
**PARKS CANADA AGENCY
QUEBEC WATERWAYS**

**REPLACEMENT OF THE SAFETY BOOM
AT THE SAINT-OURS CANAL NHS**

SAINT-OURS (QUEBEC) CANADA

**SPECIFICATION
CIVIL AND MECANICAL**

**PCA PROJECT #: COUR-ESTA-BAR-01
WSP PROJECT #: 151-03113-03**

ISSUED FOR BID

DO NOT USE THIS DOCUMENT FOR CONSTRUCTION PURPOSE.



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Quebec City, August 18, 2016

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CIVIL - STRUCTURE

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END OF SECTION

Section Number	Section Title	No. of Pages
GENERAL		
00 00 00	Title Page	1
00 01 07	Seal Page and Signatures	1
00 01 10	Table of Contents	2
01 11 01	Work Related General Information	5
01 29 00	Measurement Procedures	3
01 31 19	Project Meetings	3
01 32 16.06	Construction Progress Schedule- Critical Path Method (CPM)	7
01 33 00	Submittal Procedures	4
01 35 29.06	Health Safety Requirements	3
01 35 43	Environmental Procedures	5
01 45 00	Quality Control	2
01 61 00	Common Products Requirements	4
01 74 11	Cleaning	2
01 74 21	Construction Demolition Waste Management and Disposal	4
01 77 00	Closeout Procedures	2
01 78 00	Closeout Submittals	7
CONCRETE		
03 10 00	Concrete Forming and Accessories	3
03 20 00	Concrete Reinforcing	4
03 30 00	Cast-in-Place Concrete	6
03 41 00	Precast Structural Concrete	5
METALS		
05 12 23	Structural Steel for Buildings	4
05 50 00	Metal Fabrications	3
CIVIL		
31 05 16	Aggregate Materials	4
31 23 33.01	Excavating, Trenching and Backfilling	7
31 61 13	Pile Foundations, General Requirements	5
31 62 16.19	Unfilled Tubular Steel Piles	5
WATERWAY AND MARINE CONSTRUCTION		
35 41 15	Safety Boom	7
35 42 19	Preservation of Water Courses and Wetlands	2
	Total pages:	110

APPENDICES		
A1	Drawings of Anchoring Piles and Darvard Island Retaining Wall – Existing Safety Boom	
A2	Drawings, Photos and Installation Process for the Existing Upstream Safety Boom – SPG Hydro, 2010	
A3	Geotechnical Study, Darvard Island – WSP, 2015	
A4	Hydraulic Study, Richelieu River, Saint-Ours Dam – WSP, 2016	
A5	Photos	
A6	Survey Markers Data Sheet	

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Used.

1.2 SCHEDULE OF WORK AND CONSTRUCTION PHASES

- .1 The works shall comply with the following requirements:
 - .1 The Contractor must install the two (2) safety booms (upstream and downstream) of the Saint-Ours dam in Spring 2017 in time for the opening of the navigational period on the Richelieu River, in the Saint-Ours area. Date may vary depending on the spring freshet (around May 17, 2017). To be coordinated with PCA at the beginning of May 2017.
 - .2 Except the installation of the safety booms, all work must be carried out within the period starting at contract awarding and ending April 28, 2017, as authorized by the Department of Fisheries and Oceans (DFO). The existing upstream boom must stay in place until the end of the 2016 navigational period, i.e. around mid-October 2016.

1.3 SCOPE OF WORK

- .1 Work must be carried out while taking into account the 50-year useful life of the civil structures (such as anchors) and includes design, provision, manufacture, painting, assembly, transport, delivery, handling (including handling equipment), temporary on-site storage (if applicable) and installation for the following equipment and work:
 - .1 New upstream safety boom
 - .1 Design (design notes, shop and production drawings, and technical data), manufacture and provision of a new temporary safety boom (installed only during the navigational period) located upstream of the Saint-Ours dam, including, but not limited to: buoys, handrails, graphic lettering in accordance with PCA standards, assembly accessories for the safety barrier and equipment for the installation of the boom.
 - .2 Design (design notes, construction and as-built plans and specifications, technical data), provision and installation of a permanent underwater anchor located at the tip of the “V” of the upstream safety boom, including: summer and winter buoys with lettering in accordance with PCA standards.
 - .3 Installation of the upstream safety boom in Spring 2017.
 - .4 Design (design notes, shop drawings, construction and as-built plans and specifications, technical data), provision and installation for the modification of the upstream boom’s anchor ties to the two (2) existing concrete piles and to the Darvard Island retaining wall, including:

- .1 Hand-operated hoist as to tighten the safety boom, if required, and fastening hardware for the new boom.
 - .2 Anchoring points, sliding rails and/or other mechanisms installed on the existing structures so that the safety boom keeps up with variations of the river's water level upstream.
 - .3 Dismantlement of structures and existing metal hardware (steel strapping, anchors, hookeys, etc.) located on the concrete piles and the retaining wall and allowing the anchoring of the existing upstream boom.
- .2 Existing safety boom relocated downstream
- .1 Modification of the existing upstream safety boom as to relocate it downstream of the dam, including all accessories required to secure it to the new anchors, as well as a new hand-operated hoist as to tighten the safety boom, if required. This safety barrier shall only be installed for the duration of the annual navigational period. Includes the provision of shop drawings and technical data.
 - .2 Design (design notes, construction and as-built plans and specifications, technical data), manufacture, provision and installation of anchors (on the right and left banks) for the existing boom relocated downstream of the dam.
 - .1 On the right bank: existing retaining concrete wall. There is no data available for this wall. The Contractor's Design Expert must choose an anchoring method which shall not create additional load on the existing structure.
 - .2 On the left bank: the Contractor must provide an anchorage composed of concrete blocks buried under the road which goes along the left bank of Darvard Island. The anchoring point of the boom shall be accessible through the riprap.
 - .3 The Contractor is in charge of carrying out all studies necessary for the design of the types of anchors, such as required geotechnical studies. His choice of design must be validated by standard and valid studies and tests.
 - .3 Provision and installation of four (4) warning panels, as specified in the tender drawings.
 - .4 Installation of the downstream safety boom (Spring 2017).
- .2 Work also includes the following:
- .1 Realization and provision for review of all design notes, construction and production drawings signed/sealed by an engineer from Quebec, signed/sealed construction technical specifications (if they are not included in the present document), as-built plans and specifications and all shop drawings required for the project.
 - .2 More specifically, development and provision of design notes proving that the new upstream safety boom, its anchors, as well as the anchors of the boom relocated downstream comply with the requirements of the contract documents.

- .3 Development and provision of an installation and removal procedure for two (2) safety booms (upstream and downstream).
 - .4 Signed/sealed drawings by engineer from Quebec.
 - .5 Signed/sealed technical specifications, if not included in present document.
 - .6 Provision of data sheet for every piece of equipment and components provided as part of the project.
 - .7 Provision of shop drawings.
 - .8 Preparation and provision of a maintenance and operation manual.
 - .9 If required, soil and seabed geotechnical surveys and investigations near the new anchors to be installed.
 - .10 If required, measurement of existing structures and any other measurements needed for the realization of work.
 - .11 Training of PCA personnel for the installation and removal of safety booms (consider one (1) day with eight (8) hours of training; the Contractor shall provide powerboats).
 - .12 All engineering services related to the monitoring of manufacture, assembly, commissioning, from provision to final acceptance.
 - .13 If applicable, presence and assistance of a certified materials testing laboratory.
 - .14 All work, materials and services, that are not specified in the present section, but that are necessary for the manufacture, transport, installation, testing and proper operation of equipment, are considered as part of Work and must be provided by the Contractor.
- .3 Work excludes the following:
- .1 Requests for environmental permits and certificates of authorization, which are the expense of the PCA.

1.4 WORK SEQUENCE

- .1 Co-ordinate Progress Schedule and co-ordinate with the occupancy during construction.
- .2 Maintain fire access/control.

1.5 CONTRACTOR USE OF PREMISES

- .1 Limit use of premises for Work, for storage, and for access.
- .2 The Contractor can store his material near the boat launching ramp located close to the parking area, in the gravel zone (see tender drawings). The storage area must be safe and fenced.
- .3 Co-ordinate use of premises under direction of Departmental Representative and instruction presented in tender documents.
- .4 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.6 ACCESS TO THE RIVER

- .1 The Contractor can use PCA's boat launching ramp. It is located near the parking area, right of the lock, and facing downstream of the dam. The Contractor is responsible for assessing directly on site the location, condition and limits of the existing ramp.
- .2 The Contractor can launch his equipment (without ramp, mobile crane required) at the end of the parking area, on the upstream side (see tender drawing).
- .3 As a reference, the ramp is about 3.5 m in width (to be verified by the Contractor). It is in poor condition; launch is impossible when water level is too low. Information on the ramp's capacity is not available. However, there is no record of a PCA's trucks and trailers getting stuck during handling of the site's barge. PCA uses the ramp for the launching of a barge which possesses the following characteristics:
 - .1 Engine: 2 x 60 hp.
 - .2 Hull length: 22 ft (6.7 m).
 - .3 Overall width: 7 ft and 11.5 in (2.43 m).
 - .4 Moulded depth: 1 ft and 2 in (0.36 m).
 - .5 Construction material: aluminum.
- .4 When using the launching ramp, the Contractor must coordinate his work 72 hours in advance (if passage through the lock is required). Note that in some cases, the lock could be inoperable given the presence of ice. Likewise, PCA stores its docks in the lock outside of the navigational period. If the Contractor wants to use the lock, he shall bear responsibility for removing the docks, properly securing them during work, and putting them back in the lock once work is done.

