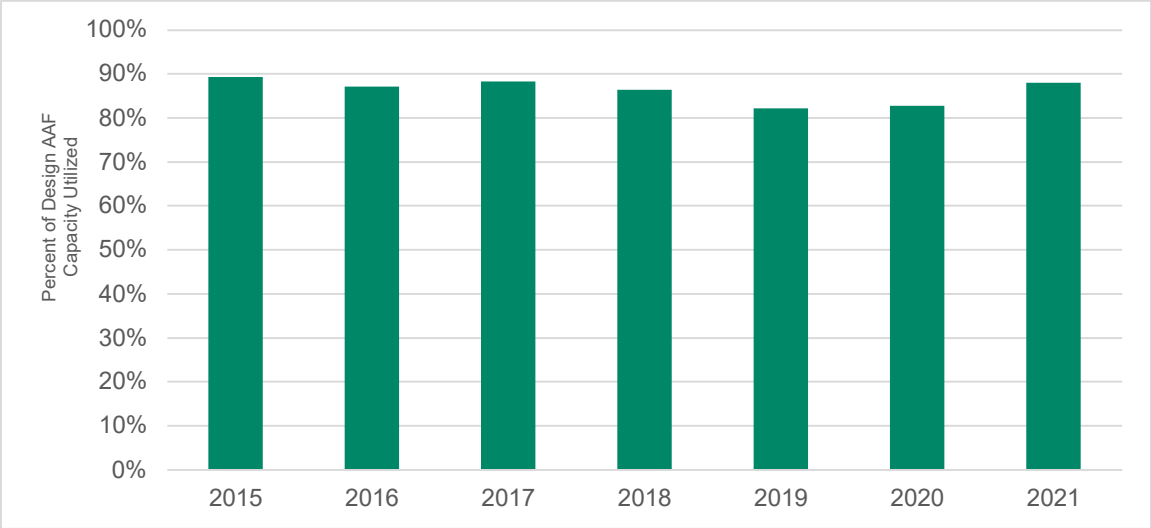

Figure 2-1. FCPCC - Percent of AAF Capacity Utilized (2015 – 2021)

Permit PE-4200 states that the maximum rate a which effluent may be discharged from FCPCC to the Salish Sea is 16,000 m^3/day. The characteristics of the discharge to the Salish Sea shall not exceed 45 mg/L BOD_5 and 60 mg/L TSS. The FCPCC is also operated to meet the current WSER effluent discharge requirements. The number of times the permit limits were exceeded at FCPCC in recent years, including flow limits, are shown in Figure 2-2.

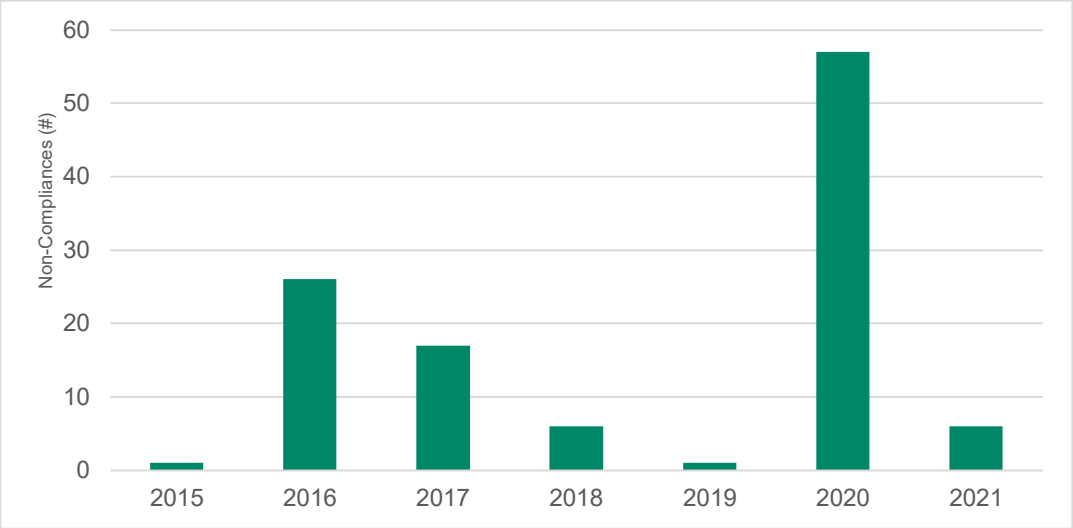

Figure 2-2. Number of Non-Compliances at FCPCC

The non-compliance events in 2016 are attributed to maintenance on the trickling filter influent channel and solids contact tank when the trickling filter needed to be bypassed. Similarly, in 2020 the non-compliances were primarily related to an approved bypass for maintenance of the contact tanks. In general, the FCPCC secondary treatment operates acceptably to meet the current permit requirements. However, additional capacity is required to treat the growing population in the catchment.

3. Flows and Loads

The historical and future projected flow and load data are discussed in this section. Stage 4 and Stage 5 Expansion flow and load estimates are used as the design basis and sizing in this feasibility study.

3.1 Historical Flows and Loads

AECOM prepared the per capita flow and load data using the historical flow, influent loading, and population data from the FCPCC annual monitoring reports between 2003 and 2016. The detailed evaluation can be found in the previous AECOM submission, "*FCPCC Stage 4 Expansion, Summary of Design Criteria -Technical Memorandum 1"* (AECOM, 2017), and the summary tables are enclosed in Appendix A of this report.

The influent loading data was aggregated into winter and summer loading data. Summer loading includes the months of April to September, and winter loading includes the balance of the year. The determination of summer (dry weather) months and winter (wet weather) months is based on the City of Parksville Rainfall Records average rainfall records measured at the Public Works yard from 2005 to 2015.

3.2 Design Flows and Loads

AECOM reviewed the historical population data and predicted the future projected population based on available information (AECOM, 2017). Considering the 2016 population growth estimate, the projected service population in 2035 (the Stage 4 Expansion design year) was estimated to be 36,200 people. Assuming that future development will be similar to the 2016 development in the catchment, and per capita, flow and loading will be similar, the Stage 5 Expansion was estimated to have a design population of 44,900 person equivalents. The design year was not established for Stage 5 because the population growth estimates past 2035 are not available.

Table 3-1 provides the summary of historical and future design flows and loads. Stage 4 and Stage 5 Expansion flows and loads have been used in this feasibility study.

Table 3-1. Design Flows and Loads

Parameters	Units	Historical Data	Stage 4 Expansion (2035)			Stage 5 Expansion		
			Annual	Summer	Winter	Annual	Summer	Winter
Service Population		27,513 (year 2016)	36,200			44,900		
Average Annual Flow[a]	L / cap / d	380	389			389		
Average Dry Weather Flow[a]	L / cap / d	363	383			383		
Maximum Month Flow[a]	L / cap / d	429	445			445		
Maximum Day Flow[a]	L / cap / d	652	647			647		
Average Annual Flow	m^3/d	10,457[a]	14,100[b]			17,500[b]		
Average Dry Weather Flow (PF 0.95)	m^3/d	9,984[a]	13,900[b]			17,200[b]		
Maximum Month Flow (PF 1.13)	m^3/d	11,792[a]	16,200[b]			20,000[b]		
Maximum Day Flow (PF 1.72)	m^3/d	17,935[a]	23,500[b]			29,100[b]		
Peak Wet Weather Flow (PF 3.7)	L/s	448[c]	-	-	604[c]	-	-	749[c]
Average Day BOD[d]	kg/cap/d	0.059	0.064	0.068	0.061	0.064	0.068	0.061
Maximum Month BOD[d]	PF	1.28	1.25	1.16	1.18	1.25	1.16	1.18
Average Day TSS[d]	kg/cap/d	0.103	0.119	0.126	0.109	0.119	0.126	0.109
Maximum Month TSS[d]	PF	2.42	2.65	1.11	1.15	2.65	1.11	1.15
Average Day NH3[d]	kg/cap/d	0.013	0.012	0.012	0.012	0.012	0.012	0.012
Average Annual BOD[e]	kg/d	1,611	2,400	2,500	2,300	2,900	3,100	2,800
Maximum Month BOD[e]	kg/d	2,060	3,000	2,900	2,700	3,700	3,600	3,300
Average Annual TSS[e]	kg/d	2,843	4,300	4,600	4,000	5,300	5,700	4,900
Maximum Month TSS[e]	kg/d	6,873	11,300	5,100	4,600	14,000	6,300	5,600
Average Annual NH3[e]	kg/d	346	500			600		
Maximum Day BOD[f]	mg/L	380	380			380		
Maximum Day BOD[g]	kg/d	3,794	5,282			6,536		
Maximum Day TSS[f]	mg/L	680	680			680		
Maximum Day TSS[g]	kg/d	6,789	9,520			11,696		

Notes:

(a) See Appendix A for details.
(b) Values are the product of per capita flows and future service population (Values are rounded up to 100 m3/d).
(c) Peaking factor x AAF
(d) Calculated based on loading for the period (i.e., annual, summer, or winter), AAF, and population
(e) Calculated based on per capita loading in this table and population
(f) From Table 3-3 in FCPCC Stage 5 Expansion, Summary of Design Criteria -Technical Memorandum 1.
(g) Calculated based on Max Loading presented and ADWF presented in this table.

4. Process Design Feasibility

This section discusses the feasibility of process design for the modified Stage 4 and 5 Expansion concept. The discussion includes proposing approaches to modify the existing plant, identifying any fatal flaws that could prevent the changes to occur, and BioWin modeling of the new secondary treatment processes.

4.1 Process Flow – 2021 Stage 4 Design

The secondary treatment process for the 2021 Stage 4 Expansion design is a conventional activated sludge process designed for BOD/TSS removal. The conventional activated sludge process involves installation of suspended growth aeration tanks (bioreactors) and SCs.

The proposed process for the 2021 Stage 4 Expansion does not include primary treatment. A portion of screened raw sewage would be sent directly to the new Stage 4 bioreactors for treatment. This was intended to simplify the tie-in to the existing plant. Further, eliminating primary treatment reduces the capital cost of the upgrade by reducing the amount of process tankage and equipment required, simplifies the process, and reduces the site footprint. The disadvantage of eliminating primary treatment is that additional energy will be needed for aeration of suspended BOD that would have otherwise been removed in the PCs.

Flow distribution would be achieved by an extension to the screened raw sewage channel, which would distribute flows to the existing PCs, a new equalization (EQ) tanks, and the new secondary treatment process. Flow control weirs were proposed for the channel extension to divert a portion of the screened raw sewage flow to either the new EQ tank and/or the new Stage 4 bioreactors. The design intent of the EQ tank is to store diurnal peak flows and discharge those flows during plant low flow periods at night for improved effluent quality. In addition, equalization will also provide some attenuation of wet weather flows.

Flow from the existing and proposed plant expansion is combined downstream of the Parshall flumes and passes through a channel designated for a future UV reactor before discharging to the secondary effluent pump station wet-well.

4.2 Process Flow – Modified Stage 4 & 5 Expansion

The modified Stage 4 and 5 Expansion concept involves using and expanding the existing PCs' capacity and re-purposing the existing SCs to operate as primary treatment for all flows entering the plant. The existing TF/SC process is proposed to be decommissioned, with all primary effluent conveyed to the new CTUs for secondary treatment. UV disinfection is also proposed to be included in the modified design, with space allocated for tertiary filtration if it is needed in the future. A bypass of the secondary treatment process will also be incorporated into the modified design, which will include flow measurement and disinfection.

A process flow diagram has been developed as part of this feasibility study, showing the major process units, liquid stream, solids stream and major recycle streams related to the Stage 4 and 5 Expansions and the existing infrastructure. The process flow diagram is included in Appendix B of this report.

4.3 Process Simulation using BioWin™

BioWin™ process simulation software was used to develop a process model for the modified Stage 4 and 5 Expansion. The purpose of the model is to determine the minimum total bioreactor volume and SC surface area required for the new CTUs.

In this model (shown in Figure 4-1), the tank elements are aggregates of all the process tanks and represent the total volume of all parallel process streams. For example, only one SC is shown, but the surface area is based on the combined surface area of all four proposed SCs. Similarly, the primary treatment element shown represents the total combined surface area of the existing PCs and existing SCs that will be repurposed to provide primary treatment as part of the modified Stage 4 and 5 Expansion concept.

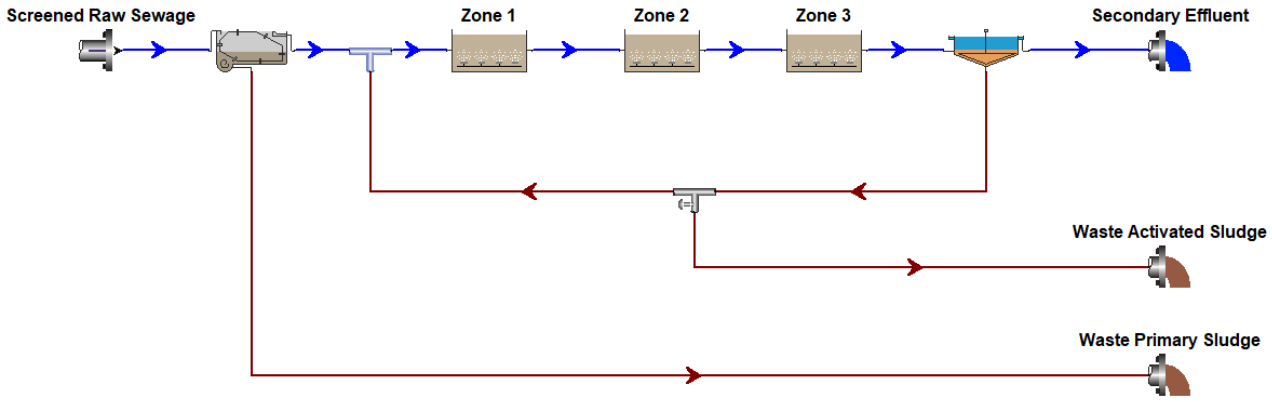

Figure 4-1. BioWin Model

The design flows and concentrations used for the model were derived from Table 3-1 and are summarized in Table 4-1.

Table 4-1. Design Flows and Concentrations for BioWin Model

Parameter	Value	Comments
Flow, m^3/d	20,000	Maximum Month Flow
BOD_5, mg/L	206 (summer) 191 (winter)	Derived from the maximum month BOD_5 load divided by the average annual flow
TSS, mg/L	362 (summer) 326 (winter)	Derived from the maximum month TSS load divided by the average annual flow
Ammonia, mg/L	42.6 – annual	Derived from the average annual ammonia load divided by the average annual flow, and then multiplied by an assumed max month peaking factor of 1.2

The values presented in Table 4-1 were used to derive the values required for the BioWin input file. Assumptions used in the development of the BioWin input files are as follows:

- Flow – the maximum month flow noted in Table 4-1 was used for all normal operating scenarios. 75 percent of this flow (15,000 m^3/d) was used for the scenario involving one CTU out of service.
- Total chemical oxygen demand (COD) – this parameter was adjusted to meet the required maximum month carbonaceous biochemical oxygen demand ($cBOD_5$) concentration based on the wastewater fractions used in each scenario. It was further assumed that the $cBOD_5$ to BOD_5 ratio equals 0.84.
- Total Kjeldahl nitrogen – this parameter was adjusted to meet the required maximum month ammonia concentration based on the wastewater fractions used in each scenario.
- Total Phosphorus – the default BioWin value of 10 mg/L was used in all scenarios as there was no information on phosphorus concentration available.
- Nitrate N – the default BioWin value of 0 mg/L was used in all scenarios as there was no information on nitrate concentration available.

- Alkalinity – Based on the influent wastewater characterization, a value of 4.5 mmol/L was used for all scenarios.
- Inert Suspended Solids – this parameter was adjusted to meet the required maximum month TSS concentration based on the wastewater fractions used in each scenario.
- Calcium, Magnesium and dissolved oxygen – the default BioWin values of 80, 15 and 0 mg/L (respectively) were used in all scenarios as there was no information on these concentrations available

BioWin models were run for the following scenarios:

- Summer conditions with BioWin default wastewater fractions
- Summer conditions with wastewater fractions outlined in Table 2-11 of the *FCPCC Stage 4 Expansion Project 60% Design Report* (AECOM, 2019) (derived from the Envirosim influent specifier spreadsheet)
- Winter conditions with BioWin default wastewater fractions
- Winter conditions with wastewater fractions outlined in Table 2-11 of the *FCPCC Stage 4 Expansion Project 60% Design Report* (AECOM, 2019) (derived from the Envirosim influent specifier spreadsheet)
- Winter conditions with BioWin default wastewater fractions, one SC out of service, and 75% of the influent maximum month flow. This scenario was run to account for the MWR requirement that at least 75% of the design maximum flow must be treated in the “Final Sedimentation” process (called SCs in this report) when the largest unit is out of service.

The following parameters were common for all of the simulation scenarios:

- Dissolved oxygen in Zones 1, 2 and 3 – 2.0, 1.5, and 1.5 mg/L, respectively
- Return Activated Sludge = 50 percent of influent flow

Using the inputs described above, the bioreactor volume and SC surface area was adjusted such that bioreactor mixed liquor suspended solids concentrations were between 2,000 and 3,000 mg/L under all scenarios, and clarifier solids overflow rates (SOR) and solids loading rates (SLR) were within standard ranges (SOR = 16-20 $m^3/m^2/d$, SLR = < 6 $kg/m^2/h$) for all scenarios.

To achieve these operating conditions, the model indicated that the minimum total bioreactor volume and SC surface area required is 5,500 m^3 and 960 m^2 (assuming 5 m clarifier side water depth), respectively. These values were subsequently used as the minimum requirements when sizing the new CTUs (described in Section 4.5.1).

4.4 Primary Treatment Process Units (Existing Facility)

4.4.1 Headworks Screening

AECOM reviewed the screening capacity of the existing plant and documented the assessment in *“FCPCC Stage 4 Expansion Project, 60% Design Report”* (AECOM, 2019). The report concluded that the mechanical screening facility is not required to be expanded under the Stage 4 upgrade project, but it will require expansion under the Stage 5 upgrades. The report also noted that a new emergency bypass channel with a manual bar rake would be required. In the event of screen failure, if the remaining screen cannot handle the influent flow to the plant, the bypass channel may be used.

4.4.2 Grit Removal

AECOM reviewed the grit removal capacity of the existing plant and documented the evaluation in *"FCPCC Stage 4 Expansion Project, 60% Design Report"* (AECOM, 2019). Similar to the screening assessment, the report concluded that the grit removal facility would not be expanded under the Stage 4 upgrade project but would require expansion under the Stage 5 upgrades. The total grit removal capacity is near the existing peak flow to the plant. As flows increase, the peak flow will eventually exceed the total grit removal capacity. Therefore, there is a risk of grit carryover to the primary treatment process. Grit carryover will ultimately be deposited in the ATADs, which will require more frequent shutdowns for cleaning by plant staff if there is insufficient grit removal capacity.

4.4.3 Primary Treatment

The RDN requested AECOM to confirm if, by making modifications to the existing facility, sufficient primary treatment capacity can be provided during normal operation in Stage 4 and Stage 5 upgrades.

In this section, AECOM proposes an approach to repurpose the existing SCs into PCs, which will effectively increase the primary treatment capacity of the existing plant. The total primary clarification capacity made by this change is also evaluated for the Stage 4 and Stage 5 flows to check if the operation is possible under such conditions.

4.4.3.1 Repurposing Existing SCs to PCs

The existing plant includes three PCs and three SCs. For the modified Stage 4 and 5 Expansion, the existing SCs would be repurposed into SCs and the six tanks will collectively form the primary treatment process for the upgraded facility.

For the Stage 4 Expansion, AECOM proposes to convert SCs No.2 and No.3 to PCs No.5 and No.6 and put them into operation. In the future, the RDN could put SC No.1 into service as PC No.4. This naming approach would ultimately lead to consistent naming of the clarifiers from east to west of the plant. This conversion would also resolve an issue related to the MWR reliability requirements of primary sedimentation tankage (described in Section 2.2.3), where 50% of the maximum design flow must be treated when the largest tank is taken out of service.

The water elevation in the existing clarifiers can be found based on their effluent weir elevations. Out of the three existing SCs, one has the same water elevation as the other PCs and two are at a lower elevation. In future operations, this would cause a challenge in feeding all the PCs at the same time. To address this issue, AECOM is proposing minor modifications to the lower elevation clarifiers (Future PCs No.5 and No.6) so that the tanks can be fed separately. There is an existing distribution box, "Solids Contact Tank Effluent Splitter Box", that currently directs solid contact tank effluent to the SCs in the current operation. With minor modifications to the weir elevation in the box and the influent channel structures, it can be used to feed the lower elevation clarifiers in the future. The flow path to future PC No.4 would require the addition of a small portion of the channel running perpendicular to the current "Primary Effluent Channel" that currently transfers primary effluent flow from south to north between PC No.3 and existing SC No.1.

Appendix B of this report includes the structural schematics demonstrating how this change can be made.

As part of this modification, the existing secondary sludge handling pumps for the SCs will be decommissioned and new primary sludge handling pumps and piping will be installed in the sludge pumping gallery.

AECOM compared the expanded capacity of the plant for primary clarification under this change against flows expected in Stage 4 and Stage 5 Expansions at different scenarios (different numbers of units in operation). The outcomes of this assessment are listed below:

- In general, by applying this modification, the existing facility will have enough capacity for the primary treatment of Stage 4 and Stage 5 Expansion flows.

- To operate the system following standard SOR, different numbers of PCs are required to be in service. The calculated number of units are shown below:
  - Stage 4 Flows: three PCs for AAF and MMF, four PCs for MDF and five PCs for 2xADWF.
  - Stage 5 Flows: four PCs for AAF and MMF, five PCs for MDF and six PCs for 2xADWF.

4.4.4 Equalization Storage

The RDN does not wish to construct a new EQ storage basin, but rather evaluate the possibility of using existing infrastructure for this purpose. Since the existing TF/SC infrastructure would not be used to provide treatment once the Stage 4 and Stage 5 plant upgrades are complete, AECOM has reviewed the possibility of using this infrastructure for flow equalization purposes.

4.4.4.1 Repurposing TF/SC Structures to EQ Basins

TF/SCs are part of the secondary treatment in the existing plant. They will be out of operation once the new plant is commissioned. AECOM is proposing to decommission the TF/SCs and repurpose the foundation structure for flow equalization purposes. The decommissioning would include removing the spray headers, the filter media, the feed pumps, the recirculation pumps, and the structure above the 10.5 m floor elevation. The active volume of the modified equalization storage tank is estimated to be 2,200 m^3.

The preliminary structural assessment confirmed that the TF/SC foundation structure can withstand the water load once it is filled. The basin would equalize the plant influent flow variations, which would occur during different times of the day. Based on current plant operation data and feedback from operators, the influent flow drops significantly overnight, which causes wastewater in the PCs to become “septic” overnight and cause odour issues in the vicinity of the PCs. The application of a new EQ basin could reduce the impact of low nighttime flows by introducing the wastewater collected in the EQ basin can be fed to the head of the plant overnight, and thereby reducing the septicity of the water in the PCs.

In terms of operation, the influent would pass through the PCs to remove solids and primary scum. Primary effluent would flow through the existing secondary effluent channel to the current final effluent discharge point. At this location, the flow would be split to the new secondary treatment process, or the existing effluent pump station wet well. New pumps would be installed in the wet well to transfer flow into the EQ basin. Stored primary effluent in the EQ basin would be transferred back to the upstream end of the PCs using pumps in the existing trickling filter drainage sump. The existing sump pumps’ capacity should be reviewed as they may need to be upgraded to suit this application.

4.4.4.2 Management of Peak Wet Weather Flows

During an August 17, 2022 meeting, the RDN and AECOM discussed the potential for using the new flow equalization/storage system (details discussed in the previous section) to divert flows that exceed 2xADWF around the secondary treatment process by pumping into the existing effluent pipe to discharge into the outfall. During the meeting, the consensus was that this approach could be achieved, although there would also be a need for flow measurement.

Upon further review of this approach, it was determined that additional efforts would be required, including monitoring/sampling of effluent quality and the potential future need to chlorinate/dechlorinate the wet weather by-pass stream. This issue had been discussed in the past during the initial predesign phase and was considered resolved by not bypassing the peak flows and blending the flows from the two plants before sampling. The entire flow would then be passed through a future UV disinfection channel before discharge to the environment. AECOM recommended that the study proceed without the inclusion of peak flow bypass.

4.5 Secondary Treatment Process Units (New Facility)

4.5.1 Combined Treatment Units (CTU)

The secondary process is configured in a CTU configuration. Under this design, a bioreactor and a SC is installed in a common circular tank. Figure 4-2 illustrates the configuration.

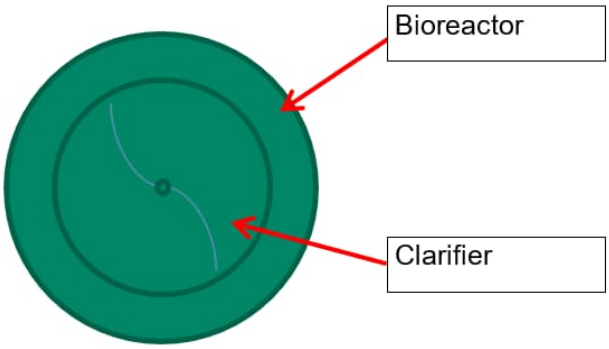

Figure 4-2. CTU Configuration

The CTU configuration operates in the same way as a conventional rectangular bioreactor / circular clarifier configuration. There is no change to the activated sludge process in the CTU configuration.

Four CTUs are proposed to be constructed for the modified Stage 4 and 5 Expansion, which will allow three CTUs to remain in service and treat 75% of max month flow when one of the units is out of service. The latter requirement is a reliability requirement of Category I of the MWR, which states that at least 75% of the design maximum flow must be achievable in the final sedimentation (secondary clarification) process when the largest unit is out of service. This four-unit configuration differs from the original Stage 4 design which only had two CTUs since most of the flow was treated via the TF/SC process. Without the TF/SC process the new CTUs must meet the MWR redundancy requirements.

The team elected to size the CTUs in this evaluation for the Stage 5 population once it became apparent that the new approach would trigger the redundancy requirements of the MWR and four units would be needed. Building slightly larger CTUs provides the benefit of “economy of scale” since it costs significantly less to build slightly larger units rather than having to build additional tankage in the future. There are also cost savings for civil, process mechanical, electrical, and instrumentation as a result. The CTUs for Stage 4 flows would be about 3 metres in diameter smaller.

A splitter box is constructed between the tanks to split primary effluent evenly into the four CTU tanks. Means of isolation and interconnection are provided between the CTU tanks to allow operations staff to take a unit out of service while keeping the rest of the units in service.

A building will be constructed to the south of the CTUs to house the equipment needed to support the secondary treatment process including the waste activated sludge (WAS) pumps and process air blowers. This building will also house an electrical room, ultraviolet disinfection system, the final effluent pump station, a maintenance workshop, and a heated parts and vehicle storage space. The building will be known as the CTU Building although it serves a variety of functions.

4.5.1.1 Bioreactors

Using the total bioreactor volume obtained by the BioWin model (refer to Section 4.2) as the minimum design basis, the bioreactor portion of the four CTs were sized using “practical” dimensions for construction. The sizing (shown in Table 4-2) resulted in a slightly larger total reactor volume (6,248 m^3) than required per the BioWin model (5,500 m^3).

Table 4-2. Bioreactors Design

Parameter	Units	Value
Average Annual Flow	MLD	17.5
Maximum Month Flow	MLD	20.0
Maximum Day Flow	MLD	29.1
Peak Wet Weather Flow	L/s	749
Number of Tanks	-	4
Surface area per tank, based on 4 m width	m^2	286
Side water depth	m	5.46
Volume per tank	m^3	1,562
Total bioreactor volume	m^3	6,248

4.5.1.2 Secondary Clarifiers

Four circular, centre-feed, centre-drive clarifiers with large diameter flocculation wells, suction header removal mechanisms, and perimeter launders are proposed for the expansion. Similar to the bioreactor sizing methodology, the total SC surface area obtained by the BioWin model was used as the basis to determine clarifier sizing using “practical” dimensions for construction. The sizing (shown in Table 4-3) resulted in a slightly larger total surface area (1,020 m^2) than required per the BioWin model (960 m^2). When accounting for concrete wall thickness, each CTU (bioreactor plus SC) will be 27.6 meters in diameter.

Design sizing for the SCs is presented in Table 4-3.

Table 4-3. Secondary Clarifiers Design

Parameter	Units	Value
Average Annual Flow (AAF)	MLD	17.5
Maximum Month Flow (MMF)	MLD	20.0
Maximum Day Flow (MDF)	MLD	29.1
Peak Wet Weather Flow (PWWF)	L/s	749
Number of clarifiers	-	4
Clarifier diameter	m	18
Side water depth	m	5
Surface area per clarifier	m^2	255
Total surface area	m^2	1,020

4.5.1.3 Waste Activated Sludge Thickening

WAS thickening will remain as proposed in the original Stage 4 Expansion design. Two new thickeners will be installed within a new second floor of the structure.

Final effluent currently flows in a channel through the thickening building to the existing outfall infrastructure. After the Stage 4 expansion, the channel will convey primary effluent to the tie-in point leading to the new CTUs. Opening air sections of the channel will be covered and air from the headspace of the channel will be removed and treated in the primary treatment odour control system.

4.5.2 Flow Measurement

The existing plant Parshall flume will be decommissioned under the modified Stage 4 and Stage 5 Expansions and one new Parshall flume will be constructed upstream of the secondary effluent pump station. Flow from the proposed plant expansion is measured by the Parshall flume and passes through the UV disinfection channel before discharging to the secondary effluent pump station wet well. The original design required two Parshall flumes to measure flows from the existing plant and the new infrastructure.

The Parshall flume design parameters are presented in Table 4-4. The new Parshall Flume will have similar dimensions to the existing plant flume.

Table 4-4. Parshall Flume Design

Parameters	Unit	Existing Plant Flume	Stage 5 Expansion (Plant Buildout and Design Basis)
Average Annual Flow	m^3/d	10,457	17,500
Average Dry Weather Flow	m^3/d	9,984	17,200
Maximum Month Flow	m^3/d	11,792	20,000
Maximum Day Flow	m^3/d	17,935	29,100
Peak flow	L/s	448	749
Flume Information			
Flume throat width	m	0.610	0.610
Minimum inlet head	m	0.045	0.046
Maximum inlet head	m	0.750	0.76
Minimum flow rate	L/s	11.7	12.1
Maximum flow rate	L/s	915	937

Reference: Bos, 1976.

4.5.3 UV Disinfection

The germicidal properties of the radiation emitted from UV light sources have been used for wastewater disinfection. With the proper dosage, ultraviolet radiation has proved to be an effective bactericide and virucide for wastewater, while not contributing to the formation of toxic by-products. The germicidal portion of the UV radiation band is between 220 and 320 nm, mainly in the UV-C range. To produce UV radiation, lamps that contain mercury vapor are charged by the striking and electric arc. The energy generated by the excitation of the mercury vapor contained in the lamp results in the emission of UV light.

Factors that affect the minimum number of UV lamps necessary for disinfection are the UV reactor hydraulic loading rate, the aging and fouling characteristics of the UV lamp/quartz assembly, wastewater quality, and the disinfection limit in the discharge permit.

The modified design will include UV disinfection in accordance with direction from the RDN on October 25, 2023. Details of the UV disinfection system will be further developed during the next detailed design phase.

4.5.4 Reclaimed Water System

The reclaimed water system is fed by the final effluent of the plant. In the future, the final effluent will be available at the new plant's discharge; therefore, the existing reclaimed water system will be out of use. It is proposed to decommission the existing reclaimed water system and consider a new treatment system at the new plant for the reclaimed water. The decommissioning will not include the reclaimed water storage tank and the distribution pumps. They will be connected to the new system in the future.

4.5.5 Morningstar Golf Course Effluent Supply

The new configuration of the plant means that final effluent is no longer available at the current location of the pump that supplies final effluent to the Morningstar Golf Course. The RDN agreed that the future project needs to accommodate the supply of final effluent to the golf course and that this feasibility study includes the addition of pumping infrastructure that was not incorporated into the original design concept.

4.6 Tertiary Treatment (Future Facility)

The RDN requested that AECOM allocate space in the revised design for future installation of a tertiary treatment process. The following section provides general information on cloth-media disk filters, which are often used for tertiary treatment in wastewater facilities. These filters have 10-30 µm pore sizes which can further remove the suspended solids and colloidal matters. This removal would increase the plant's performance in meeting regulatory requirements, especially if more stringent levels will be in place in the future.

Sizing the tertiary treatment process is out of the scope of this feasibility study and will be done in the design phase.

4.6.1 Cloth-Media Disk Filter

The cloth-media disk filter (CMDF), as shown in Figure 4-3, consists of several disks mounted vertically in a tank. Two different types of cloths can be used in the CMDF: 1) a needle felt cloth made of polyester or 2) a synthetic pile fabric cloth. The needle-felt cloth has a random three-dimensional weave to facilitate particle removal. In addition to the normal backwashing, the felt cloth must be cleaned periodically with a high-pressure spray. The pile fabric does not require the use of a high-pressure spray wash and can be cleaned completely by the use of a backwash alone.

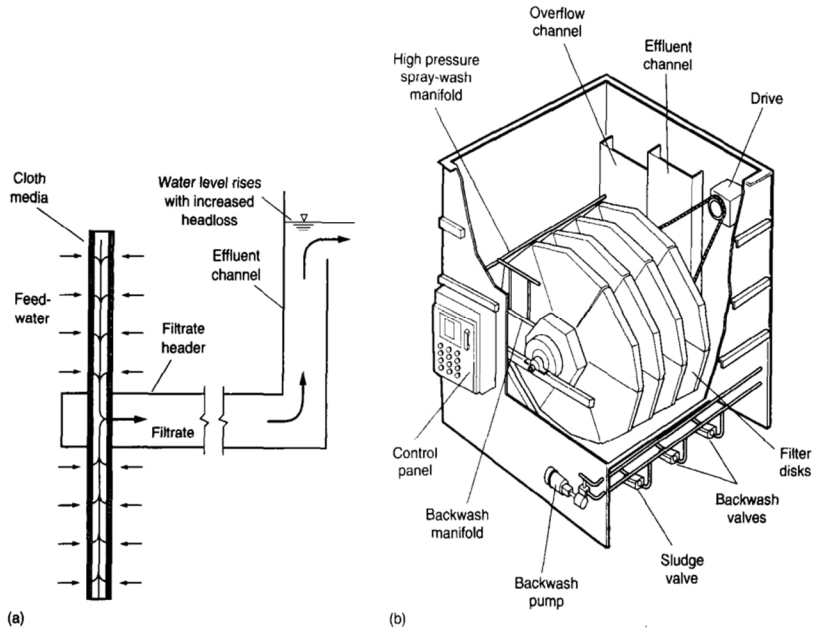

Figure 4-3. Cloth-Media Disk Filter: (a) definition sketch for operation & (b) pictorial schematic (adapted from Aqua-Aerobic Systems)

Water enters the feed tank and flows through the filter cloth into a central collection tube or header. The resulting CMDF filtrate is collected in a central tube or a filtrate header where it flows to final discharge over an overflow weir in the effluent channel. As solids accumulate on and in the cloth medium, resistance to flow or headloss increases. When the headloss through the cloth medium reaches a predetermined level, the disks are backwashed. After filtering to waste after the backwash cycle, the filter is put back into operation.