1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING WORKS

- .1 Execute work with least possible interference or disturbance to works operations, users, public and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.8 REQUIRED DOCUMENTS

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.

- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified.

1.9 SPECIFICATIONS DIVISIONS AND SECTIONS

- .1 Shall the Contractor propose solutions for which the sections are not included, he shall provide his own specification for review by the Departmental Representative.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 The method of measurement for the categories of labour, plant, equipment, materials, supervision and services which constitute the work is described in the following sentences.

1.2 MEASUREMENT PROCEDURES

- .1 Mobilization and Demobilization
 - .1 All worksite material, workforce, construction equipment and machinery, materials, services, supervision and other expenses/fees incurred for this project and that are not covered by the other items measured and listed in the price schedule must be included in the present item.
 - .2 Item also includes all activities and expenses related to mobilization and demobilization on site.
 - .3 If required, concrete cooling and protection when the weather is hot are considered to be incidental to work and must be included in this item.
 - .4 This item includes environmental mitigation measures.
 - .5 Upon contract award notice, the Contractor shall submit a more detailed cost breakdown for this item in accordance with main activities (mobilization, demobilization, equipment rentals, site organization, etc.) as to allow progress payment of the item on a pro rata basis of the accomplished work total.
- .2 Training of the PCA personnel and provision of procedures and manuals.
 - .1 Item includes workforce, equipment and material for:
 - .1 Training of PCA personnel by the Contractor for the installation and removal of two (2) dam safety booms, including power boats.
 - .2 Provision of an installation and removal procedure for safety booms downstream and upstream of dam.
 - .3 Provision of a maintenance and operation manual.
 - .2 Item measured as lump sum price.
- .3 Provision of the new upstream safety boom.
 - .1 Item includes, but not limited to: detailed design, manufacture, assembly and provision activities for a new safety boom located upstream of the Saint-Ours dam. Also included are: buoys, handrails, graphic lettering, assembly accessories for the safety boom and equipment for the boom installation.
 - .2 Item measured as lump sum price.
- .4 Installation of the new upstream anchor and provision of buoys.
 - .1 Item includes, but not limited to: choice of anchor, detailed design, manufacture, provision and installation of an underwater permanent anchor located at the tip of

- the “V” upstream safety boom, including summer and winter buoys with graphic lettering.
- .2 Item also includes expenses associated with material and equipment (boats, barges, etc.) required for the installation of anchor.
 - .3 If deemed necessary by the Contractor, cost associated to geotechnical surveys and investigations of soil and sea bottom must be included in this item.
 - .4 Item measured as lump sum price.
- .5 Modification to the existing upstream piles and to Darvard Island retaining wall for the anchoring of the new safety boom.
- .1 Item includes, but not limited to: detailed design, manufacture, provision and installation of new anchoring points for existing piles wall as to secure the new safety boom, including all fastening hardware. Item also includes:
 - .1 Selection and provision of a hand-operated hoist to tighten the safety boom, if required.
 - .2 Anchoring points, sliding rails and/or other mechanisms installed on the concrete piles so that the safety boom keeps up with the variations in the river’s water level upstream of the dam and that it stays secured to the pile.
 - .2 Dismantlement of existing structures and metal hardware (steel strapping, anchors, hookeyes, etc.), located on the existing structures, and that will not be used to anchor the new safety boom.
 - .3 Item measured as lump sum price.
- .6 Modification to the existing safety boom as to relocate it downstream of the dam.
- .1 Item includes, but not limited to: modification to the existing upstream safety boom as to relocate it to the downstream side of the dam, including all accessories required for the securing of the new anchors, and a new hand-operated hoist to tighten the boom, if required.
 - .2 Item also includes the manufacture, provision and installation of four (4) warning panels, as specified in tender drawings.
 - .3 Item measured as lump sum price.
- .7 Installation of the downstream safety boom right bank anchoring.
- .1 Item includes, but not limited to: detailed design, manufacture, provision and installation of a new anchoring point on the right bank and downstream of the dam to secure the relocated safety boom. Item also includes:
 - .1 Anchoring point, sliding rails and/or other mechanisms installed at the anchoring point so that the safety boom keeps up with the variations in the river’s water level downstream of the dam.
 - .2 Work for the existing access road reclamation under which shall be placed and buried the concrete blocks.
 - .2 Item also includes expenses associated with material and equipment (machinery, boats, barges, etc.) required for the installation of anchoring point.
 - .3 If deemed necessary by the Contractor, cost associated to geotechnical surveys and investigations of soil and sea bottom must be included in this item.

- .4 Item measured as lump sum price.
- .8 Installation of the downstream safety boom left bank anchoring.
 - .1 Item includes, but not limited to, choice of anchor, detailed design, manufacture, provision, and installation of an anchoring point on the left bank and downstream of the dam as to secure the relocated safety boom, including:
 - .1 Anchoring points, sliding rails and/or other mechanisms installed at the anchoring point so that the safety boom keeps up with the variations in the river's water level downstream of the dam.
 - .2 Item also includes expenses associated with material and equipment (machinery, boats, barges, etc.) required for the installation of the anchoring point.
 - .3 If deemed necessary by the Contractor, cost associated to geotechnical surveys and investigations of soil and sea bottom must be included in this item.
 - .4 Item measured as lump sum price.
- .9 Installation of the upstream safety boom – Spring 2017.
 - .1 Item includes, but not limited to, the installation of the upstream safety boom in Spring 2017 (+/- mid-May) by the Contractor.
 - .2 Item also includes expenses associated with material and equipment (boats, etc.) required for the installation of the safety boom.
 - .3 Item measured as lump sum price.
- .10 Installation of the downstream safety boom – Spring 2017.
 - .1 Item includes, but not limited to, the installation of the upstream safety boom in Spring 2017 (+/- mid-May) by the Contractor.
 - .2 Item also includes expenses associated with material and equipment (boats, etc.) required for the installation of the safety boom.
 - .3 Item measured as lump sum price.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not used.

1.2 ADMINISTRATIVE

- .1 Departmental Representative schedule and administer project meetings throughout the progress of the work.
- .2 Departmental Representative shall prepare agenda for meetings.
- .3 Departmental Representative shall distribute written notice of each meeting four (4) days in advance of meeting.
- .4 Departmental Representative shall provide physical space and make arrangements for meetings.
- .5 Departmental Representative shall preside at meetings.
- .6 Departmental Representative shall record the meeting minutes, include significant proceedings and decisions, and identify actions by parties.
- .7 Departmental Representative shall reproduce and distribute copies of minutes within three (3) days after meetings and transmit to meeting participants not in attendance and PCA Representative.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings shall be qualified and authorized to act on behalf of party each represents.

1.3 PRECONSTRUCTION MEETING

- .1 Within fifteen (15) days after award of Contract, Departmental Representative shall request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative, PCA Representative, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Departmental Representative shall establish time and location of meeting and notify parties concerned at least five (5) days before meeting.
- .4 Departmental Representative shall incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.06 - Construction Progress Schedule – Critical Path Method (CPM).
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

- .4 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .5 Owner provided products.
- .6 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .7 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .8 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .9 Monthly progress claims, administrative procedures, photographs, hold backs.
- .10 Appointment of inspection and testing agencies or firms.
- .11 Insurances, transcript of policies.

1.4 PROGRESS MEETINGS

- .1 During course of Work, Departmental Representative shall schedule progress meetings every two (2) weeks.
- .2 Major Subcontractors involved in Work, Departmental Representative and PCA Representative are to be in attendance.
- .3 Departmental Representative shall notify parties at least five (5) days prior to meetings.
- .4 Departmental Representative shall record minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for possible impact on construction schedule and on completion date.
 - .12 Others.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not used.