When a backwash cycle is initiated, the disks remain submerged and rotate at 1 rpm. Vacuum suction heads, located on either side of the CMDF, draw filtrate water from the filtrate header back through the cloth media into the vacuum heads while the disk is rotating. This reversal of flow removes particles that have become entrapped on the surface and within the cloth medium. The normal duration of the backwash cycle for the CMDF is 1 min.

Over time, particles will accumulate in the cloth medium that cannot be removed by a typical backwash. This accumulation of particles leads to increased headloss across the filter, an increase in the backwash suction pressure, and shorter run times between backwashes. When the backwash suction pressure reaches 124 kPa, or the time exceeds the desired present time interval, a high-pressure spray wash is initiated automatically. Before the high-pressure spray wash, the tank inlet valve is closed, and the influent flow is stopped. A standard backwash is initiated to remove the outer layer of solids from the cloth. The filter-to-waste valve is opened, the water level is lowered to below the midline of the disks, and then a high-pressure spray wash is initiated.

During the high-pressure spray wash, the disk rotates slowly at 1 r/min, while filtrate water is sprayed at high pressure from the outside of the filter cloth. The high-pressure spray wash flushes the particles that have become lodged inside the cloth filter medium effectively in two revolutions of the disk. After the end of the high-pressure spray wash, the inlet valve to the CMDF opens to allow the wastewater to flow to the filter. The disks continue to rotate, and the filter-to-waste valve remains open until the solids that were flushed from the filter cloth to the filtrate side of the CMDF are removed from the filtrate header and the effluent line. The time interval between high-pressure spray washes is a function of the feedwater quality.

5. Odour Control

The RDN periodically receives odour complaints related to the FCPCC, with a higher number of complaints in the summer months. Some of these complaints are likely related to the plant; however, others may result from off-site sources such as rotting herring roe on nearby beaches.

Major odour sources at the FCPCC currently include the ATADs, septage receiving area, PCs, headworks, trickling filter area, and sludge dewatering operations. The plant provides odour control for individual areas, but the RDN intends to develop a more comprehensive odour management program.

5.1 Odour Control Strategy

The FCPCC currently has adequate foul air treatment for the ATAD exhaust; however, improvements were recommended for the TF exhaust and top floor walls of the structure as part of the 2021 Stage 4 Design. The TF exhaust includes air that is collected from the PCs and headworks areas.

The modified Stage 4 and 5 Expansion concept eliminates odour control requirements for the TF exhaust as the process is proposed to be decommissioned. The modified odour control strategy for the headworks building is to separate the foul air in the headworks and from covered primary sedimentation tanks. It is also proposed to demolish the structure that is built above and covers the PCs and replace it with low-profile covers on the PCs. Low-profile covers would also be installed on the influent channels, the primary effluent channels, and the EQ basin to contain process odours. The foul air in the headspace of the new covers will be mechanically ventilated and treated through a synthetic media enclosed biofilter to treat foul air from the TF exhaust.

6. Construction Staging

The future plant will include primary treatment, secondary treatment and disinfection processes. The primary treatment is performed by the existing plant and the secondary treatment will be provided by the new plant. The existing treatment system operation cannot be stopped and should be always in operation. Moreover, based on the plant's discharge permit, the plant is obligated to meet the discharge requirement for the final effluent. To satisfy these requirements, the construction of the new plant as well as the modification of the existing plant should be planned so that the treatment capacity of the overall plant won't be compromised.

AECOM is proposing the following stages for the construction work:

1. **Construction of the new plant**

   During this stage, the full treatment of the influent would occur in the existing plant.

2. **Directing the primary effluent to the new plant**

   Once the new plant is constructed, the existing plant's secondary treatment will be stopped, and the primary effluent will be directed to the new plant for secondary treatment. At this time, the decommissioning of the existing TF/SC infrastructure and SCs can be done.

   During this time, it is expected that the reclaimed water will not be available temporarily. To address this concern, potable water can be connected to the reclaimed water system (fill the reclaimed water storage tank) until the reclaimed water is available at the new plant.

3. **Repurposing SCs to PCs**

   At this stage, the existing plant's PCs are in operation and their effluent is treated in the new plant. Modifications can be made so that the SCs will be changed to the PCs. The details of this change were mentioned in the previous section of this report.

4. **Removing roof from PCs**

   Once the new PCs (old SCs) are available, the primary treatment can be switched to them so that the construction work for the structure removal of the PCs could occur. Based on the required capacity of the plant at the time, all or some of the PCs will be out of operation during this time. This provides flexibility for the step-by-step removal of the structure from single or multiple clarifiers.

5. **Repurposing the trickling filters to EQ basins**

   This stage has the lowest priority compared to other construction works and can be done at the end of the construction work. The EQ basin would improve the operation of the future plant; however, the treatment capacity of the system will not be compromised without this system.

AECOM recommends that construction work occurs during the dry season as much as possible because the plant influent flow will be more manageable during this period.

8. Summary and Conclusions

The FCPCC Stage 4 Expansion Detailed Design was completed by AECOM in 2021. The proposed design includes the continued operation of the existing facility and extension of the screened raw sewage channel to divert excess flows to a new EQ tank and secondary treatment processes. Additional primary treatment was not included in the scope of work.

The RDN initiated a value engineering study for the FCPCC Stage 4 Expansion design, which identifies alternatives to the proposed design from a planning and optimization perspective. A modified design approach was developed by the RDN, which includes using the existing SCs as PCs, decommissioning the trickling filters, and treating all primary effluent in new, larger CTUs. The RDN retained AECOM to prepare this report to assess the feasibility of this modified approach. The assessment includes identifying any fatal flaws that prevent modifications to be made within the existing plant as well as updating the design basis for the new "full-flow" secondary facility. **AECOM's assessment revealed no major issues with the proposed approach.**

As part of the original Stage 4 Expansion scope, AECOM reviewed the historical population data and estimated the future projected population based on the available information (AECOM, 2017). This estimation was used to develop design flows and loads for Stage 4, with a population of 36,200 people and a design year of 2035. Stage 5 flows and loads have also been estimated based on a future population of 44,900 people.

A summary of the key conclusions made in this study is provided below:

- By applying minor modifications to the existing plant, it is feasible to repurpose the existing SCs into PCs and increase primary treatment capacity within the existing plant infrastructure. AECOM concludes that the expanded primary clarification capacity will be sufficient for Stage 5 flows and loads.
- The existing TF/SC process will not be part of the modified Stage 4 and 5 Expansion and will be abandoned. It is feasible to repurpose the structures for flow equalization. The modification would include removing the spray headers, the filter media, the feed pumps, the recirculation pumps, and the structure above the 10.5 m floor elevation.
- The application of a new EQ basin, retrofitted from the existing TF/SC structure, may mitigate the current septicity issues originating from the PCs due to the wastewater becoming septic during low flows. This is achieved by transferring the collected wastewater in the EQ basin to the head of the plant overnight.
- The secondary treatment process is proposed to include four new CTUs, which are sized based on Stage 5 flows and loads. According to preliminary sizing done in this study, each CTU will have an overall diameter of 27.6 meters.
- Effluent flow from the modified Stage 4 and 5 Expansion is proposed to be measured by a Parshall flume and then disinfected through open-flow channel UV reactors before discharging to the secondary effluent pump station wet well.
- A new reclaimed water treatment is proposed to be installed at the new secondary treatment process location.
- The final effluent water supply for the Morningstar Golf Course will be relocated to the new secondary treatment process location.
- To mitigate the odour issue within the primary treatment area, it was proposed to separate and enclose the headwork building and install covers on open-top areas that contain primary influent. Foul air will be extracted from these spaces and treated through a new synthetic media biofilter.

An estimate of AECOM's opinion of probable cost for the Modified Stage 4 & 5 Expansion concept, assuming a construction start of April 2024, was determined to be $81,180,000. The cost estimate has an expected range of accuracy between ±20%.

In closing, AECOM is of the opinion that the modified approach to the future development of the FCPCC is very feasible, will eliminate long term odour sources at the plant, and will result in a more effective facility for the existing community and future population growth.

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Appendix A – Historical Flow and Load Data (2003 to 2016)

Table A – 1. Historical Flow Data

Parameter	Units	Average	Year													
			2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average Annual Flow	m3/d	N/A	9,353	9,083	8,675	8,483	9,545	9,768	9,550	10,252	9,913	10,247	10,268	11,064	10,714	10,457
Average Dry Weather Flow	m3/d		9,186	9,108	8,596	7,925	9,188	9,443	9,426	10,138	9,827	10,268	10,763	10,802	10,457	9,984
Maximum Month Flow	m3/d		10,502	9,808	10,214	10,476	11,140	10,615	11,545	11,313	11,070	11,486	11,830	12,561	12,718	11,792
Maximum Day Flow	m3/d		16,098	13,230	16,319	15,567	18,872	15,493	18,030	18,874	14,853	14,461	12,909	18,983	15,963	17,935
Peaking Factors	ADWF:AAF	0.98	0.98	1.00	0.99	0.93	0.96	0.97	0.99	0.99	0.99	1.00	1.05	0.98	0.98	0.95
	MMF:AAF	1.14	1.12	1.08	1.18	1.23	1.17	1.09	1.21	1.10	1.12	1.12	1.15	1.14	1.19	1.13
	MDF:AAF	1.66	1.72	1.46	1.88	1.84	1.98	1.59	1.89	1.84	1.50	1.41	1.26	1.72	1.49	1.72
	MDF:ADWF	1.70	1.75	1.45	1.90	1.96	2.05	1.64	1.91	1.86	1.51	1.41	1.20	1.76	1.53	1.80

Notes: Flow data presented in table based on FCPCC Annual Monitoring Reports from 2003 to 2016.

Table A – 2. Per Capita Flow Data

Parameter	Units	Average	Year												
			2003	2004	2005	2006	2007	2008	2010	2011	2012	2013	2014	2015	2016
Population	Person Equivalents	N/A	22,350	22,805	23,262	23,718	24,174	24,630	25,646	26,047	26,454	26,870	26,856	27,513	27,513
Average Annual Flow	L/cap/d	389	418	398	373	358	395	397	400	381	387	382	412	389	380
Average Dry Weather Flow	L/cap/d	383	411	399	370	334	380	383	395	377	388	401	402	380	363
Maximum Month Flow	L/cap/d	445	470	430	439	442	461	431	441	425	434	440	468	462	429
MM Summer Flow	L/cap/d	410	438	430	391	358	406	422	414	399	417	440	423	401	391
Maximum Day Flow	L/cap/d	647	720	580	702	656	781	629	736	570	547	480	707	580	652

Notes: Flow data presented in table based on FCPCC Annual Monitoring Reports from 2003 to 2016 and yearly population data.

Table A – 3. Historical Loading Data

Parameter			Units	Year													
				2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BOD	Summer	Average Annual	kg / d	1,391	1,565	1,557	1,520	1,897	1,766	1,892	1,338	1,479	1,751	2,146	2,130	1,887	1,771
		Maximum Monthly	kg / d	1,587	1,830	1,855	1,926	2,162	2,012	2,149	1,620	1,596	2,060	2,557	2,368	2,154	2,060
	Winter	Average Annual	kg / d	1,463	1,424	1,439	1,387	1,748	1,571	1,568	1,152	1,394	1,689	1,886	1,719	1,602	1,452
		Maximum Monthly	kg / d	1,597	1,665	1,684	1,688	2,052	1,719	1,776	1,333	1,824	2,306	2,033	2,091	1,907	1,694
TSS	Summer	Average Annual	kg / d	2,968	3,073	2,747	2,785	3,296	3,325	3,019	2,756	3,037	3,282	3,250	3,937	3,659	3,261
		Maximum Monthly	kg / d	3,131	3,608	3,135	2,953	3,657	3,831	3,209	3,014	3,598	3,412	3,707	4,503	4,211	3,514
	Winter	Average Annual	kg / d	2,647	2,723	2,539	2,426	2,968	2,973	2,545	2,507	2,713	2,762	2,870	3,258	2,875	2,424
		Maximum Monthly	kg / d	3,043	3,190	2,971	2,941	3,218	3,463	2,970	2,707	3,083	3,197	3,173	3,950	3,300	2,656
NH_3	Average Annual		kg / d	263	293	274	230	294	297	282	343	359	381	318	312	376	346

Note: Data presented in table is calculated based on monthly average BOD and TSS data presented in FCPCC Annual Monitoring Reports from 2003 to 2016.

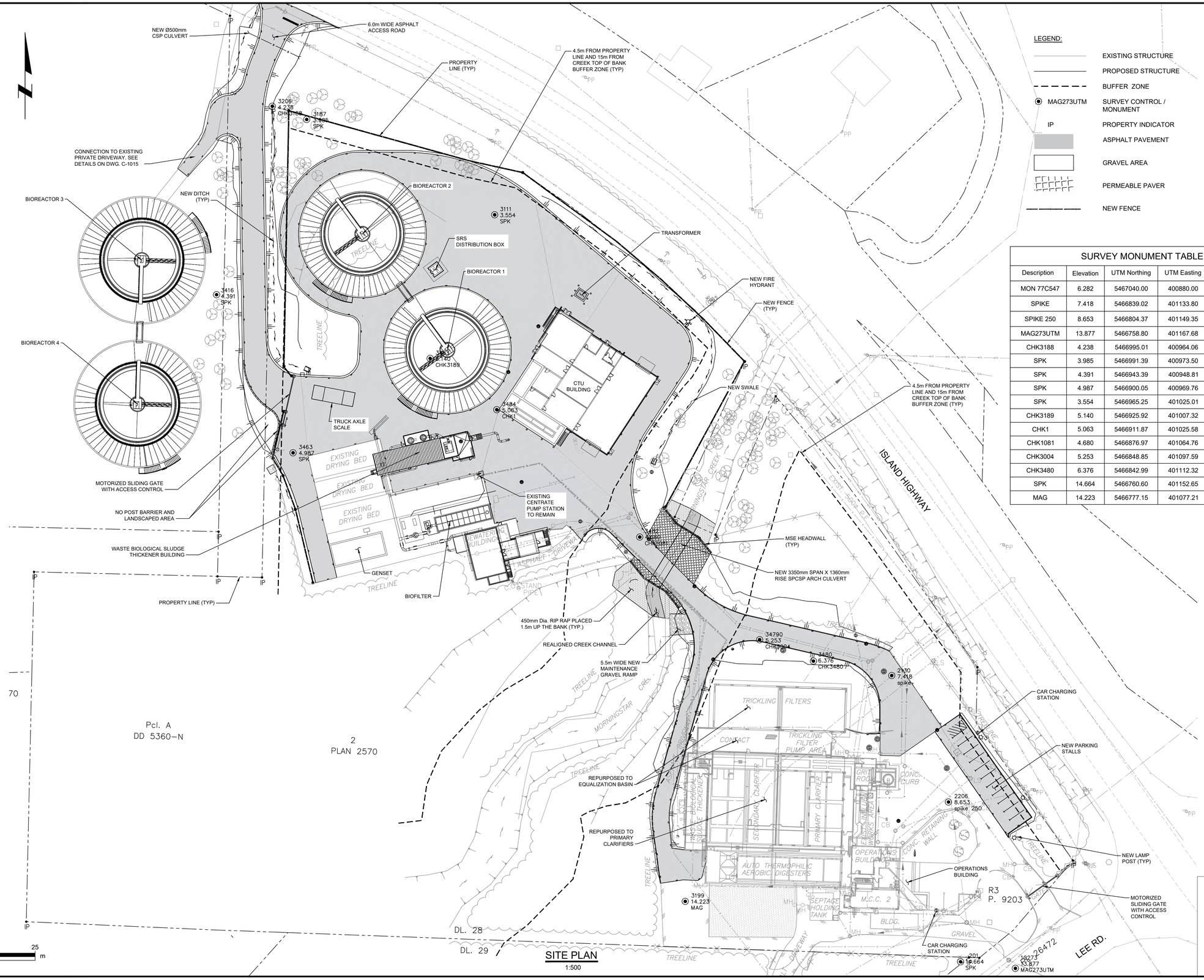
Table A – 4. Per Capita Loads

Parameter			Units	Average	Year													
					2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Population			Person Equivalents	N/A	22,350	22,805	23,262	23,718	24,174	24,630	25,138	25,646	26,047	26,454	26,870	26,856	27,513	27,513
BOD	Summer	Average Annual	kg / cap / d	0.068	0.062	0.069	0.067	0.064	0.078	0.072	0.075	0.052	0.057	0.066	0.080	0.079	0.069	0.064
		Maximum Monthly	kg / cap / d	0.079	0.071	0.080	0.080	0.081	0.089	0.082	0.085	0.063	0.061	0.078	0.095	0.088	0.078	0.075
	Winter	Average Annual	kg / cap / d	0.061	0.065	0.062	0.062	0.058	0.072	0.064	0.062	0.045	0.054	0.064	0.070	0.064	0.058	0.053
		Maximum Monthly	kg / cap / d	0.072	0.071	0.073	0.072	0.071	0.085	0.070	0.071	0.052	0.070	0.087	0.076	0.078	0.069	0.062
TSS	Summer	Average Annual	kg / cap / d	0.126	0.133	0.135	0.118	0.117	0.136	0.135	0.120	0.107	0.117	0.124	0.121	0.147	0.133	0.119
		Maximum Monthly	kg / cap / d	0.140	0.140	0.158	0.135	0.125	0.151	0.156	0.128	0.118	0.138	0.129	0.138	0.168	0.153	0.128
	Winter	Average Annual	kg / cap / d	0.109	0.118	0.119	0.109	0.102	0.123	0.121	0.101	0.098	0.104	0.104	0.107	0.121	0.104	0.088
		Maximum Monthly	kg / cap / d	0.125	0.136	0.140	0.128	0.124	0.133	0.141	0.118	0.106	0.118	0.121	0.118	0.147	0.120	0.097
NH_3	Average Annual		kg / cap / d	0.012	0.012	0.013	0.012	0.010	0.012	0.012	0.011	0.013	0.014	0.014	0.012	0.012	0.014	0.013

Note: Data presented in table is calculated based on Annual estimated information presented in Table 2-5 and yearly population.

Appendix B – Cost Estimate Summary Tables

Appendix C – Concept Sketches



LEGEND:

- EXISTING STRUCTURE
- PROPOSED STRUCTURE
- BUFFER ZONE
- MAG273UTM — SURVEY CONTROL / MONUMENT
- IP — PROPERTY INDICATOR
- ASPHALT PAVEMENT
- GRAVEL AREA
- PERMEABLE PAVER
- NEW FENCE

SURVEY MONUMENT TABLE

Description	Elevation	UTM Northing	UTM Easting	Combined Factor
MON 77C547	6.282	5467040.00	400880.00	0.9997223
SPIKE	7.418	5466839.02	401133.80	0.999723
SPIKE 250	8.653	5466804.37	401149.35	0.999723
MAG273UTM	13.877	5466758.80	401167.68	0.999680
CHK3188	4.238	5466995.01	400964.06	
SPK	3.985	5466991.39	400973.50	
SPK	4.391	5466943.39	400948.81	
SPK	4.987	5466900.05	400969.76	
SPK	3.554	5466965.25	401025.01	
CHK3189	5.140	5466925.92	401007.32	
CHK1	5.063	5466911.87	401025.58	
CHK1081	4.680	5466876.97	401064.76	
CHK3004	5.253	5466848.85	401097.59	
CHK3480	6.376	5466842.99	401112.32	
SPK	14.664	5466760.60	401152.65	
MAG	14.223	5466777.15	401077.21	

						2022/11/XX	DATE (Y/M/D)
					AH	CHK	
					PTL	DRN	
VERIFY SCALE IF PLAN SHEET IS REDUCED							
30 mm							
					P1	ISSUED FOR CONCEPTUAL DESIGN	REV
						DESCRIPTION	
DRN BY: SI	DES BY:	AH	CHK BY:	TJ	APP BY:	TJ	

PREPARED FOR:

REGIONAL DISTRICT OF NANAIMO

PREPARED BY:

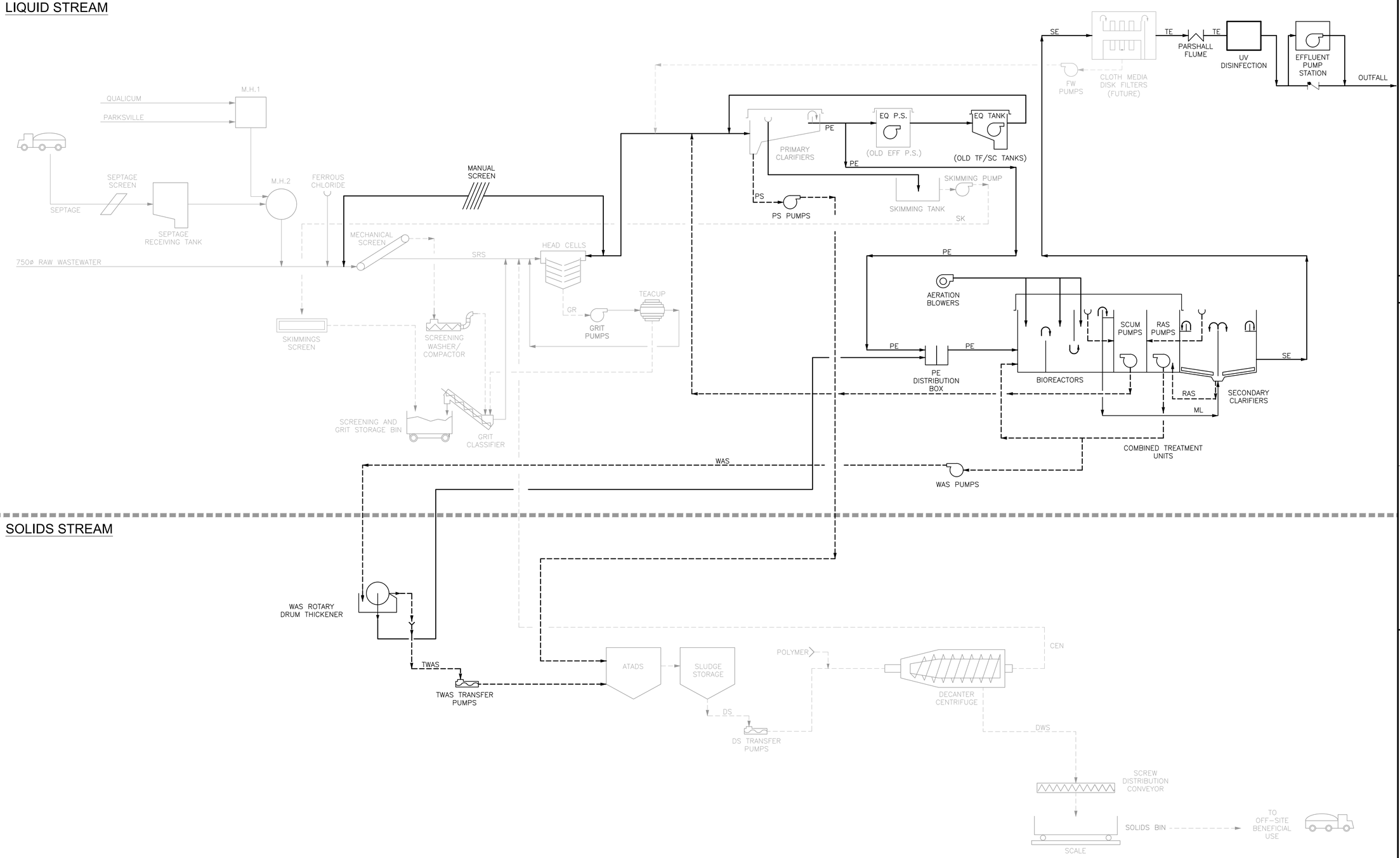
AECOM
4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK POLLUTION CONTROL CENTRE
STAGE IV EXPANSION
CIVIL
OVERALL SITE PLAN

PROJECT START DATE (M / Y)	SEP/2019
PROJECT NO.	60590631
FILENAME	60590631-SK-1000.dwg
RDN DRAWING No.	
DRAWING No.	SK-1000

Plotted By: LeongP
Plot File Date Created: Nov/24/2022 10:23 AM
Layout-Sheet Name: SK-1000
Filename: C:\USERS\LEONGP\DOCUMENTS\60590631\06-XREFS\60590631-SK-1000.DWG

LIQUID STREAM



SOLIDS STREAM

LEGEND:

- LIQUID STREAM
- SOLIDS/RESIDUALS STREAM

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REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
A	ISSUED FOR FEASIBILITY STUDY	PTL	AH	DEC. 2022

VERIFY SCALE IF PLAN SHEET IS REDUCED — 30 mm

DRN BY: PTL | DES BY: AH | CHK BY: AH | APP BY: LL

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PREPARED BY: AECOM
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REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK POLLUTION CONTROL CENTRE
STAGE V EXPANSION
GENERAL
PROCESS FLOW DIAGRAM
LIQUID AND SOLIDS STREAM

PROJECT START DATE (M / Y)	OCTOBER 2022
PROJECT NO.	60590631
FILENAME	Layouts.dwg
RDN DRAWING No.	
DRAWING No.	**G-101**

REGIONAL DISTRICT OF NANAIMO

AECOM

Regional District of Nanaimo

FRENCH CREEK WATER POLLUTION CONTROL CENTRE

STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY

ISSUED FOR FEASIBILITY STUDY

JANUARY 2023

AECOM Project No. 60590631

Plotted By: LeongP
Plot File Date Created: Jan/23/2023 10:55 AM
Layout-Sheet Name: LAYOUT1
Filename: C:\USERS\LEONGP\DOCUMENTS\60590631\SKETCHES\60590631-G001-SITE PLAN.DWG

LEGEND:

STRUCTURE TO BE REMOVED OR DEMOLISHED

TRUE NORTH

0 20m 40m

SITE PLAN
SCALE: 1:500

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REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
EXISTING PLANT DEMOLITION
SITE PLAN

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PREPARED FOR:

REGIONAL DISTRICT OF NANAIMO

DRAWING No.	G-001
RDN DRAWING No.	
FILENAME	60590631-G001-SITE PLAN.dwg
PROJECT NO.	60590631
PROJECT START DATE (M / Y)	OCTOBER 2022

DRN BY: | PTL | DES BY: | AH | CHK BY: | TJ | APP BY: -

30 mm — VERIFY SCALE IF PLAN SHEET IS REDUCED

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
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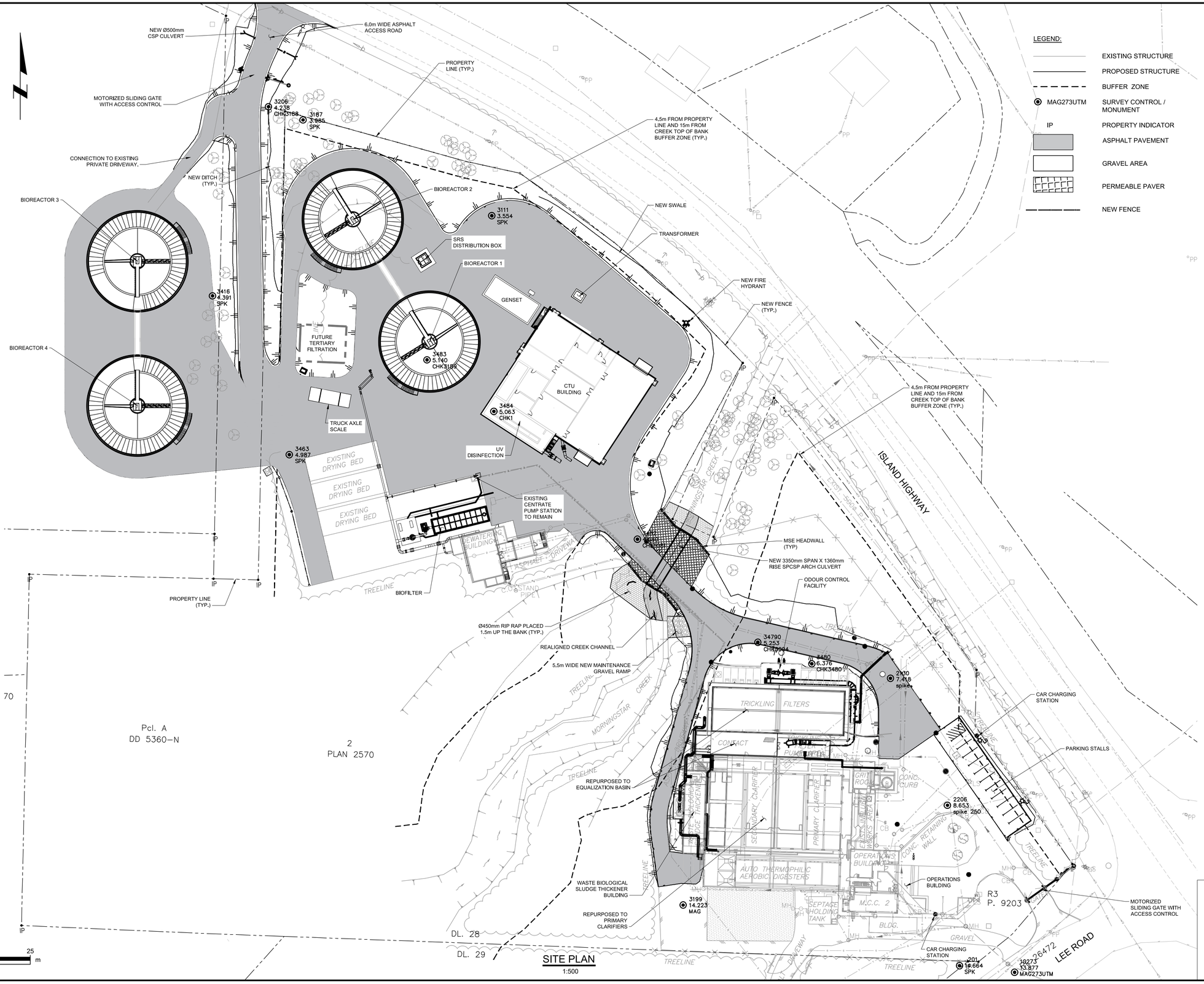

VERIFY SCALE IF PLAN SHEET IS REDUCED
30 mm

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
P1	ISSUED FOR CONCEPTUAL DESIGN	PTL	AH	DEC. 2022

DRN BY: SI
DES BY: AH
CHK BY: TJ
APP BY: TJ

PREPARED FOR:
REGIONAL DISTRICT OF NANAIMO

PREPARED BY:
AECOM
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604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK POLLUTION CONTROL CENTRE STAGE IV EXPANSION
CIVIL
OVERALL SITE PLAN

PROJECT START DATE (M / Y)	SEP/2019
PROJECT NO.	60590631
FILENAME	60590631-SK-1000.dwg
RDN DRAWING No.	
DRAWING No.	SK-1000

Plotted By: LeongP
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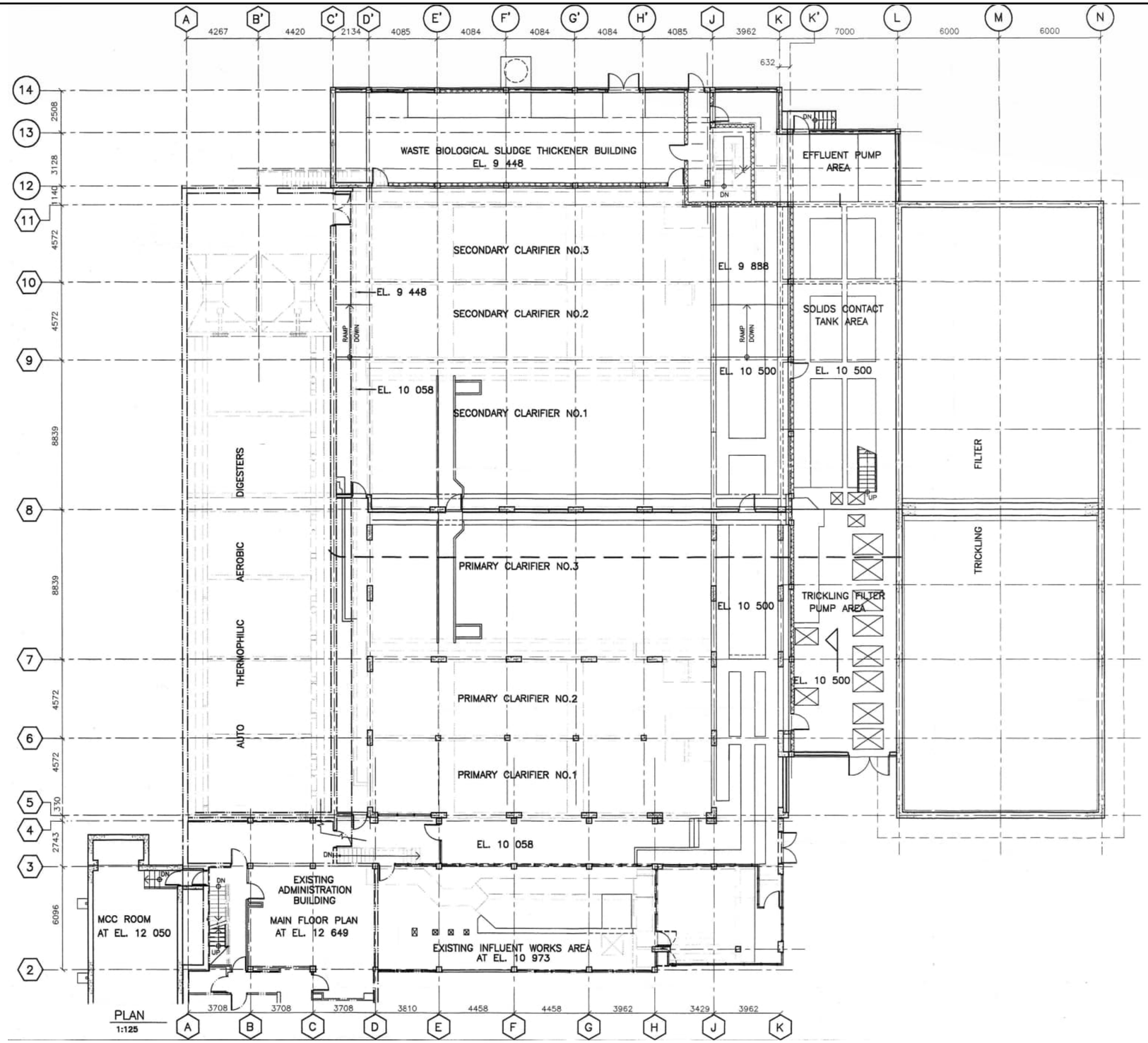

PLAN
1:125

PLAN
SCALE: 1:125

PREPARED FOR:

REGIONAL DISTRICT OF NANAIMO

DRN BY:	APP BY:	0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX
PTL	TJ	REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
DES BY:	CHK BY:					
-	TJ					

30 mm — VERIFY SCALE IF PLAN SHEET IS REDUCED

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REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
EXISTING PLANT
KEY PLAN