1.2 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Actual Finish Date (AF): point in time that Work actually ended on activity
- .3 Actual Start Date (AS): point in time that Work actually started on activity.
- .4 Bar Chart (Gantt chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars.
- .5 Baseline: original approved plan (for Project, work package, or activity), plus or minus approved scope changes.
- .6 Completion Milestones: they are firstly Interim Certificate Substantial Completion and secondly Final Certificate.
- .7 Constraint: applicable restriction that will affect performance of Project. Factors that affect activities can be scheduled.
- .8 Control: process of comparing actual performance with planned performance, analyzing variances, evaluating possible alternatives, and taking appropriate corrective action as needed.
- .9 Critical Activity: any activity on a critical path. Most commonly determined by using critical path method.
- .10 Critical Path: series of activities that determines duration of Project. In deterministic model, critical path is usually defined as those activities with float less than or equal to specified value, often zero. It is longest path through Project.
- .11 Critical Path Method (CPM): network analysis technique used to predict Project duration by analyzing which sequence of activities (which path) has least amount of scheduling flexibility (least amount of float).
- .12 Data Date (DD): date at which, or up to which, Project's reporting system has provided actual status and accomplishments.
- .13 Duration (DU): number of work periods (not including holidays or other non-working periods) required to complete activity or other Project element. Usually expressed as workdays or work weeks.
- .14 Early Finish Date (EF): in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can finish, based on network logic and schedule constraints. Early finish dates can change as Project progresses and changes are made to Project plan.

- .15 Early Start Date (ES): in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can start, based on network logic and schedule constraints. Early start dates can change as Project progresses and changes are made to Project Plan.
- .16 Finish Date: point in time associated with activity's completion. Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
- .17 Float: amount of time that activity may be delayed from its early start without delaying Project finish date. Float is mathematical calculation, and can change as Project progresses and changes are made to Project plan. This resource is available to both PCA and Contractor.
- .18 Lag: modification of logical relationship that directs delay in successor task.
- .19 Late Finish Date (LF): in critical path method, latest possible point in time that activity may be completed without delaying specified milestone (usually Project finish date).
- .20 Late Start Date (LS): in critical path method, latest possible point in time that activity may begin without delaying specified milestone (usually Project finish date).
- .21 Lead: modification of logical relationship that allows acceleration of successor task.
- .22 Logic Diagram: see Project network diagram.
- .23 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .24 Milestone: significant event in Project, usually completion of major deliverable.
- .25 Monitoring: capture, analysis, and reporting of Project performance, usually as compared to plan.
- .26 Near-Critical Activity: activity that has low total float.
- .27 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .28 Project Control System: fully computerized system utilizing commercially available software packages.
- .29 Project Network Diagram: schematic display of logical relationships of Project activities. Always drawn from left to right to reflect Project chronology.
- .30 Project Plan: formal, approved document used to guide both Project execution and Project control. Primary uses of Project plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines. Project plan may be summary or detailed.
- .31 Project Planning: development and maintenance of Project Plan.
- .32 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of Project Work in relation to established milestones.
- .33 Project Schedule: planned dates for performing activities and planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy project objectives. Monitoring and control process involves using project schedule

in executing and controlling activities and is used as basis for decision-making throughout project life cycle.

- .34 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.
- .35 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on Project's objectives.
- .36 Scheduled Finish Date (SF): point in time that Work was scheduled to finish on activity. Scheduled finish date is normally within range of dates delimited by early finish date and late finish date.
- .37 Scheduled Start Date (SS): point in time that Work was scheduled to start on activity. Scheduled start date is normally within range of dates delimited by early start date and late start date.
- .38 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.
- .39 Work Breakdown Structure (WBS): deliverable-oriented grouping of project elements that organizes and defines total Work scope of Project. Each descending level represents increasingly detailed definition of Project Work.

1.3 CPM REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedule are practical and remain within specified Contract duration.
- .2 Master Plan and Detail Schedule deemed impractical by Departmental Representative are revised and resubmitted for approval.
- .3 Acceptance of Master Plan and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract. Duration of Contract may only be changed through bilateral Agreement.
- .4 Consider Master Plan and Detail Schedule deemed practical by Departmental Representative, showing Work completed in less than specified Contract duration, to have float.
- .5 First Milestone on Master Plan and Detail Schedule will identify start Milestone with an "ES" constraint date equal to Award of Contract date.
- .6 Calculate dates for completion milestones from Plan and Schedule using specified time periods for Contract.
- .7 Interim Certificate, Substantial Completion with "LF" constraint equal to calculated date.
- .8 Calculations on updates to be such that if early finish of Interim Certificate falls later than specified Contract duration then float calculation to reflect negative float.
- .9 Delays to non-critical activities, those with float may not be basis for time extension.
- .10 Do not use float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times or imposed dates other than required by Contract.

- .11 Allow for and show Master Plan and Detail Schedule adverse weather conditions normally anticipated. Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.
- .12 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration. Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.
- .13 Arrange participation on and off site of subcontractors and suppliers, as required by Departmental Representative, for purpose of network planning, scheduling, updating and progress monitoring. Approvals by Departmental Representative of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
- .14 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative Project Control System for planning, scheduling, monitoring and reporting of project progress.

1.5 QUALITY ASSURANCE

- .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.

1.6 PROJECT MEETING

- .1 Meet with Departmental Representative within 2 working days of Award of Contract date, to establish Work requirements and approach to project construction operations.

1.7 WORK BREAKDOWN STRUCTURE (WBS)

- .1 Prepare construction Work Breakdown Structure (WBS) within 2 working days of Award of Contract date. Develop WBS through at least five levels: Project, stage, element, sub-element and work package.

1.8 MASTER PLAN

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.

1.9 DETAIL SCHEDULE

- .1 Provide detailed project schedule (CPM logic diagram) within two (2) working days of Award of Contract date showing activity sequencing, interdependencies and duration estimates. Include listed activities as follows:
 - .1 Design calculations.
 - .2 Signed/sealed drawings and specifications.
 - .3 Shop drawings.

- .4 Samples.
 - .5 Approvals.
 - .6 Procurement.
 - .7 Construction/Dismantling.
 - .8 Installation.
 - .9 Site works.
 - .10 Testing.
 - .11 Commissioning and acceptance.
- .2 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Plan.
- .1 The Schedule must include enough detail to allow proper planning and execution of Work.
 - .2 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.
 - .3 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Departmental Representative for review effects created by insertion of new Change Order.

1.10 REVIEW OF THE CONSTRUCTION DETAIL SCHEDULE

- .1 Allow five (5) working days for review by Departmental Representative of proposed construction Detail Schedule.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Departmental Representative for review within five (5) work days.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by Departmental Representative.
- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

1.11 COMPLIANCE WITH DETAIL SCHEDULE

- .1 Comply with reviewed Detail Schedule.
- .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after written receipt of approval by Departmental Representative.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
 - .1 Corrective measures may include:
 - .1 Increase of personnel on site for effected activities or work package.
 - .2 Increase in materials and equipment.
 - .3 Overtime work and additional work shift.

- .4 Submit to Departmental Representative, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. Include as part of supporting evidence:
 - .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
 - .2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
 - .3 Other supporting evidence requested by Departmental Representative.
 - .4 Do not assume approval of Contract extension prior to receipt of written approval from Departmental Representative.
- .5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.
 - .1 Departmental Representative will determine and advise Contractor number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.
 - .2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

1.12 PROGRESS MONITORING AND REPORTING

- .1 On ongoing basis, Detail Schedule on job site must show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least twice monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update twice monthly with status dated on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes.
- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to Departmental Representative copies of updated Detail Schedule.
- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit once a month written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report must summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:
 - .1 Description of progress made.

- .2 Pending items and status of: permits, shop drawings, Change Orders, possible time extensions.
- .3 Status of Contract completion date and milestones.
- .4 Current and anticipated problem areas, potential delays and corrective measures.
- .5 Review of progress and status of Critical Path activities.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence not to cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present procedures, design notes, signed/sealed plans and specifications, shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission, in accordance with the requirements of the contract documents, is not relieved by Departmental Representative's review of submittals.
- .9 Keep one reviewed copy of each submission on site.

1.2 PROCEDURES, DESIGN NOTES, PLANS AND SPECIFICATIONS, SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings, plans and specifications, and design notes stamped and signed by an engineer registered in good standing with the Ordre des Ingénieurs du Québec.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 10 days for Departmental Representative's review of each submission.

- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After Departmental Representative's review, distribute copies of procedures, plans and specifications, and design notes.
- .10 Submit one (1) electronic copy of procedures, plans and specifications, design notes, product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

- .11 Submit one (1) electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 1 year of date of contract award for project.
- .12 Submit one (1) electronic copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .13 Submit one (1) electronic copy of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Submit one (1) electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit one (1) electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .20 Submit final as-built drawings at completion of Work.

1.3 SAMPLES

- .1 Submit for review two (2) samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's site office.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.

- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

- .1 Erect mock-ups in accordance with Section 01 45 00 - Quality Control.

1.5 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit the required documents to the *Commission des normes, de l'équité, de la santé et de la sécurité du travail (CNESST)*.
- .2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Quebec
 - .1 An Act Respecting Occupational Health and Safety, R.S.Q.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site-specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation.
- .3 Submit one (1) PDF copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative and authority having jurisdiction, weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within seven (7) days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 7 days after receipt of comments from Departmental Representative.
- .7 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
- .9 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities (CNESST) prior to beginning of Work.

1.4 SAFETY ASSESSMENT

- .1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.6 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.7 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act, Industrial and Commercial Establishments Regulation, R.R.Q.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.9 UNFORESEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.10 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

1.11 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected by Contractor.

1.12 BLASTING

- .1 Blasting or other use of explosives is not permitted.

1.13 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.
- .2 Reference Standards:
 - .1 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities, Chapter 3.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review and approval Departmental Representative.
- .3 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.

- .6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Ensure plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Ensure plan includes measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan to be included and updated, as required.

1.3 FIRES

- .1 Fires and burning of rubbish on site not permitted.

1.4 DRAINAGE

- .1 Provide Erosion and Sediment Control Plan identifying type and location of erosion and sediment controls provided. Ensure plan includes monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.
- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.

- .4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 WORK ADJACENT TO WATERWAYS

- .1 Implement mitigation measures specified in notice by Department of Fisheries and Oceans (DFO). Said notice shall be obtained by the PCA and communicated to the Contractor following request for review.
- .2 Do not use waterway beds for borrow material.
- .3 Waterways to be free of excavated fill, waste material and debris. Waste introduced in waterways accidentally must be removed at once.
- .4 Do not skid logs or construction materials across waterways.

1.6 USE, MAINTENANCE, CLEANING AND REFUELING OF MACHINERY

- .1 Machinery circulating or being used less than 30 m away from waterways must use biodegradable vegetable oil.
- .2 Maintain vehicles and machinery, including marine equipment, in good working order.
- .3 Carry out maintenance and cleaning work of machinery in an area where contaminants can be confined in case of spill. Provide clearly identified tight containers meant to contain separately used petroleum products and waste generated by the maintenance of the machinery.
- .4 Prior to execution, the location of maintenance and cleaning work, as well as the containment measures, must be approved by the Departmental Representative.
- .5 Refueling and replenishment of lubricant must be carried out at least 30 m away from a lake, watercourse or wetland. If this proves to be impossible, containment measures must be implemented so that said activities can be carried out without causing runoff of hydrocarbons or other contaminants towards waterbodies. The location for refueling and replenishment work, as well as containment measures if applicable, must be approved by the Departmental Representative.
- .6 Equipment used on site must be free of oil and fuel leaks (or any other product). Inspect equipment daily as to make sure there is no leak. Equipment leaking must be removed from site as soon as leak is noted.
- .7 Equipment must be equipped with functioning silencer.

1.7 SPILL OF PETROLEUM PRODUCTS AND HAZARDOUS MATERIAL

- .1 Petroleum products and hazardous material must be stored at least 30 m from lake, watercourse or wetland.
- .2 Make sure the Spill Control Plan is implemented before start of work.
- .3 Make sure there is a hydrocarbon spill recovery kit within the work area and a hydrocarbon spill recovery in aquatic environment kit on all equipment.

- .4 In case of spill, notify relevant responders at once. Report spill to Environment Canada emergency services at once (1-866-283-2323) for spill on ground, and Cost Guard (1-800-363-4735) for spill in water.

1.8 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.9 HISTORICAL/ARCHAEOLOGICAL CONTROL

- .1 Provide historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

1.10 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
 - .1 Do not take action until after receipt of written approval by Departmental Representative.
 - .2 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
 - .3 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Clean in accordance with Section 01 74 11 – Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Bury rubbish and waste materials on site after receipt of written approval from Departmental Representative.
- .4 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 20 00 – Concrete Reinforcing.
- .2 Section 03 30 00 – Cast-in-Place Concrete.
- .3 Section 31 05 16 – Aggregate Materials.
- .4 Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .5 Section 35 41 15 – Safety Boom.

1.2 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected not to be in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.
- .5 If it is mentioned in some sections, the Contractor shall provide the services of a materials testing laboratory.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Provide equipment required for executing inspection and testing by appointed agencies.
- .2 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .3 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

1.4 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off-site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.5 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence not to cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.7 REPORTS

- .1 Submit 2 copies of inspection and test reports to Departmental Representative.

1.8 MILL TESTS

- .1 Submit mill test certificates as requested and required of specification Sections.

1.9 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 35 41 15 – Safety Boom.

1.2 REFERENCES

- .1 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.3 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.5 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .5 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.6 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Departmental Representative. Unload, handle and store such products.

1.7 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.8 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.9 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.10 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.11 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.12 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

1.13 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.14 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.15 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

1.16 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not used.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Department Representative or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Department Representative. Do not burn waste materials on site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Dispose of waste materials and debris at designated dumping areas on Crown property and off-site.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.3 FINAL CLEANING

- .1 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .2 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .3 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/ Demolition Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

- .1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss PCA's Waste Management Plan and Goals.
- .2 PCA's Waste Management Goal is to reduce by 75 percent (75%) the total Project Waste to be diverted towards landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environmental damage.

1.2 DEFINITIONS

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .3 Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .4 Inert Fill: inert waste - exclusively asphalt and concrete.
- .5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from remodeling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11 Separate Condition: refers to waste sorted into individual types.

- .12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Appendix A.
- .14 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.3 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Reduction Workplan.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
 - .1 Failure to submit could result in hold back of final payment.
 - .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled or disposed of.
 - .3 For each material reused, sold or recycled from project, include amount in tonnes quantities by number, type and size of items and the destination.
 - .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.5 WASTE REDUCTION WORKPLAN (WRW)

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
 - .1 Destination of materials listed.
 - .2 Deconstruction/disassembly techniques and sequencing.
 - .3 Schedule for deconstruction/disassembly.
 - .4 Location.
 - .5 Security.
 - .6 Protection.
 - .7 Clear labelling of storage areas.
 - .8 Details on materials handling and removal procedures.

- .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.6 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, waste materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.

1.7 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner into waterways, storm, or sanitary sewers.
- .3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .4 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.8 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility. Provide temporary security measures approved by Departmental Representative.

1.9 SCHEDULING

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 APPLICATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION

Part 1 General

1.1 RELATED

- .1 Not used.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Acceptance of Work Procedures:

- .1 Contractor's Inspection: Contractor conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Departmental Representative inspection.
- .2 Departmental Representative Inspection:
 - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
- .3 Completion Tasks: submit written certificates in French that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted and balanced and fully operational.
 - .4 Certificates required by Utility companies: submitted.
 - .5 Operation of systems: demonstrated to Owner's personnel.
 - .6 Work: complete and ready for final inspection.
- .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Departmental Representative, and Contractor.
 - .2 When Work incomplete according to Owner and Departmental Representative, complete outstanding items and request re-inspection.
- .5 The Contractor must bring back the areas he used for his work to an acceptable or superior state, prior to his land use.

1.3 FINAL CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Used.

1.2 REFERENCES

- .1 Canadian Environmental Protection Act (CEPA).

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one week prior to contract completion with Departmental Representative, to:
 - .1 Verify Project requirements.
 - .2 Review manufacturer's installation instructions and warranty requirements.
 - .2 Departmental Representative to establish communication procedures for:
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
 - .3 Contact information for licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
 - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in French.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.5 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.

- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on [CD].

1.6 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project:
 - .1 Date of submission; names.
 - .2 Addresses and telephone numbers of Contractor with name of responsible.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.7 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Procedures.
 - .6 Reviewed shop drawings, product data, and samples.
 - .7 Field test records.
 - .8 Inspection certificates.
 - .9 Manufacturer's certificates.

- .2 Store record documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

1.8 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Field changes of dimension and detail.
 - .2 Changes made by change orders.
 - .3 Details not on original Contract Drawings.
 - .4 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.9 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

- .3 Include installed colour coded wiring diagrams.
- .4 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .5 Include manufacturer's printed operation and maintenance instructions.
- .6 Include sequence of operation by controls manufacturer.
- .7 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .8 Provide installed control diagrams by controls manufacturer.
- .9 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .10 Include test and balancing reports as specified in Section 01 45 00 - Quality Control.
- .11 Additional requirements: as specified in individual specification sections.

1.10 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
 - .1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

1.11 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site location as directed; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site location as directed; place and store.

- .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site location as directed; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.12 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.13 WARRANTIES

- .1 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .2 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties until time specified for submittal.
- .3 Except for items put into service with Departmental Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

- .4 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, for automatic transfer switch, PLC components, etc.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .5 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .6 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.14 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.

- .2 Model number.
- .3 Serial number.
- .4 Contract number.
- .5 Warranty period.
- .6 Inspector's signature.
- .7 Contractor's signature.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 30 00 - Cast-In-Place Concrete.
- .3 Section 03 41 00 - Precast Structural Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-O86S1-05, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.
 - .3 CSA O121-M1978(R2003), Douglas Fir Plywood.
 - .4 CSA O151-04, Canadian Softwood Plywood.
 - .5 CSA O153-M1980(R2003), Poplar Plywood.
 - .6 CAN/CSA-O325.0-92(R2003), Construction Sheathing.
 - .7 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
 - .8 CAN/CSA-S269.3-M92(R2003), Concrete Formwork, National Standard of Canada.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings for formwork and falsework. A preliminary review of said documents has been performed by the expert designer of the Contractor.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.
- .3 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CAN/CSA-S269.1 for formwork drawings.
- .4 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .5 Indicate sequence of erection and removal of formwork/falsework as directed by Consultant.