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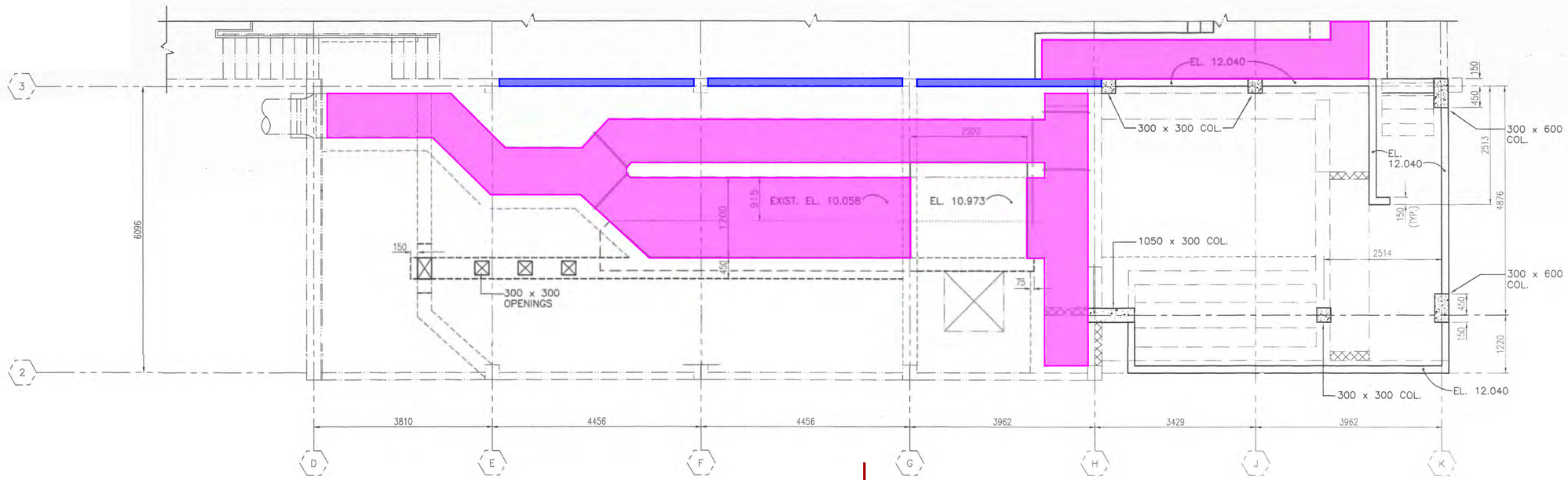
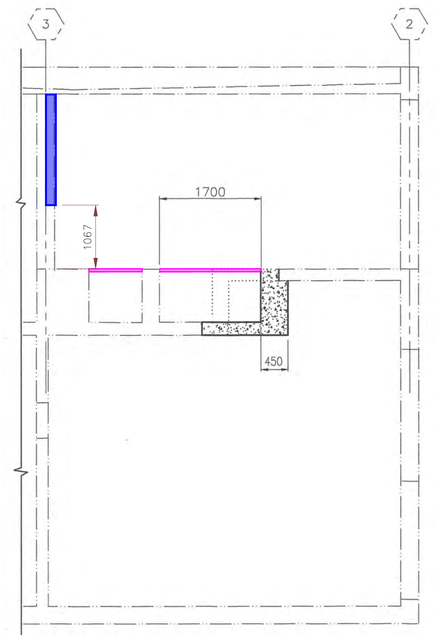
PROJECT START DATE (M / Y)	OCTOBER 2022
PROJECT NO.	60590631
FILENAME	Key Plan.dwg
RDN DRAWING No.	
DRAWING No.	**KEY PLAN**

Plotted By: LeongP
Plot File Date Created: Jan/23/2023 10:13 AM
Layout-Sheet Name: PLAN
Filename: C:\USERS\LEONGP\DOCUMENTS\60590631\SKETCHES\KEY PLAN.DWG



INFLUENT WORKS - UPPER PLAN - EL. 10.970
SCALE: 1:50



INFLUENT WORKS - SECTION 1
SCALE: 1:50

LEGEND:
- COVER (PLAN & SECTIONAL VIEWS)
- TRANSLUCENT SANDWICH PANEL

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VERIFY SCALE IF PLAN SHEET IS REDUCED — 30 mm

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

DRN BY: PTL | DES BY: - | CHK BY: TJ | APP BY: TJ

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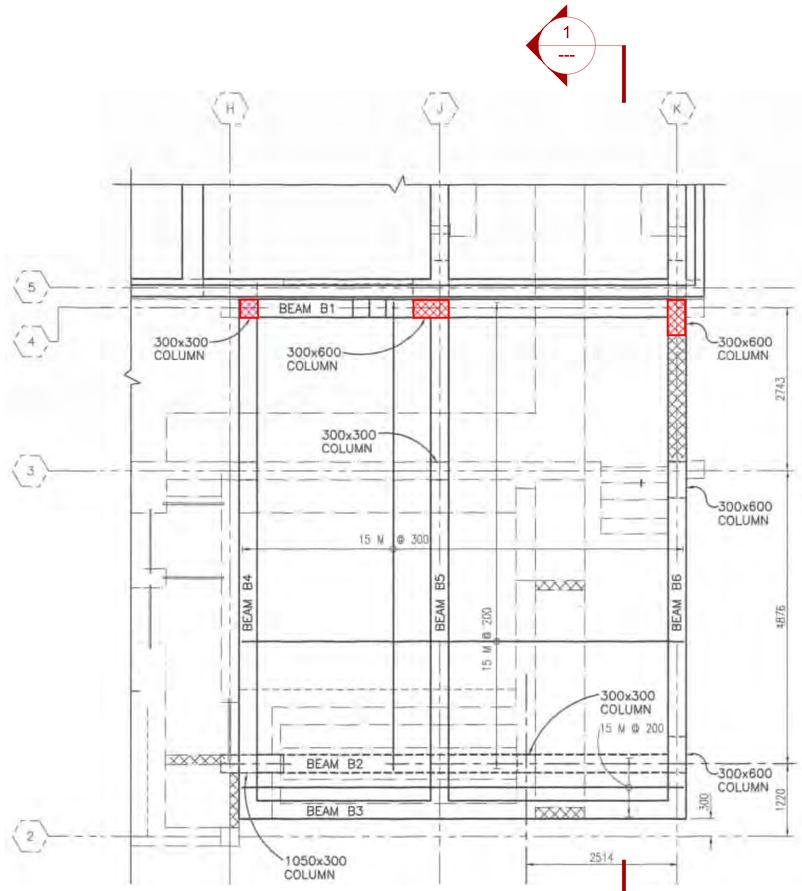
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
INFLUENT WORKS
STRUCTURAL - PLAN AND SECTION

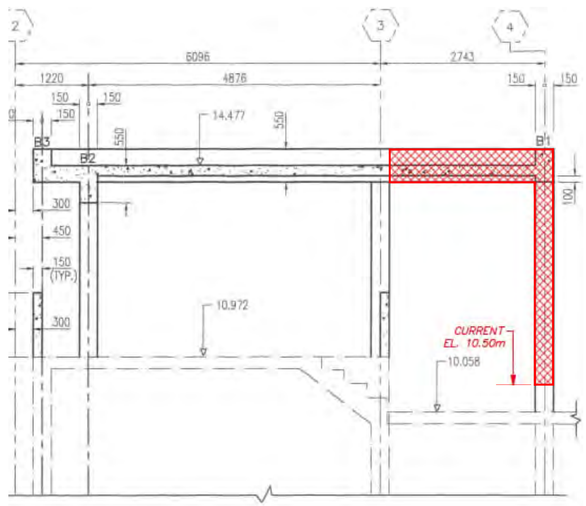
PROJECT START DATE (M / Y)	OCTOBER 2022
PROJECT NO.	60590631
FILENAME	SK-01.dwg
RDN DRAWING No.	
DRAWING No.	**SK-01**

Plotted By: LeongP
Plot File Date Created: Jan/23/2023 11:00 AM
Layout-Sheet Name: PLAN
Filename: C:\USERS\LEONGP\DOCUMENTS\60590631\SKETCHES\SK-01.DWG



ROOF PLAN

SCALE: 1:50



SECTION 1

SCALE 1:50

LEGEND:

STRUCTURE TO BE DEMOLISHED OR REMOVED

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604-444-6400

DRN BY:	DES BY:	CHK BY:	APP BY:		DESCRIPTION	DRN	CHK	DATE (Y/M/D)
PTL	-	TJ	TJ	0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX
				REV				

30 mm — VERIFY SCALE IF PLAN SHEET IS REDUCED

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
INFLUENT WORKS DEMOLITION
STRUCTURAL - PLAN AND SECTION

PROJECT START DATE (M / Y)	OCTOBER 2022
PROJECT NO.	60590631
FILENAME	SK-02.dwg
RDN DRAWING No.	
DRAWING No.	SK-02

Plotted By: LeongP
Plot File Date Created: Jan/23/2023 11:12 AM
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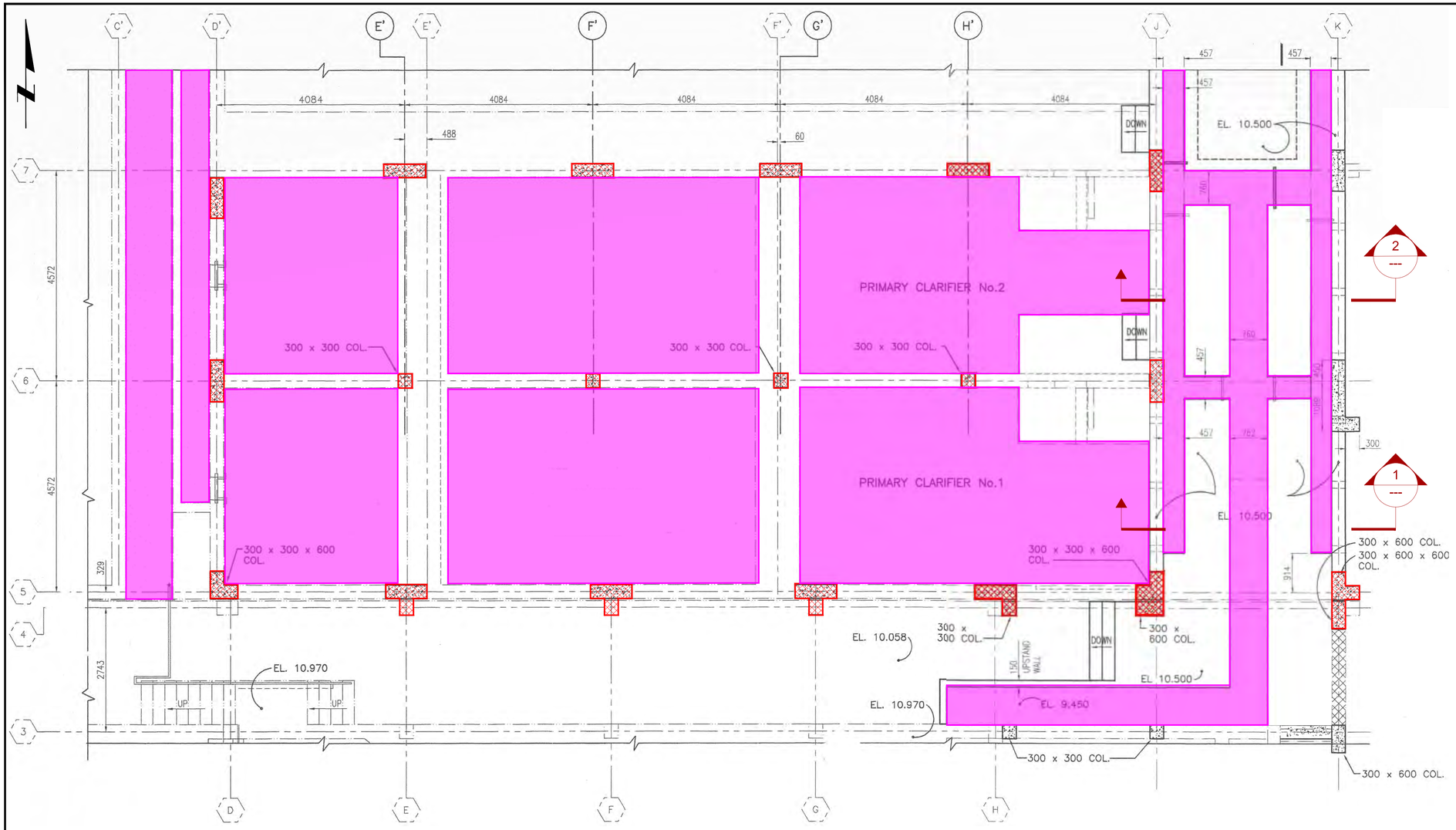
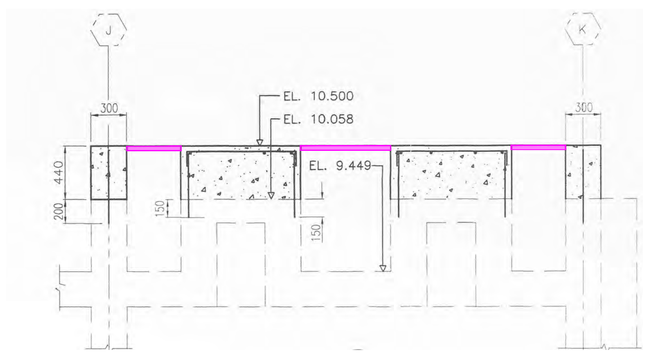
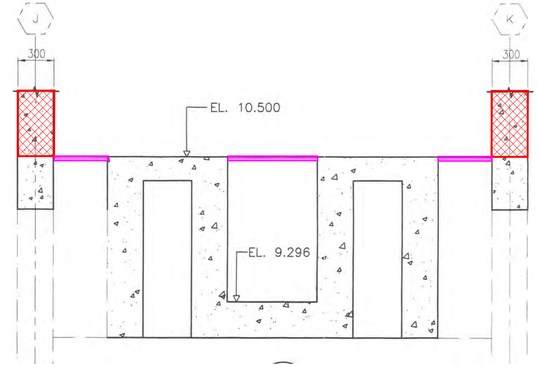


PLAN ABOVE EL. 10.970m
SCALE: 1:50



SECTION 1 / ---
SCALE: 1:25



SECTION 2 / ---
SCALE: 1:25

LEGEND:

- STRUCTURE TO BE DEMOLISHED OR REMOVED
- COVER (PLAN & SECTIONAL VIEWS)

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DES BY:	-							DRN	CHK	DATE (Y/M/D)
CHK BY:	TJ									
APP BY:	TJ	0	ISSUED FOR FEASIBILITY STUDY							
	REV	DESCRIPTION								

VERIFY SCALE IF PLAN SHEET IS REDUCED — 30 mm

PREPARED FOR: REGIONAL DISTRICT OF NANAIMO

PREPARED BY: AECOM
4th FLOOR, 3292 PRODUCTION WAY, BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
PRIMARY CLARIFIER DEMOLITION AND COVERS
PLAN AND SECTIONS

PROJECT START DATE (M / Y)	OCTOBER 2022
PROJECT NO.	60590631
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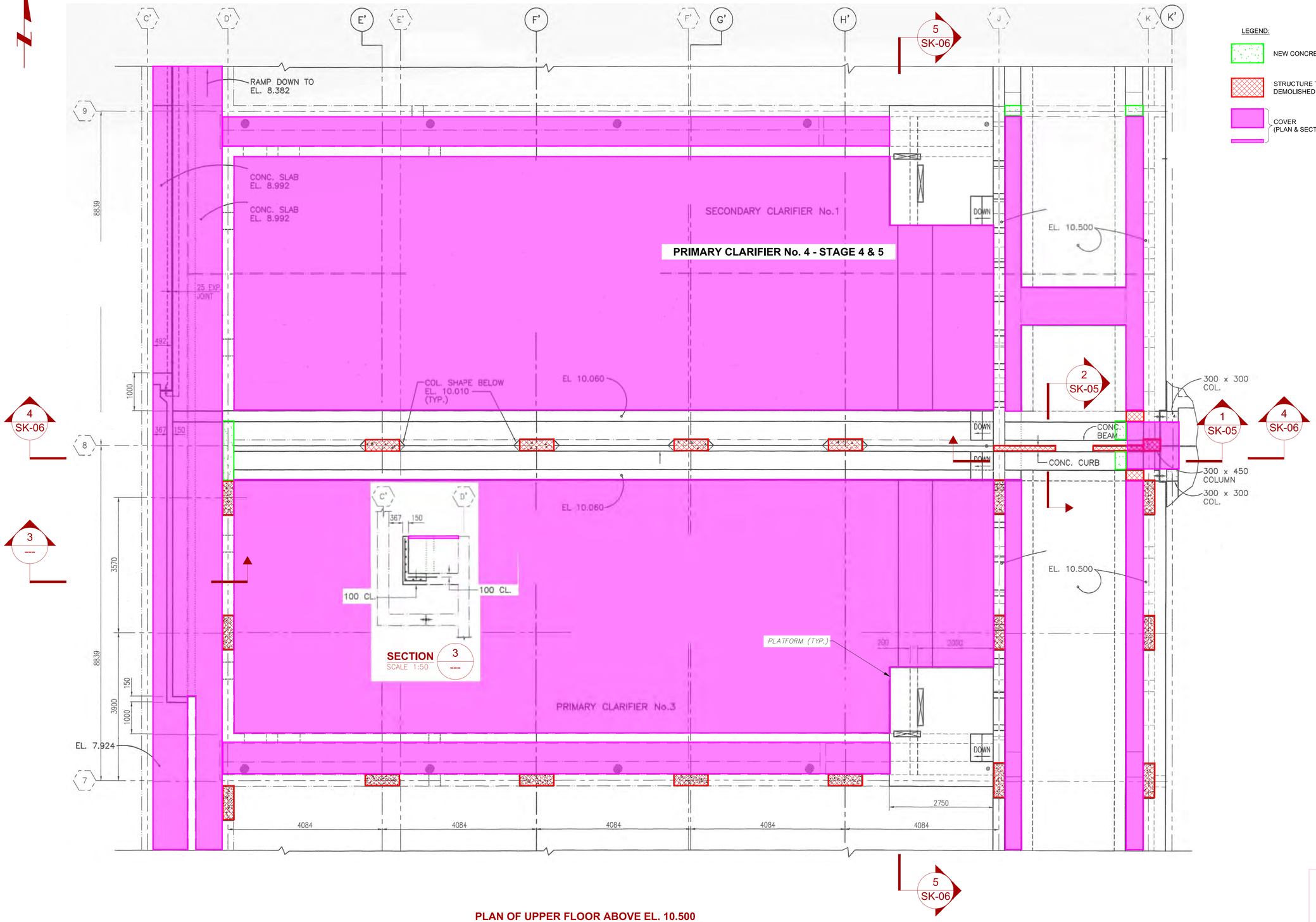
RDN DRAWING No.	
DRAWING No.	SK-03