Part 2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series and CSA-O153.
- .2 Form release agent: non-toxic, biodegradable and low VOC.
- .3 Falsework materials: to CSA-S269.1.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Contractor's design expert approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .8 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .10 Build in anchors required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .11 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for the period of time recommended by the Contractor's design expert after placing concrete.
- .2 The Contractor shall not remove formwork or form supports and braces until authorization has been obtained from the Contractor's design expert.

- .3 Formwork is considered removed when they are loosened and a portion of it is no longer in contact with concrete.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 30 00 - Cast-In-Place Concrete.
- .3 Section 03 41 00 - Precast Structural Concrete.

1.2 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and Payment:
 - .1 No measurement will be made under this Section.
 - .1 Include reinforcement costs in items of concrete work in Section 03 30 00 - Cast-In-Place Concrete.

1.3 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 SP-66-04, ACI Detailing Manual 2004.
- .2 ASTM International
 - .1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A143/A143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .3 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .4 ASTM A775/A775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3 CSA International
 - .1 CSA-A23.1-0 A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.3-04(R2010), Design of Concrete Structures.
 - .3 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA-G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .6 CSA W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2006, Reinforcing Steel Manual of Standard Practice.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures, which have been previously reviewed by the expert designer of the Contractor.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by O.I.Q professional engineer, or engineer licensed to work in Canada.
 - .1 Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

1.5 QUALITY ASSURANCE

- .1 Submit as described in PART 2 - SOURCE QUALITY CONTROL.
 - .1 Mill Test Report: provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work, if requested.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Contractor's Design Expert.

- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
- .5 Deformed steel wire for concrete reinforcement: to ASTM A82/A82M.
- .6 Welded steel wire fabric: to ASTM A185/A185M.
- .7 Welded deformed steel wire fabric: to ASTM A82/A82M.
- .8 Galvanizing of non-prestressed reinforcement: to CAN/CSA-G164, minimum zinc coating 610 g/m².
 - .1 Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
 - .2 If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
 - .1 Temperature of solution equal to or greater than 32 degrees and galvanized steels immersed for minimum 20 seconds.
 - .3 If galvanized steels are at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.
 - .1 In this case, no restriction applies to temperature of solution.
- .9 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .10 Mechanical splices: subject to approval of Departmental Representative.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Design Expert's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four (4) weeks prior to beginning reinforcing work, if requested.
- .2 Inform Departmental Representative of proposed source of material to be supplied, if requested.

Part 3 Execution

3.1 PREPARATION

- .1 Galvanizing to include chromate treatment.
 - .1 Duration of treatment to be 1 hour per 25 mm of bar diameter.
- .2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

3.2 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

3.3 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.
- .2 Prior to placing concrete, Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.

3.4 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

3.5 CLEANING

- .1 Cleaning: in accordance with Section 01 74 11 – Cleaning.
- .2 Waste Management: in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 41 00 - Precast Structural Concrete.

1.2 PRICE AND PAYMENT PROCEDURES

- .1 Refer to Section 01 29 00 – Measurement Procedures.

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
 - .1 Type GU, GUb or GUL - General use cement.
 - .2 Type MS or MSb - Moderate sulphate-resistant cement.
 - .3 Type MH, MHb or MHL - Moderate heat of hydration cement.
 - .4 Type HE, HEb or HEL - High early-strength cement.
 - .5 Type LH, LHb or LHL - Low heat of hydration cement.
 - .6 Type HS or HSb - High sulphate-resistant cement.
 - .2 Fly ash:
 - .1 Type F - with CaO content less than 15%.
 - .2 Type CI - with CaO content ranging from 15 to 20%.
 - .3 Type CH - with CaO greater than 20%.
 - .3 GGBFS - Ground, granulated blast-furnace slag.
- .2 Reference Standards:
 - .1 ASTM International
 - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-07, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494/C494M-10a, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .5 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .6 ASTM D624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

- .7 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .8 ASTM D1752-04a(2008), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 CSA International
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-06, Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures, which were previously reviewed by the expert designer of the Contractor and approved by the materials testing laboratory appointed by the Contractor.
- .2 At least 4 weeks prior to beginning Work, provide Departmental Representative with datasheets of materials proposed for use as follows:
 - .1 Curing compound.
 - .2 Each type of supplementary cementing material.
 - .3 Each type of blended hydraulic cement.
 - .4 Each admixture.
 - .5 Each fine and coarse aggregate.
- .3 Provide testing results reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .4 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .5 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Departmental Representative.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 To CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Contractor and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU.
- .2 Blended hydraulic cement: Type GU to CSA A3001.
- .3 Supplementary cementing materials: with minimum 5% GGBFS and 8% Type F fly ash replacement, by mass of total cementitious materials to CSA A3001.
- .4 Water: to CSA A23.1.
- .5 Aggregates: to CSA A23.1/A23.2.

- .6 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixture: to ASTM C494/ASTM C1017. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
 - .3 Corrosion-inhibiting admixture: to performance.
 - .4 Lithium-based admixture: to performance.
 - .5 Shrinkage-reducing admixture (SRA): MAPECURE –SRA or same approved.
 - .6 Viscosity-modifying agent (VMA): to performance.
- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 30 MPa at 28 days.
 - .2 Net shrinkage at 28 days: maximum 2%.
- .8 Non premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 40 MPa at 28 days.
- .9 Post-Tensioning Ducts: to CSA A23.1/A23.2.
- .10 Curing compound: to CSA A23.1/A23.2.

2.4 MIXES

- .1 For the concrete, if used: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following plastic state requirements:
 - .1 Uniformity.
 - .2 Workability: free of loss of mortar and segregation.
 - .3 Set time: 3 hours maximum.
 - .3 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure F-1.
 - .2 Compressive strength at 28d age: 30 MPa minimum.
 - .3 Aggregate size 20 mm minimum.
 - .4 Volume stability: acceptable volume change range 12 mm due to shrinkage, creep and freeze-thaw cycle.
 - .4 Provide quality management plan to ensure verification of concrete quality to specified performance.
 - .5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete.
 - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
 - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .11 Do not place load upon new concrete until results from laboratory are received and minimum required compressive strength is reached.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work according to CSA A23.1/A23.2.
- .2 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
 - .4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .3 Waterstops:
 - .1 Install waterstops to provide continuous water seal.

- .2 Do not distort or pierce waterstop in way as to hamper performance.
- .3 Do not displace reinforcement when installing waterstops.
- .4 Use equipment to manufacturer's requirements to field splice waterstops.
- .5 Tie waterstops rigidly in place.
- .6 Use only straight heat sealed butt joints in field.
- .7 Use factory welded corners and intersections unless otherwise approved by Departmental Representative.

3.3 SURFACE TOLERANCE

- .1 Concrete tolerance to CSA A23.1 Straightedge Method.

3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory identified by Contractor for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory is certified to CSA A283.
 - .3 Ensure test results are distributed to Departmental Representative for discussion at pre-pouring concrete meeting.
 - .4 The Contractor will pay for costs of tests.
 - .5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
 - .6 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 CLEANING

- .1 Cleaning: in accordance with Section 01 74 11 – Cleaning.
- .2 Waste Management: in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
 - .1 Provide appropriate area on job site where concrete trucks and be safely washed. Area must be approved by PCA.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 - Concrete Reinforcing.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A185/A185M-05a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM C260-01, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM D412-98a(2002)e1, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - .4 ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-2004, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-A23.3-04, Design of Concrete Structures.
 - .3 CSA-A23.4-05, Precast Concrete - Materials and Construction.
 - .4 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .5 CAN/CSA-G40.20/G40.21-2004, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .6 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .7 CSA-W47.1-03, Certification of Companies for Fusion Welding for Steel.
 - .8 CAN/CSA W48-01(R2006), Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .9 CSA-W59-03, Welded Steel Construction (Metal Arc Welding) (Metric version).

1.3 DESIGN REQUIREMENTS

- .1 Design precast elements to CSA-A23.3 CSA-A23.4 to carry handling stresses.
- .2 Design assembly and fixing furniture on precast elements with loads and forces specified on plans.

- .3 Submit precast structure's shop drawing in accordance with PART 1- ACTION AND INFORMATIONAL SUBMITTALS.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, which were previously reviewed by the expert designer of the Contractor.
- .2 Submit shop drawings in accordance with CSA-A23.4 and include following items:
 - .1 Design calculations for items designed by manufacturer.
 - .2 Finishing schedules.
 - .3 Methods of handling and erection.
 - .4 Openings, sleeves, inserts and related reinforcement.
- .3 Submit detailed calculations and design drawings for typical precast elements and connections for review by Departmental Representative 4 weeks prior to manufacture.
- .4 Shop Drawings: submit drawings stamped and signed by O.I.Q qualified professional engineer or engineer licensed to work in Canada.

1.5 QUALITY ASSURANCE

- .1 Quality Control Plan: submit written report, as described in PART 3 - VERIFICATION, to Departmental Representative verifying compliance that concrete provided meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.6 QUALIFICATIONS

- .1 Fabricate and erect precast concrete elements by manufacturing plant certified in appropriate categories according to CSA-A23.4.
- .2 Precast concrete manufacturer to be certified in accordance with CSA's certification procedures for precast concrete plants prior to submitting tender and to specifically verify as part of tender that plant is currently certified in appropriate categories, Structural.
- .3 Only precast elements fabricated in such certified plants to be acceptable to Departmental Representative and plant certification to be maintained for duration of fabrication, erection until warranty expires.
- .4 Welding companies certified to CSA-W47.1.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle and store precast units according to manufacturer's instructions.
- .2 Protect unit corners from contacting earth to prevent from staining.

1.8 WARRANTY

- .1 Contractor warrants that precast element will not spall or show visible evidence of corrosion of embedded steel and cracking, except for normal hairline shrinkage cracks, for 5 years.

- .2 Contractor warrants that precast elements will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, for 60 months warranty period.

Part 2 Products

2.1 MATERIALS

- .1 Cement to CAN/CSA-A3001, Type GU.
- .2 Blended hydraulic cement: type GUbsF to CAN/CSA-A3001.
- .3 Supplementary cementing materials: with minimum 5% GGBFS and minimum 8% Type F fly ash replacement, by mass of total cementitious materials to CAN/CSA A3001.
- .4 Water: to CSA-A23.1/A23.2.
- .5 Reinforcing steel: to CAN/CSA-G30.18.
- .6 Welded wire fabric: to ASTM A185/A185M.
- .7 Hardware and miscellaneous materials: to CSA-A23.1/A23.2.
- .8 Forms: to CSA-A23.4.
- .9 Anchors and supports: to CAN/CSA-G40.21 Type 300 W.
- .10 Welding materials: to CSA W48.
- .11 Welding electrodes: to CSA W48 and certified by Canadian Welding Bureau.
- .12 Galvanizing: hot dipped galvanizing with minimum zinc coating of 610 g/m² to CAN/CSA-G164.
- .13 Zinc-rich primer: to CAN/CGSB-1.181.
- .14 Air entrainment admixtures: to ASTM C260.
- .15 Chemical admixtures: to CSA-A23.1/A23.2.
- .16 Shims: plastic.
- .17 Weephole tubes: purpose made plastic.

2.2 MIXES

- .1 Concrete:
 - .1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria in accordance with CAN/CSA-A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.
 - .2 Provide concrete mix to meet following plastic state requirements:
 - .1 Uniformity: CSA-A23.1/A23.2.
 - .2 Placeability: CSA-A23.1/A23.2.

- .3 Workability: free of surface blemishes, loss of mortar, colour variations, segregation.
- .4 Finishability: CSA-A23.1/A23.2 amount of bleeding.
- .5 Set time: CSA-A23.1/A23.2.
- .3 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure: F-1.
 - .2 Minimum compressive strength at 28d age: 30 MPa.
 - .3 Volume stability: acceptable volume change range 5 mm due to shrinkage, creep and freeze-thaw cycle.
 - .4 Surface texture: steel trowel finish.
- .4 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .5 Concrete supplier's certification.
- .2 Grout:
 - .1 Cement grout: type Sika grout 212 or same approved grout.
 - .2 Minimum compressive strength: 40 MPa.
 - .3 Shrinkage compensating grout: to Section 03 30 00 - Cast-in-Place Concrete.

2.3 MANUFACTURED UNITS

- .1 Manufacture units in accordance with CSA-A23.4.
- .2 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast on part of unit not be exposed.
- .3 Provide hardware suitable for handling elements.
- .4 Galvanize anchors, steel embedments after fabrication and touch up with zinc-rich primer after welding.

2.4 FINISHES

- .1 Finish units to standard grade to CSA-A23.4.

2.5 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copies of quality control tests related to this project as specified in CSA-A23.4; CSA-G279.
- .2 Provide records from in-house quality control programme based upon plant certification requirements to Departmental Representative for inspection and review.
- .3 Provide Departmental Representative with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.
- .4 Precast plants should keep complete records of supply source of concrete material, steel reinforcement, and provide to Departmental Representative for review upon request.

Part 3 Execution

3.1 ERECTION

- .1 Do precast concrete work in accordance with CSA-A23.4;CSA-A23.3;CSA-S6.
- .2 Do welding in accordance with CSA-W59, for welding to steel structures and CSA-W186, for welding of reinforcement.
- .3 Erect precast elements within allowable tolerances as specified.
- .4 Non-cumulative erection tolerances in accordance with CSA-A23-4.
- .5 Set elevations and alignment between units to within allowable tolerances before connecting units.
- .6 Grout underside of unit bearing plates with shrinkage compensating grout.
- .7 Fasten precast units in place as indicated on reviewed.
- .8 Use grout to align elevations of surfaces at joints. Slope grout not more than 1:12. Key in grout to 10 mm thickness.

3.2 VERIFICATION

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in PART 2 - PRODUCTS, by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

3.3 CLEANING

- .1 Use cleaning methods as reviewed Departmental Representative before cleaning soiled precast concrete surfaces.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 05 50 00 – Metal Fabrications.

1.2 REFERENCES

- .1 American Association for State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO Standard Specifications for Highway Bridges-[17th Edition 2002].
- .2 ASTM International
 - .1 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.
 - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .5 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength [Metric].
 - .6 ASTM A490M, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric].
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-85.10, Protective Coatings for Metals.
- .4 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA)
 - .1 Handbook of the Canadian Institute of Steel Construction.
 - .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16, Design of Steel Structures.
 - .4 CAN/CSA-S136, North American Specifications for the Design of Cold Formed Steel Structural Members.
 - .5 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
 - .6 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
 - .7 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

- .8 CSA W59, Welded Steel Construction, (Metal Arc Welding).
- .6 Master Painters Institute
 - .1 MPI-INT 5.1, Structural Steel and Metal Fabrications.
 - .2 MPI-EXT 5.1, Structural Steel and Metal Fabrications.
- .7 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
 - .1 NACE No. 3/SSPC SP-6, Commercial Blast Cleaning.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures, which were previously reviewed by the expert designer of the Contractor.
- .2 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .3 Erection drawings:
 - .1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
 - .1 Description of methods.
 - .2 Sequence of erection.
 - .3 Type of equipment used in erection.
 - .4 Temporary bracings.
- .4 Fabrication drawings:
 - .1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Province of Quebec, Canada.
- .5 Source Quality Control Submittals:
 - .1 Upon request by Departmental Representative, submit mill test reports four (4) weeks prior to fabrication of structural steel.
 - .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
 - .2 Provide mill test reports certified by metallurgists qualified to practice in Province of Quebec, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CAN/CSA-S16 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
 - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
 - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 For composite construction select or design minimum end connection to resist reaction resulting from factored movement resistance as tabulated in the "Handbook of the Canadian Institute of Steel Construction" assuming 100% shear connection with depth of steel deck and/or slab shown on drawings.
- .4 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Quebec, Canada for nonstandard connections.

2.2 MATERIALS

- .1 Structural steel: to CSA-G40.20/G40.21, or as indicated.
- .2 Anchor bolts: to ASTM A36/A36M, CSA-G40.20/G40.21, Grade 300W or as indicated.
- .3 High strength anchor bolts: to ASTM A193/A193M, or as indicated.
- .4 Bolts, nuts and washers: to ASTM A307, ASTM A325/A325M, ASTM A490/A490M, or as indicated.
- .5 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .6 Hot dip galvanizing: galvanized steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.3 FABRICATION

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with approved shop drawings.
- .2 Continuously seal members by continuous welds where indicated. Grind smooth.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S16.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 CONNECTION TO EXISTING WORK

- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

3.4 MARKING

- .1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

3.5 ERECTION

- .1 Field cutting or altering structural members: to approval of Departmental Representative.
- .2 Clean with mechanical brush and touch up shop galvanization coating to bolts, rivets, welds and scratched surfaces at completion of erection.
- .3 Continuously seal members by continuous welds where indicated. Grind smooth.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 05 12 23 – Structural Steel for Buildings.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 CSA International
 - .1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16, Design of Steel Structures.
 - .4 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .3 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures, which were previously reviewed by the expert designer of the Contractor.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, bolts, anchors, and other materials, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties, if requested by Departmental Representative.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements, if requested by Departmental Representative.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W.
- .2 Welding materials: to CSA W59.
- .3 Welding electrodes: to CSA W48 Series.
- .4 Bolts and anchor bolts: to ASTM A307, or as indicated.
- .5 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Where possible, fit and shop assemble work, ready for erection.
- .3 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .7 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
 - .1 Primer: maximum VOC limit 250 g/L.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM D4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .2 Bureau de normalisation du Québec
 - .1 BNQ 2560-114, Travaux de génie civil – Granulats.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures, previous reviewed by the expert designer of the Contractor and approved by the materials testing laboratory appointed by the Contractor.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for aggregate materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Allow continual sampling by Laboratory during production.
 - .2 Provide Laboratory with access to source and processed material for sampling.
 - .3 Install sampling facilities at discharge end of production conveyor, to allow Laboratory to obtain representative samples of items being produced. Stop conveyor belt when requested by Laboratory to permit full cross section sampling.
 - .4 Provide front end loader or other suitable equipment including trained operator for stockpile sampling as necessary. Move samples to storage place as directed by Laboratory.
 - .5 Supply new or clean sample bags or containers according appropriate to aggregate materials.
 - .6 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.