PLAN OF UPPER FLOOR ABOVE EL. 10.500
SCALE: 1:50

LEGEND:

- NEW CONCRETE WALL OR WALKWAY
- STRUCTURE TO BE DEMOLISHED OR REMOVED
- COVER (PLAN & SECTIONAL VIEWS)

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

VERIFY SCALE IF PLAN SHEET IS REDUCED
30 mm

DRN BY: PTL
DES BY: -
CHK BY: TJ
APP BY: TJ

PREPARED FOR:
REGIONAL DISTRICT OF NANAIMO

PREPARED BY:
AECOM
4th FLOOR,
3292 PRODUCTION WAY,
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REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
PRIMARY AND SECONDARY CLARIFIERS
PLAN - DEMOLITION AND COVERS

PROJECT START DATE (M / Y)
OCTOBER 2022
PROJECT NO.
60590631
FILENAME
SK-04_05.dwg
RDN DRAWING No.
DRAWING No.
SK-04

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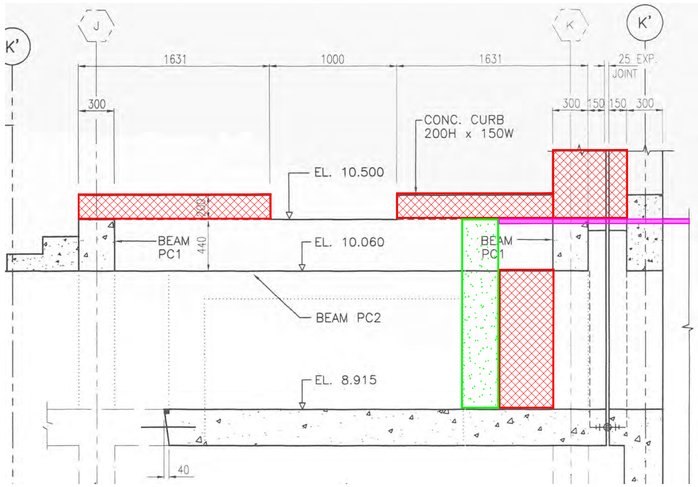
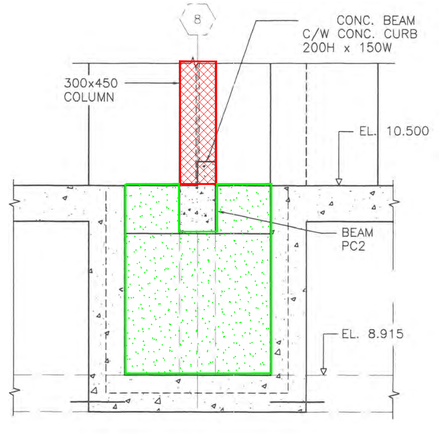


SECTION 1
SCALE 1:25 SK-05



SECTION 2
SCALE 1:25 SK-05

LEGEND:

- NEW CONCRETE WALL OR WALKWAY
- STRUCTURE TO BE DEMOLISHED OR REMOVED
- COVER (PLAN & SECTIONAL VIEWS)

VERIFY SCALE IF PLAN SHEET IS REDUCED
30 mm

DRN BY:	DES BY:	CHK BY:	APP BY:
PTL	-	TJ	TJ

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

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REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
PRIMARY AND SECONDARY CLARIFIERS
SECTIONS - DEMOLITION AND COVERS

PROJECT START DATE (M / Y)	OCTOBER 2022
PROJECT NO.	60590631
FILENAME	SK-04_05.dwg
RDN DRAWING No.	
DRAWING No.	**SK-05**

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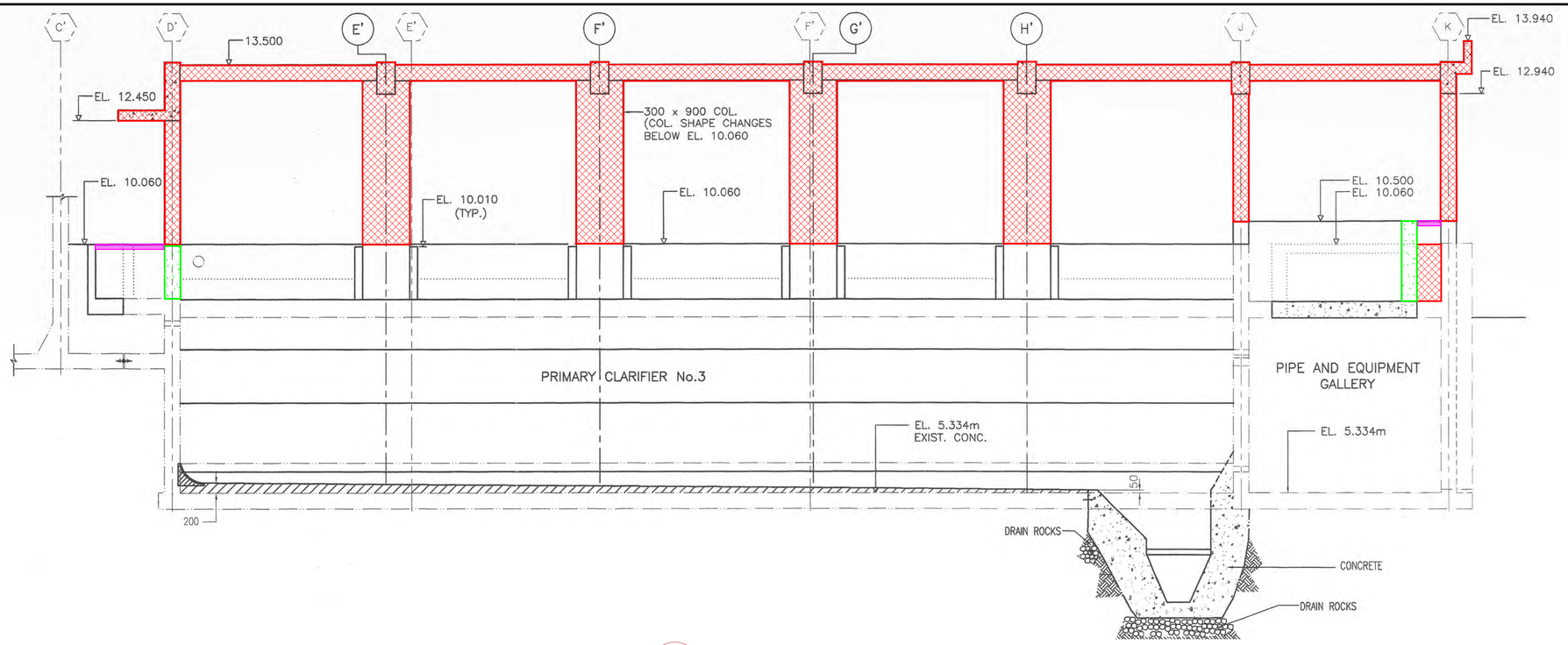
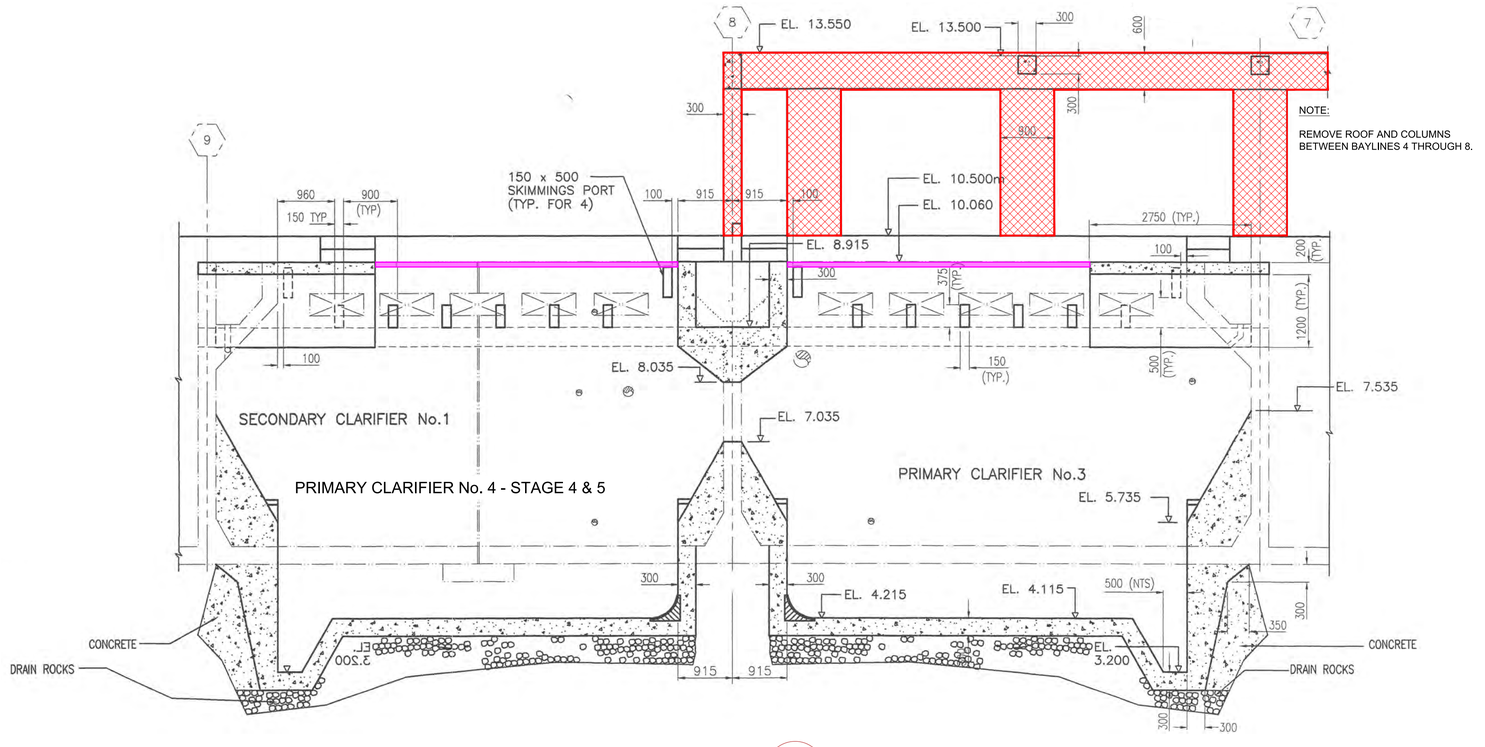


SECTION 4
SCALE 1:25 SK-04



SECTION 5
SCALE 1:25 SK-04

LEGEND:

- NEW CONCRETE WALL OR WALKWAY
- STRUCTURE TO BE DEMOLISHED OR REMOVED
- COVER (PLAN & SECTIONAL VIEWS)

AECOM Canada Ltd.
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No. 1001307

REV	DESCRIPTION	DATE (Y/M/D)
0	ISSUED FOR FEASIBILITY STUDY	2023/01/XX

VERIFY SCALE IF PLAN SHEET IS REDUCED
30 mm

DRN BY: PTL | DES BY: - | CHK BY: TJ | APP BY: TJ | DRN: PTL | CHK: TJ

PREPARED FOR: REGIONAL DISTRICT OF NANAIMO

PREPARED BY: AECOM
4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C., V5A 4R4
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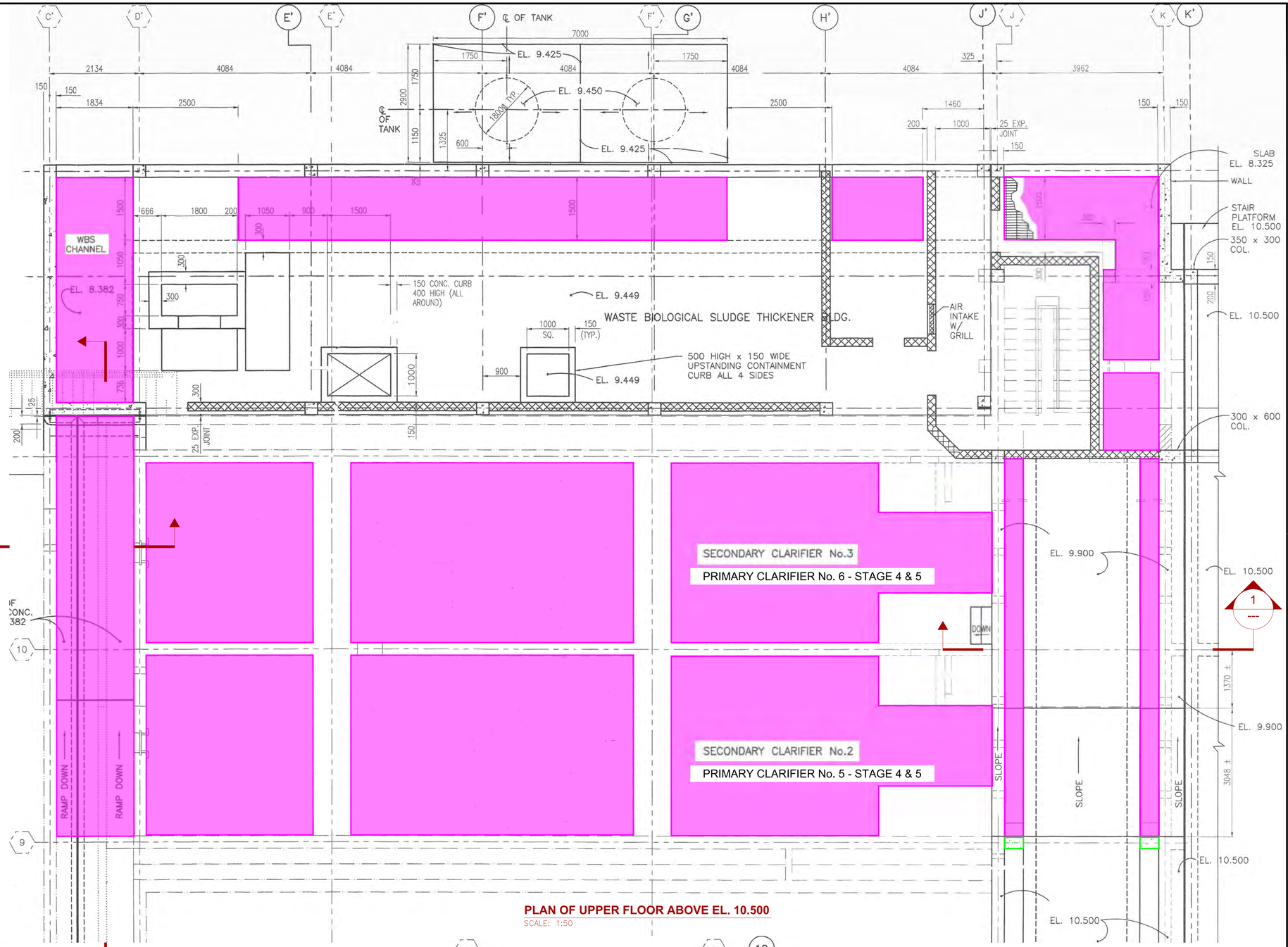
REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
PRIMARY AND SECONDARY CLARIFIERS
SECTIONS - DEMOLITION AND COVERS

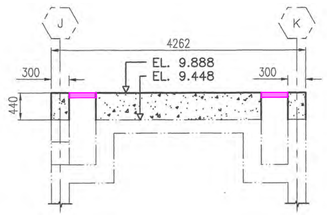
PROJECT START DATE (M / Y): OCTOBER 2022
PROJECT NO.: 60590631
FILENAME: SK-06.dwg
RDN DRAWING No.:
DRAWING No.: **SK-06**

LEGEND:

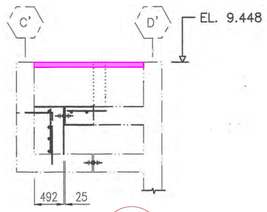
COVER
(PLAN & SECTIONAL VIEWS)



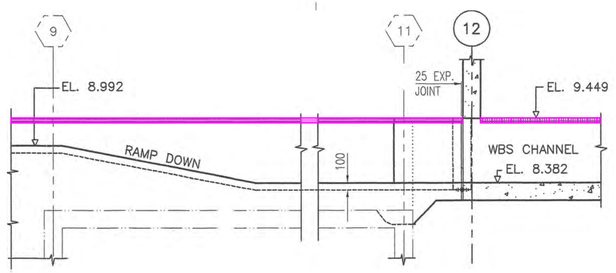
PLAN OF UPPER FLOOR ABOVE EL. 10.500
SCALE: 1:50



SECTION 1
SCALE 1:50



SECTION 2
SCALE 1:50



SECTION 3
SCALE 1:50

AECOM Canada Ltd.
Permit to Practice
No. 1001307

VERIFY SCALE IF PLAN SHEET IS REDUCED
30 mm

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

DRN BY: PTL
DES BY: -
CHK BY: TJ
APP BY: TJ

PREPARED FOR:
REGIONAL DISTRICT OF NANAIMO

PREPARED BY:
AECOM
4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
SECONDARY CLARIFIERS WASTE BIOLOGICAL SLUDGE
UPPER PLAN AND SECTIONS - COVERS

PROJECT START DATE (M / Y): OCTOBER 2022
PROJECT NO.: 60590631
FILENAME: SK-07.dwg
RDN DRAWING No.:
DRAWING No.: **SK-07**

SAME OPPOSITE HAND (TRICKLING FILTER ONLY)

SAME OPPOSITE HAND (TRICKLING FILTER ONLY)

1 SK-13

1 SK-12

2 EXP. JOINT

225 PVC WATERSTOP

TOP OF SLAB EL. 6.080

SLOPE

EL. 6.080

EL. 4.930

OPENING 700 W x 1500 H INV. EL. 5.030

400 x 400 COL.