- .3 Storage: store washed materials or materials excavated from underwater 24 hours minimum to allow free water to drain and for materials to attain uniform water content.

1.5 QUALITY ASSURANCE

- .1 Quality assurance: refer to Section 01 45 00 - Quality Control.

Part 2 Products

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D4791.
 - .1 Greatest dimension to exceed 5 times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
 - .2 Reclaimed asphalt pavement.
 - .3 Reclaimed concrete material.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Light weight aggregate, including slag and expanded shale.
 - .4 Reclaimed asphalt pavement.
 - .5 Reclaimed concrete material.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative and the materials testing laboratory appointed by the Contractor of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .3 Advise Departmental Representative 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for topsoil stripping.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with topsoil stripping. only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Topsoil stripping:
 - .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
 - .2 Begin topsoil stripping of areas after area has been cleared of brush, weeds, grass and removed from site.
 - .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.
 - .4 Dispose of topsoil off site.
- .2 Aggregate source preparation:
 - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials.
 - .2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.
 - .3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
 - .4 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
 - .5 Trim off and dress slopes of waste material piles and leave site in neat condition.
 - .6 Provide silt fence or other means to prevent contamination of existing watercourse or natural wetland features.
- .3 Processing:
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, as required, including reclaimed materials that meet physical requirements of specification is permitted in order to satisfy gradation requirements for material and, percentage of crushed particles, or particle shapes specified.
- .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate gradation.

- .5 Where necessary, screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.
- .6 Stockpiling:
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
 - .2 Stockpile aggregates in sufficient quantities to meet project schedules.
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.
 - .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.
 - .7 Stockpile materials in uniform layers of thickness as follows:
 - .1 Maximum 1.5 m for coarse aggregate and base course materials.
 - .2 Maximum 1.5 m for fine aggregate and sub-base materials.
 - .3 Maximum 1.5 m for other materials.
 - .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
 - .9 Do not cone piles or spill material over edges of piles.
 - .10 Do not use conveying stackers.
 - .11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .4 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.
- .5 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 – Aggregate Materials.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422-63, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .6 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 Bureau de normalisation du Québec
 - .1 BNQ 2560-114, Travaux de génie civil – Granulats.

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00 m³. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

- .3 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422. Sieve sizes to BNQ 2501-025.
 - .2 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- .8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures, previously reviewed by the expert designer of the Contractor and approved by the materials testing laboratory appointed by the Contractor.
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Control:
 - .1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.
 - .2 Submit for review by Departmental Representative proposed dewatering methods as described in PART 3 of this Section.
 - .3 Submit to Departmental Representative written notice at least 7 days prior to excavation work, to ensure cross sections are taken.
 - .4 Submit to Departmental Representative testing results and reports as described in PART 3 of this Section.
- .3 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field.
- .4 Samples:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

1.5 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .3 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of Quebec, Canada.
- .4 Keep design and supporting data on site.
- .5 Engage services of qualified professional Engineer who is registered or licensed in Province of Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .6 Do not use soil material until written report of soil test results are approved by Departmental Representative.
- .7 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.7 EXISTING CONDITIONS

- .1 Examine soil report attached to present document. Carry out additional studies required depending on proposed solutions.
- .2 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify Departmental Representative of location and state of use of buried utilities and structures. Authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.
 - .6 Confirm locations of buried utilities by careful test excavations.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.

- .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing.
- .9 Record location of maintained, re-routed and abandoned underground lines.
- .10 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repairs as directed by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Type 1 and Type 2 fill: properties to Section 31 05 16 - Aggregate Materials and the following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to BNQ 2501-025.
- .2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks, cinders, ashes, sods, refuse or other deleterious materials.

Part 3 Execution

3.1 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

3.2 PREPARATION/PROTECTION

- .1 Protect existing features in accordance with applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

3.3 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as indicated and remove from site.
- .2 Strip topsoil to depths as indicated.
 - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil off site.

3.4 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.5 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Construct temporary Works to depths, heights and locations as approved by Departmental Representative.

3.6 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Departmental Representative's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in collection areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

3.7 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .2 Excavate to lines, grades, elevations and dimensions as indicated Departmental Representative.

- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .5 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .6 Restrict vehicle operations directly adjacent to open trenches.
- .7 Dispose of surplus and unsuitable excavated material off site.
- .8 Do not obstruct flow of surface drainage or natural watercourses.
- .9 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .10 Notify Laboratory when bottom of excavation is reached.
- .11 Obtain Laboratory approval of completed excavation.
- .12 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as indicated.
- .13 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

3.8 BACKFILLING

- .1 Vibratory compaction equipment: as indicated by Contractor's Design Expert and as to minimize impact on existing retaining wall.
- .2 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative and Laboratory has inspected and approved installations.
 - .2 Departmental Representative and Laboratory has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .4 Do not use backfill material which is frozen or contains ice, snow or debris.
- .5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .6 Backfilling around installations:

- .1 Place bedding and surround material as specified elsewhere.
- .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
- .3 Place layers simultaneously on both sides of installed Work to equalize loading.
- .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative and Contractor's Design Expert.
 - .2 If approved by Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Departmental Representative.
- .7 Place unshrinkable fill in areas as indicated.
- .8 Consolidate and level unshrinkable fill with internal vibrators.

3.9 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as indicated.
- .3 Reinstate pavements disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .4 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .5 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .6 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 62 16.19 – Unfilled Tubular Steel Piles.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures, previously reviewed by the expert designer of the Contractor.
- .2 Product Data: submit manufacturer's printed product literature, specifications and datasheet.
- .3 Submit schedule of planned sequence of driving to Departmental Representative for review, as specified.
- .4 Spliced piles: when authorized, submit design details of splice complete with signature and stamp of qualified professional engineer registered or licensed in Province of Quebec, Canada.
- .5 Equipment:
 - .1 Submit prior to pile installation for review by Departmental Representative, list and details of equipment for use in installation of piles.
 - .2 Impact hammers: submit manufacturer's written data as specified.
 - .3 Non-impact methods; submit characteristics to evaluate performance.
- .6 Submit driveability analysis as specified, to Departmental Representative for approval of hammers.
- .7 Quality assurance submittals:
 - .1 Test reports: submit 3 copies of certified test reports for piles from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's instructions Section 01 61 00 - Common Product Requirements.
- .2 Protect piles from damage due to excessive bending stresses, impact, abrasion or other causes during delivery, storage and handling.
- .3 Replace damaged piles as directed by Departmental Representative.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 EXISTING CONDITIONS

- .1 Perform required geotechnical assessment.

1.6 SCHEDULING

- .1 Drive piles in accordance with sequence indicated.
- .2 Provide schedule of planned sequence of driving to Departmental Representative for review, not less than two weeks prior to commencement of pile driving.

Part 2 Products

2.1 MATERIALS

- .1 Supply or fabricate full length piles as indicated and provide equipment to handle full length piles without cutting and splicing.
- .2 Splice piles only with written authorization of Contractor's Design Expert.
 - .1 When permitted, provide details for Departmental Representative review.
 - .2 Design details of splice to bear dated signature stamp of professional engineer registered or licensed in Province of Quebec, Canada.

2.2 EQUIPMENT

- .1 Impact hammers: provide manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.
- .2 Non-impact methods of installation such as augering, jacking, vibratory hammers or other means: provide full details of characteristics necessary to evaluate performance.
- .3 Hammer:
 - .1 Hammers to be selected on basis of driveability analysis using wave equation theory, performed to show that piles can be driven to levels indicated.
 - .2 Driveability analysis to include, but not be limited to, following: hammer, cushion, and cap block details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses and energy throughput at representative penetrations.
 - .3 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.

Part 3 Execution

3.1 PREPARATION

- .1 Protection:
 - .1 Protect adjacent structures, services and work of other sections from hazards due to pile driving operations.