400 x 400 COL.

SLOPE

EL. 4.930

EL. 5.180

EL. 5.280

EL. 5.280

EL. 4.830

SLOPE

OPENING 800 W x 800H INV. EL. 9.200 C/W

SLOPE

EL. 6.080

EL. 4.730

EL. 6.080

2 SK-13

SOLIDS CONTACT AREA

EL. 5.334

OPENING 600 W x 400 H INV. EL. 9.800

25 EXP. JOINT

OPENING 600 W x 800 H INV. EL. 5.334

OPENING 600 W x 800 H INV. EL. 5.334

EL. 5.334

25 EXP. JOINT

OPENING 600 W x 800 H INV. EL. 4.700

OPENING 600 W x 800 H INV. EL. 4.300 (TYP.)

EL. 4.30

EL. 4.20

OPENING 600 W x 800 H INV. EL. 4.200

EL. 2.200

25 EXP. JOINT

OPENING 600 W x 800 H INV. EL. 4.200

1 SK-10

OPENING 600 W x 1500 H INV. EL. 4.730

EL. 3.600

SLAB EL. 4.300

TRICKLING FILTER PUMP AREA

TOP OF WALL EL. 6.800

EL. 3.600

CONC. BENCHING

EL. 3.600

EL. 8.635

EL. 8.635

TOP OF PRE-FAB MEDIA SUPPORT BEAMS EL. 8.635 (TYP.)

300 W x 450 H PRE-FAB. MEDIA SUPPORT CONC. BEAMS (TYP.)

EL. 8.185 (TOP OF WALL BELOW)

400 x 450 BEAM (TYP.) TOP EL. 8.185

BEAM TB1

BEAM TB2

400 x 400 COL.

400 x 400 COL.

EL. 8.635

1 SK-10

1 SK-12

PLAN BELOW EL. 7.000

PLAN BELOW EL. 10.300

LEGEND:

NEW CONCRETE WALL OR WALKWAY

STRUCTURE TO BE DEMOLISHED OR REMOVED

AECOM Canada Ltd.
Permit to Practice
No. 1001307

VERIFY SCALE IF PLAN SHEET IS REDUCED

30 mm

DRN BY:	DES BY:	CHK BY:	APP BY:	REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
PTL	-	TJ	TJ	0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

PREPARED FOR:

REGIONAL DISTRICT OF NANAIMO

PREPARED BY:

AECOM
4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
TRICKLING FILTER - PUMP STATION - SOLIDS CONTACT
DEMOLITION - PLANS BELOW EL. 7.000 & EL. 10.300

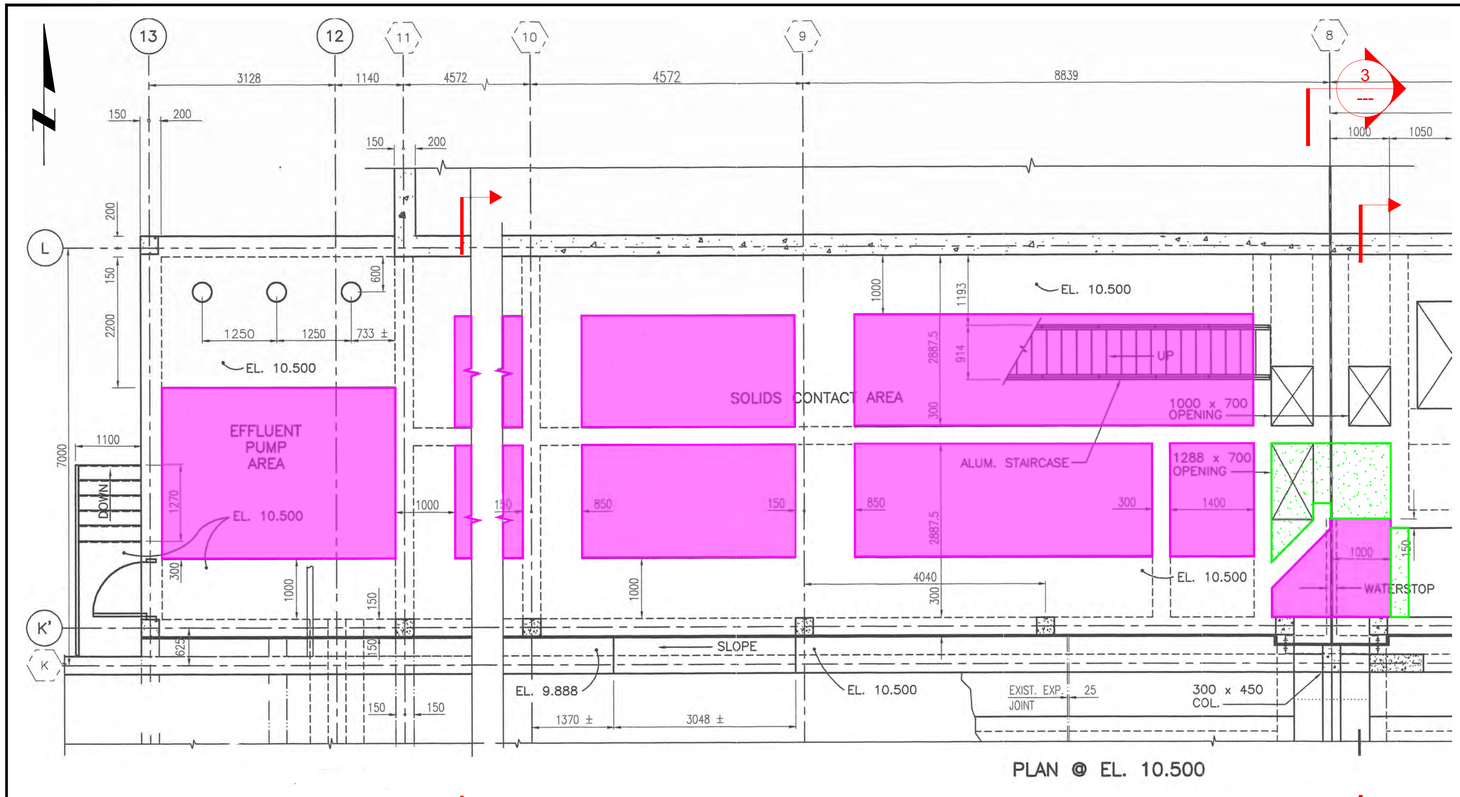
PROJECT START DATE (M / Y)
OCTOBER 2022

PROJECT NO.
60590631

FILENAME
SK-8.dwg

RDN DRAWING No.

DRAWING No.
SK-8

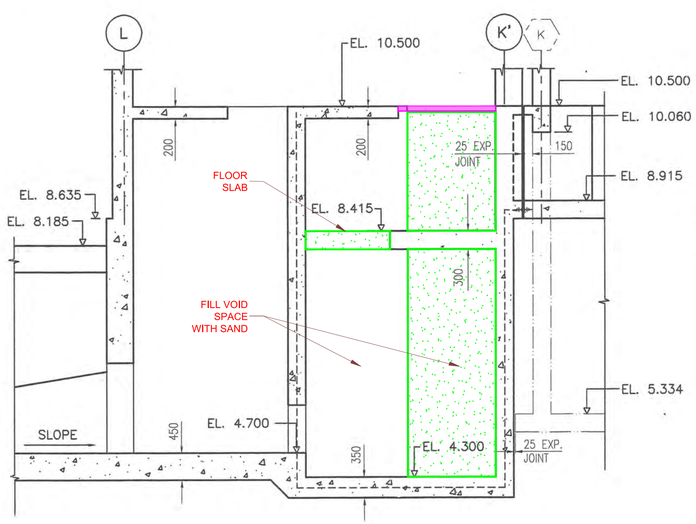


PLAN @ EL. 10.500

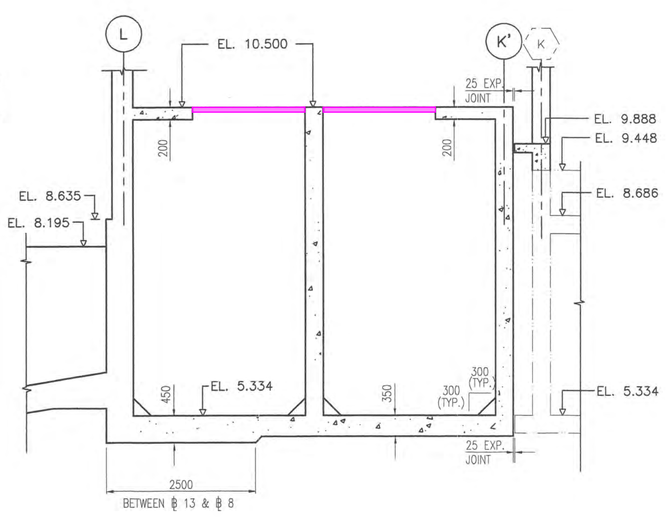
LEGEND:

NEW CONCRETE WALL OR WALKWAY

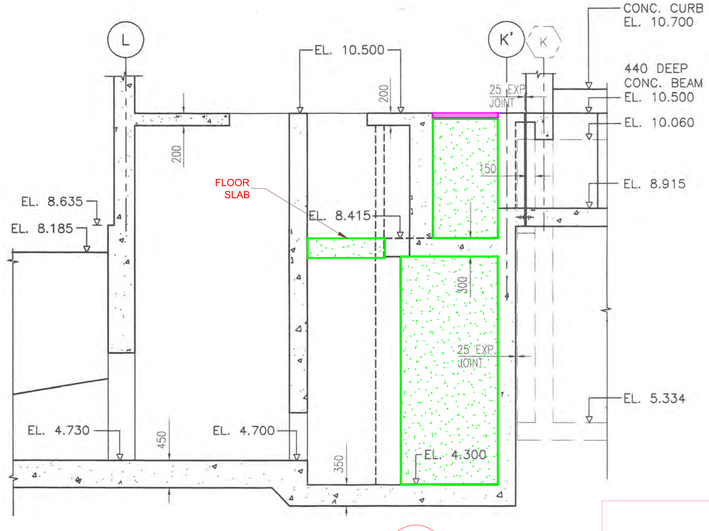
COVER (PLAN & SECTIONAL VIEWS)



SECTION 1 / 1 (SK-8)
SCALE 1:50



SECTION 2
SCALE 1:50



SECTION 3
SCALE 1:50

AECOM Canada Ltd.
Permit to Practice
No. 1001307

PREPARED FOR:
REGIONAL DISTRICT OF NANAIMO

PREPARED BY:
AECOM
4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C., V5A 4R4
604-444-6400

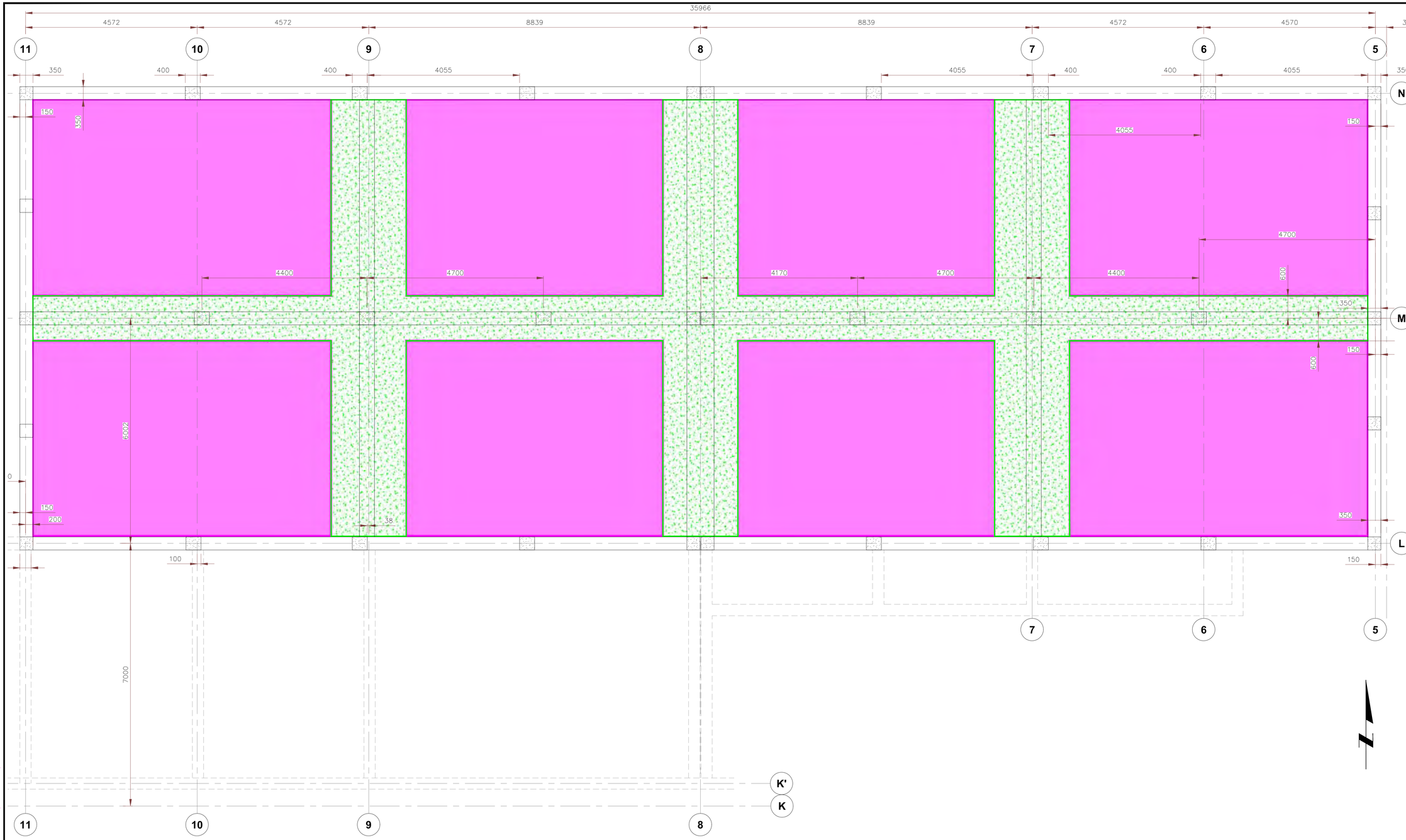
DRN BY:	DES BY:	CHK BY:	APP BY:	REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
PTL	-	TJ	TJ	0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

VERIFY SCALE IF PLAN SHEET IS REDUCED — 30 mm

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
PUMP STATION - SOLIDS CONTACT
COVERS - PLAN AT EL. 10.500 AND SECTIONS

PROJECT START DATE (M / Y): OCTOBER 2022
PROJECT NO.: 60590631
FILENAME: SK-9.dwg
RDN DRAWING No.:
DRAWING No.: **SK-9**



LEGEND:

NEW CONCRETE WALL OR WALKWAY

COVER
(PLAN & SECTIONAL VIEWS)

PLAN AT EL. 10.500

SCALE: 1:50

AECOM Canada Ltd.
Permit to Practice
No. 1001307

VERIFY SCALE IF PLAN SHEET IS REDUCED

30 mm

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

DRN BY: PTL
DES BY: -
CHK BY: TJ
APP BY: TJ

PREPARED FOR:

REGIONAL DISTRICT OF NANAIMO

PREPARED BY:

AECOM

4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
TRICKLING FILTER - PUMP STATION - SOLIDS CONTACT
COVERS - PLAN AT EL. 10.50

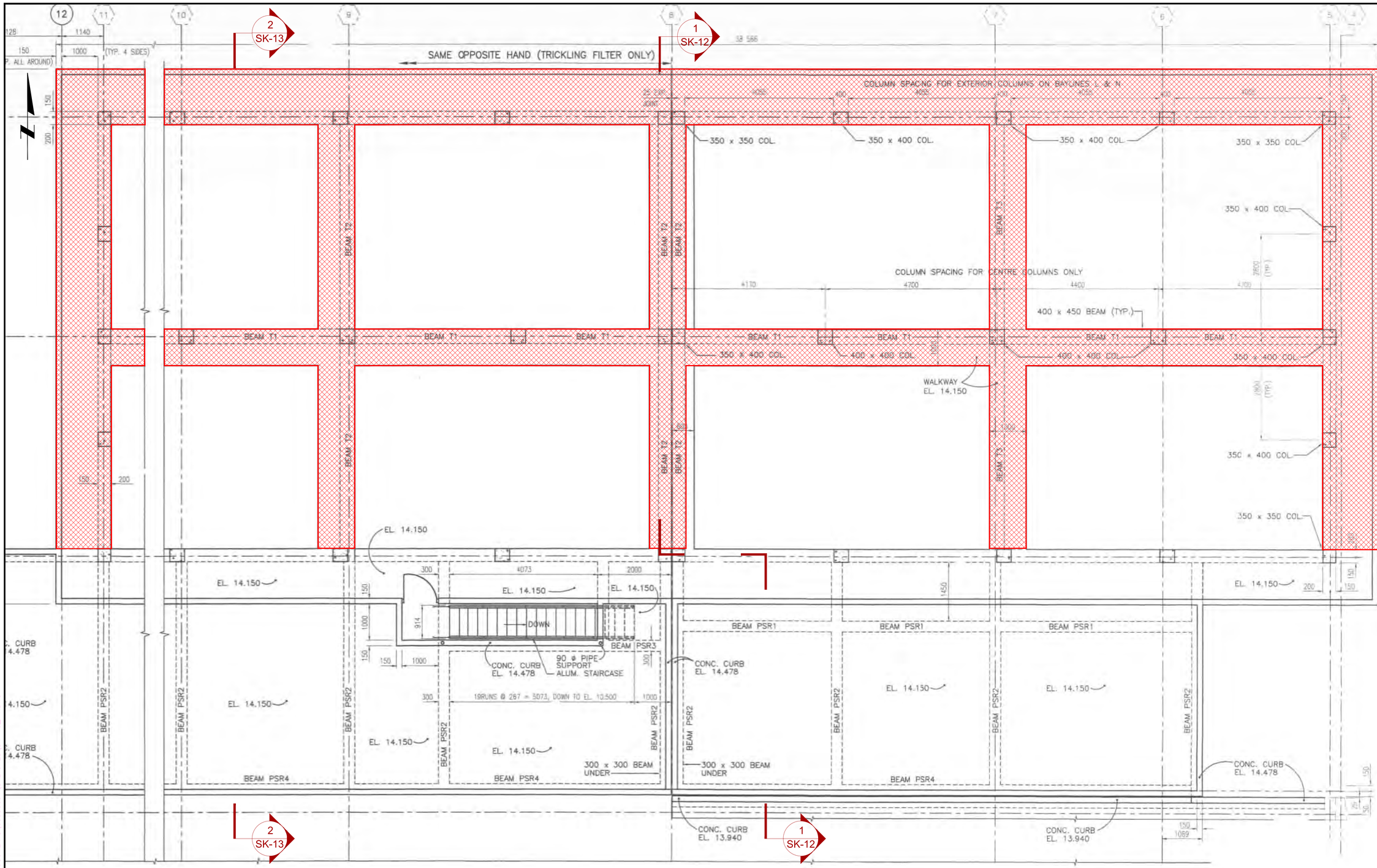
PROJECT START DATE (M / Y)
OCTOBER 2022

PROJECT NO.
60590631

FILENAME
SK-10_11.dwg

RDN DRAWING No.

DRAWING No.
SK-10



PLAN AT EL. 14.150

SCALE: 1:50

LEGEND:

STRUCTURE TO BE DEMOLISHED OR REMOVED

AECOM Canada Ltd.
Permit to Practice
No. 1001307

DRN BY:	DES BY:	CHK BY:	APP BY:
PTL	-	TJ	TJ

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

VERIFY SCALE IF PLAN SHEET IS REDUCED

30 mm

PREPARED FOR:

REGIONAL DISTRICT OF NANAIMO

PREPARED BY:

AECOM
4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

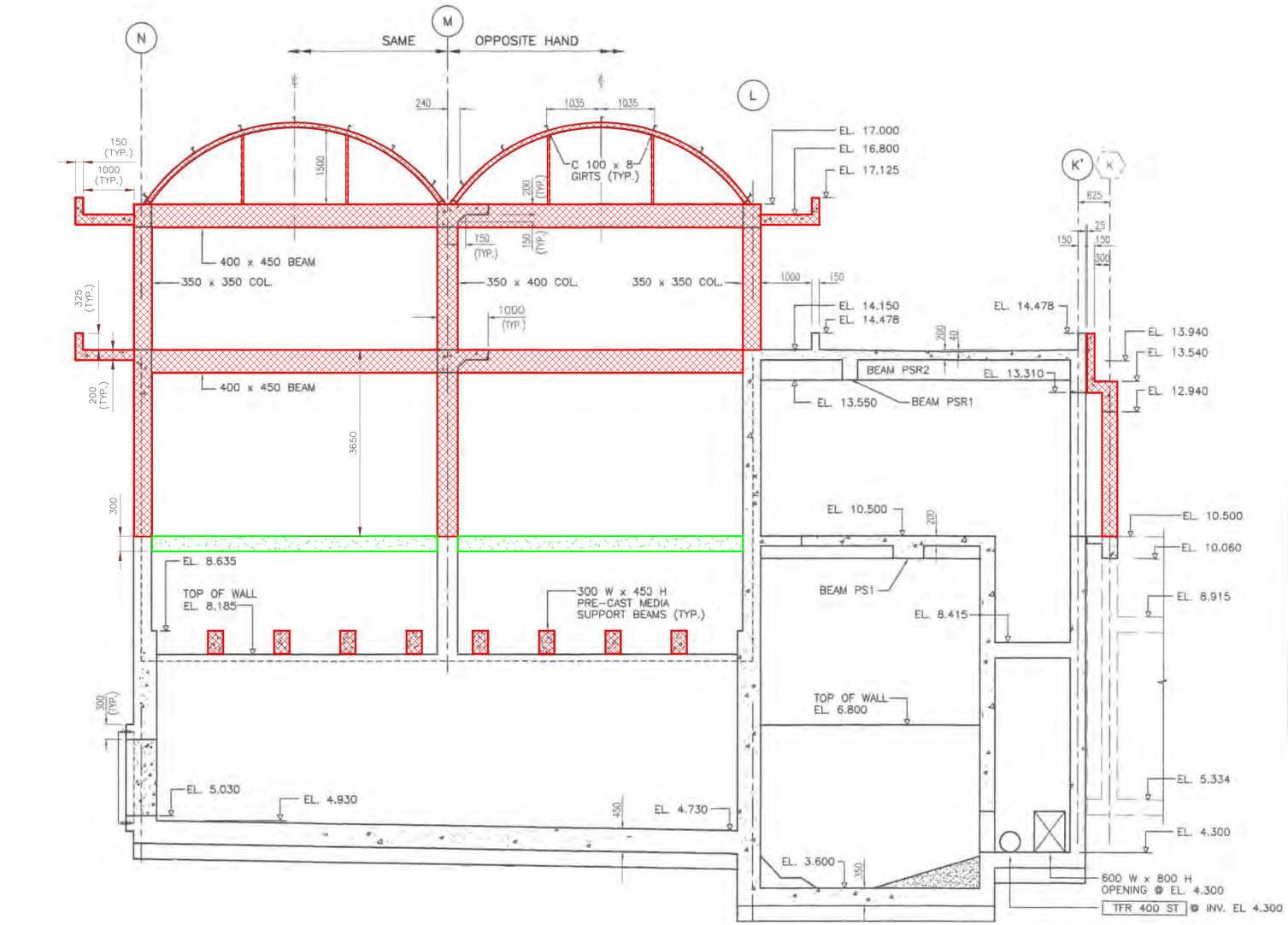
SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
TRICKLING FILTER - PUMP STATION - SOLIDS CONTACT
DEMOLITION - PLAN AT EL. 14.150

PROJECT START DATE (M / Y)	OCTOBER 2022
PROJECT NO.	60590631
FILENAME	SK-10_11.dwg
RDN DRAWING No.	
DRAWING No.	**SK-11**

LEGEND:

NEW CONCRETE WALL OR WALKWAY

STRUCTURE TO BE DEMOLISHED OR REMOVED



SECTION 1 / SK-8 — 1 / SK-11

SCALE 1:50

AECOM Canada Ltd.
Permit to Practice
No. 1001307

DRN BY:	DES BY:	CHK BY:	APP BY:	REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
PTL	-	TJ	TJ	0	ISSUED FOR FEASIBILITY STUDY	PTL	TJ	2023/01/XX

30 mm — VERIFY SCALE IF PLAN SHEET IS REDUCED

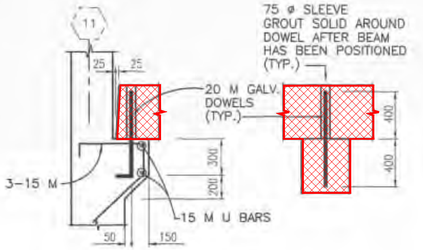
PREPARED FOR: REGIONAL DISTRICT OF NANAIMO

PREPARED BY: AECOM
4th FLOOR,
3292 PRODUCTION WAY,
BURNABY, B.C. V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

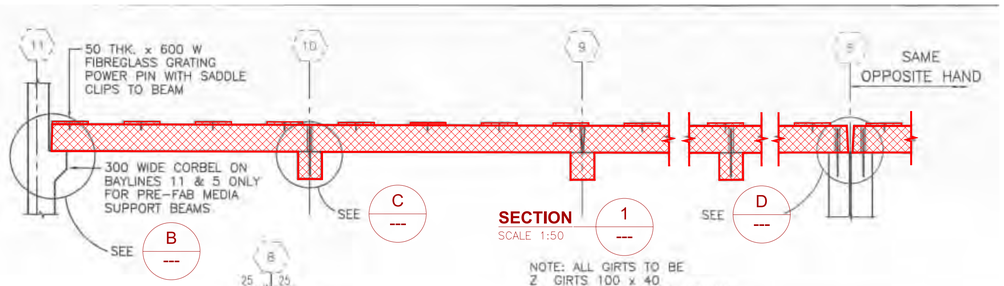
SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
TRICKLING FILTER
DEMOLITION - SECTION

PROJECT START DATE (M / Y): OCTOBER 2022
PROJECT NO.: 60590631
FILENAME: SK-12_13.dwg
RDN DRAWING No.:
DRAWING No.: **SK-12**



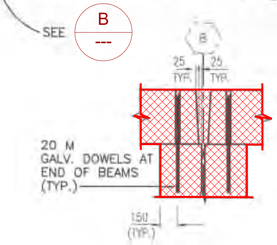
DETAIL B — SCALE 1:25

DETAIL C — SCALE 1:25

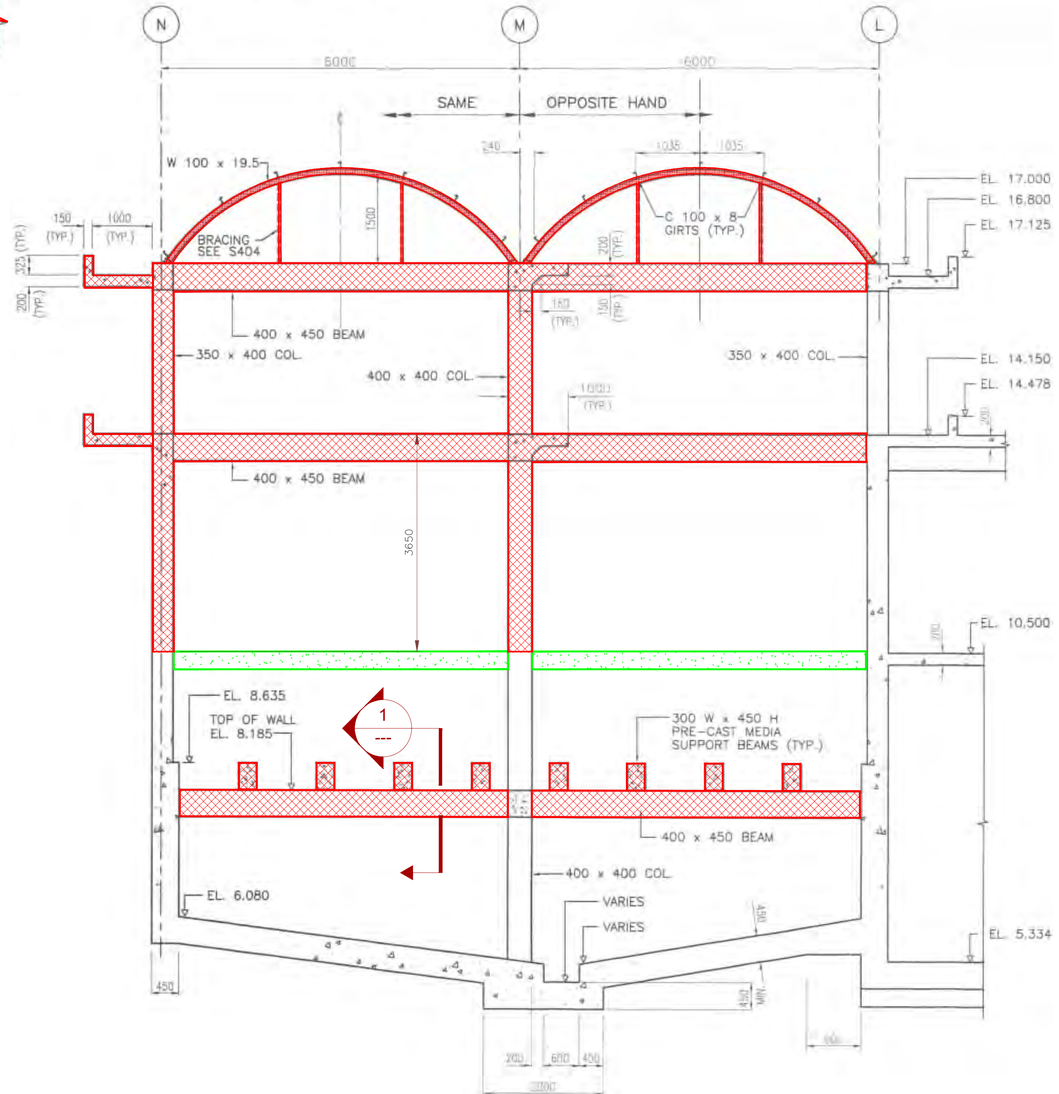


SECTION 1 — SCALE 1:50

NOTE: ALL GIRTS TO BE Z GIRTS 100 x 40 12 GAUGES EXCEPT AS NOTED



DETAIL D — SCALE 1:25



SECTION 2 — SCALE 1:50 — SK-8 / SK-11

LEGEND:

- NEW CONCRETE WALL OR WALKWAY
- STRUCTURE TO BE DEMOLISHED OR REMOVED

AECOM Canada Ltd.
Permit to Practice
No. 1001307

	DRN	CHK	DATE (Y/M/D)
0	PTL	TJ	2023/01/XX

ISSUED FOR FEASIBILITY STUDY

VERIFY SCALE IF PLAN SHEET IS REDUCED — 30 mm

DRN BY: PTL | DES BY: - | CHK BY: TJ | APP BY: TJ

PREPARED FOR: REGIONAL DISTRICT OF NANAIMO

PREPARED BY: AECOM
4th FLOOR, 3292 PRODUCTION WAY, BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK WATER POLLUTION CONTROL CENTER
STAGE IV EXPANSION

SECONDARY TREATMENT PROCESS FEASIBILITY STUDY
TRICKLING FILTER
DEMOLITION - SECTIONS AND DETAILS

PROJECT START DATE (M / Y): OCTOBER 2022
PROJECT NO.: 60590631
FILENAME: SK-12_13.dwg
RDN DRAWING No.:
DRAWING No.: **SK-13**

PLANT AREAS	
AREA 100	PRELIMINARY TREATMENT
AREA 200	SEDIMENTATION TANKS
AREA 300	ATADs
AREA 400	TRICKLING FILTERS
AREA 500	SLUDGE DEWATERING
AREA 600	SECONDARY TREATMENT
AREA 800	OPERATIONS BUILDING

Site Plan from 2021 AECOM Design
Provided for General Site Layout
and Naming of Plant Areas

6.0m WIDE ASPHALT ACCESS ROAD
PROPOSED FENCE (TYP)
BIOREACTOR 2
SECONDARY CLARIFIER 5
SRS DISTRIBUTION BOX
SECONDARY CLARIFIER 4
BIOREACTOR 1
TRUCK AXLE SCALE
TRANSFORMER
AREA 600
CTU BUILDING
PROPERTY LINE (TYP)
MOTORIZED SLIDING GATE. SEE DWG. C-1016
EXISTING DRYING BED
EXISTING DRYING BED
EXISTING DRYING BED
CENTRATE PUMP STATION
DEWATERING BUILDING
ASPHALT DRIVEWAY
GENSET
AREA 500
TREELINE
MORNINGSTAR CREEK
ISLAND HIGHWAY
AREA 100
EQUALIZATION TANK
TRICKLING FILTERS
AREA 400
CONTACT
RIPARIAN AREA
SRS SPLITTER BOX
PARKING STALLS
AREA 300
AREA 200
AREA 800
RETAINING WALL
CONC. CURB
WASTE BIOLOGICAL THICKENER BUILDING
SEPTAGE HOLDING TANK
OPERATIONS BUILDING
MOTORIZED SLIDING GATE. SEE DWG. C-1017
LEE ROAD
GRAVEL
BLDG.
Pcl. A
DD 5360–N
2
PLAN 2570
4
PLAN 2570
15m BUFFER ZONE FROM MORNINGSTAR CREEK AND 4.5m FROM PROPERTY LINE. (TYP)
SURVEYED HIGH WATER MARK OF MORNINGSTAR CREEK (TYP)
DL. 28
R3
P. 9203

0 12.5 25 m
1:500

SITE PLAN
1:500

VERIFY SCALE IF PLAN SHEET IS REDUCED
30 mm

REV	DESCRIPTION	DRN	CHK	DATE (Y/M/D)
C	ISSUED FOR DRAFT TENDER	SI	BY	2021/02/26
B	ISSUED FOR 90% DETAILED DESIGN	SI	BY	2020/07/24
A	ISSUED FOR 60% DETAILED DESIGN	SI	KM	2019/09/24

DRN BY: SI
DES BY: BY
CHK BY: KM
APP BY: MC

PREPARED FOR:
REGIONAL DISTRICT OF NANAIMO

PREPARED BY:
AECOM
4th FLOOR, 3292 PRODUCTION WAY, BURNABY, B.C., V5A 4R4
604-444-6400

REGIONAL DISTRICT OF NANAIMO
FRENCH CREEK POLLUTION CONTROL CENTRE
STAGE 4 EXPANSION
CIVIL
SITE LAYOUT AND AREA PLAN

PROJECT START DATE (M / Y): SEP/2019
PROJECT NO.: 60590631
FILENAME: 60590631-C-1001.dwg
RDN DRAWING No.:
DRAWING No.: **C-1001**

Plotted By: snejа.ignatova
Plot File Date Created: Apr/22/2021 9:02 AM
Layout-Sheet Name: C-1001
Filename: C:\USERS\SNEJA.IGNATOVA\DESKTOP\60590631-DESKTOP\910-CAD\20-SHEETS\C\60590631-C-1001.DWG