- .2 Arrange sequencing of pile driving operations and methods to avoid damages to adjacent existing structures.
- .3 When damages occur, remedy damaged items to restore to original or better condition at own expense.
- .2 Ensure that ground conditions at pile locations are adequate to support pile driving operation and load testing operation.
 - .1 Make provision for access and support of piling equipment during performance of Work.

3.2 INSTALLATION

- .1 Allowable design load capacity of pile at load as indicated.
- .2 Drive each pile to final driving resistance measured in mm per blow, in accordance with Contractor's Design Expert.
 - .1 Determine required driving resistance from load test on a test pile as directed by Contractor's Design Expert.
 - .2 Prior to final set drive piles without interruption for a sufficient interval to break or prevent development of freeze.
 - .3 If load test is not carried out, determine required final driving resistance using formula approved by Contractor's Design Expert.
- .3 Drive each pile to practical refusal in bedrock.
 - .1 Do not overdrive to cause damage to piles in bedrock.
 - .2 Contractor's Design Expert will determine refusal criteria for piles driven to rock based on type of pile and driving equipment.
- .4 Drive each pile to pile tip elevation as indicated.

3.3 APPLICATION / DRIVING

- .1 Use driving caps and cushions to protect piles.
 - .1 Reinforce pile heads as required by Contractor's Design Expert.
 - .2 Piles with damaged heads as determined by Departmental Representative will be rejected.
- .2 Hold piles securely and accurately in position while driving.
- .3 Deliver hammer blows along axis of pile.
- .4 Ensure no contact between pile and structure takes place when driving batter piles adjacent to existing structures.
- .5 Restrike already driven piles lifted during driving of adjacent piles to assure set.
- .6 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.
- .7 Use of water jet:

- .1 If permitted by Contractor's Design Expert, provide details for Departmental Representative review.
- .2 Restriction: when conditions are unacceptable, as determined by Departmental Representative, stop using water jet.
- .8 Cut off piles neatly and squarely at elevations as indicated.
 - .1 Provide sufficient length above cut-off elevation so that part damaged during driving is cut off.
 - .2 Do not cut tendons or other reinforcement, which will be used to tie pile caps to pile.
- .9 Remove cut-off lengths from site on completion of work.

3.4 OBSTRUCTIONS

- .1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, remove obstruction.

3.5 REPAIR AND RESTORATION

- .1 Remove rejected pile and replace with new, and if necessary, longer pile.
- .2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

3.6 FIELD QUALITY CONTROL

- .1 Pile Driving Analyzer:
 - .1 Use Pile Driving Analyzer and Wave Equation Analysis to determine and confirm driving criteria such as hammer size and variation in impact, suitability of driving cap and cushions and penetration resistance relative to set on at least 2 piles before start of pile placement.
 - .1 Confirm criteria during pile installation by using Pile Driving Analyzer and Wave Equation Analysis on additional piles when requested by Departmental Representative.
 - .2 Departmental Representative to select piles.
 - .3 Work to be performed by geotechnical engineer registered or licensed in Province of Quebec, Canada.
- .2 Testing agency appointed by Contractor will use Pile Driving Analyzer and Wave Equation Analysis to confirm driving criteria. Included are: hammer size and variation in impact, suitability of driving cap and cushions, and penetration resistance relative to set for initial driving and restriking.
 - .1 Departmental Representative to select piles for testing.
- .3 Prepare piles to be instrumented by drilling and tapping holes for installation of strain transducers and accelerometers.
- .4 Provide assistance, as required, in instrumentation process during initial set-up and during test.

- .5 Make allowance for probable interruption in driving for:
 - .1 Changing/modifying hammer, cap, cushions, or other equipment.
 - .2 Replacing/adjusting of transducers and accelerometers.
 - .3 Assessing of monitored results.
- .6 Confirm that final set has been achieved, when instructed by restriking instrumented piles.
- .7 Measurement:
 - .1 Maintain accurate records of driving for each pile, including:
 - .1 Type and make of hammer, stroke or related energy.
 - .2 Other driving equipment including water jet, driving cap, cushion.
 - .3 Pile size and length, location of pile in pile group, location or designation of pile group.
 - .4 Sequence of driving piles in group.
 - .5 Number of blows per metre for entire length of pile and number of blows per mm for last mm, as indicated by the Contractor's Design Expert.
 - .6 Final tip and cut-off elevations.
 - .7 Other pertinent information such as interruption of continuous driving, pile damage.
 - .8 Record elevation taken on adjacent piles before, during, and after driving of each pile.
 - .2 All measurements, observations and calculations associated with pile driving analyzer and wave equation analysis.
 - .3 Provide Departmental Representative with three copies of records.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 61 13 – Pile Foundations, General Requirements.

1.2 REFERENCES

- .1 American Petroleum Institute (API)
 - .1 API SPEC 5L, Specification for Line Pipe, Includes Errata 1, 43rd Edition.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - .2 ASTM A252, Standard Specification for Welded and Seamless Steel Pipe Piles.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.171, Inorganic Zinc Coating.
 - .2 CAN/CGSB-1.184, Coal Tar-Epoxy Coating.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
 - .3 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
 - .4 CSA W59, Welded Steel Construction (Metal Arc Welding) (metric version).
 - .5 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .6 CSA-Z245.1, Steel Pipe.
- .5 The Master Painters Institute/MPI ASM, Architectural Painting Specification Manual.
 - .1 MPI #19, Inorganic Zinc Rich Primer.
- .6 The Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume 2, Systems and Specifications.
 - .1 SSPC-SP2, Hand Tool Cleaning.
 - .2 SSPC-SP3, Power Tool Cleaning.
 - .3 SSPC-SP5/NACE No.1, White Metal Blast Cleaning.
 - .4 SSPC-SP6/NACE No.3, Commercial Blast Cleaning.
 - .5 SSPC-SP7/NACE No.4, Brush-Off Blast Cleaning.
 - .6 SSPC-SP8, Pickling.
 - .7 SSPC-SP10/NACE No.2, Near-White Blast Cleaning.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures, previously reviewed by the expert designer of the Contractor.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheet.
- .3 Submit shop drawings and indicate: pile shoes, splice detail, pile cap, tip reinforcement.
 - .1 Each drawing stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .4 Quality Assurance: test reports:
 - .1 Prior to fabrication, and, if requested, provide Departmental Representative with two copies of steel producer's certificates in accordance with ASTM A252.
 - .2 One Charpy V-notch test required per heat and results reported to Departmental Representative by manufacturer.
 - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Submit details of pile stock material to be used, as described in PART 3 - FABRICATION, for review by Departmental Representative.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver new, undamaged materials to site, accompanied by certified test reports, with manufacturer's logo and mill identification mark provided on pipe piling.
- .4 Storage and Protection:
 - .1 Store and handle pipe piling in accordance with manufacturer's written instructions to prevent permanent deflection, distortion or damage to interlocks.
 - .2 Support pipe piling on level blocks or racks spaced not more than 3 m apart and not more than 0.60 m from ends.
 - .3 Store pipe piling to facilitate required inspection activities and prevent damage to coatings and corrosion prior to installation.
- .5 Waste Management and Disposal:
 - .1 Separate waste materials in accordance with Section 01 74 21 - Construction/ Demolition Waste Management and Disposal.
 - .2 Unused paint material must not be disposed of into sewer system, into streams, lakes, onto ground or in any other location where it will pose a health or environmental hazard.

Part 2 Products

2.1 MATERIALS

- .1 Steel pipe: as indicated, of sizes and wall thicknesses indicated, to API SPEC 5L, grade as indicated by Contractor's Design Expert.
- .2 Pipe material to have following minimum properties indicated by Contractor's Design Expert.
- .3 Pipe chemical composition: to CSA-Z245.1 and ASTM A252.
- .4 Pipe allowable tolerances:
 - .1 Deviation from straight line, specified diameter, wall thickness and out-of-roundness on body of pipe and at pipe ends to conform to API SPEC 5L.
 - .2 Pipe to be checked for deviations before leaving mill.
- .5 Pile tip reinforcement: to CSA-G40.20/G40.21, Grade as indicated by Contractor's Design Expert.
- .6 Pile driving shoes: to CSA-G40.20/G40.21, Grade as indicated by Contractor's Design Expert.
- .7 Shear rings: to CSA-G40.20/G40.21, Grade as indicated by Contractor's Design Expert.
- .8 Splices: to CSA-G40.20/G40.21, Grade as indicated by Contractor's Design Expert.
- .9 Steel pile caps: to CSA-G40.20/G40.21, Grade as indicated by Contractor's Design Expert.
- .10 Welding electrodes: to CSA W48 series.
- .11 Exterior protective coating: coal tar epoxy to CAN/CGSB-1.184, and inorganic zinc to CAN/CGSB-1.171.
- .12 Concrete: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .13 Reinforcing steel: in accordance with Section 03 20 00 - Concrete Reinforcing, grade, sizes and details as indicated.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 FABRICATION

- .1 Fabricate full length piles to eliminate splicing during installation wherever possible.
- .2 Full length piles may be fabricated from piling material by splicing lengths together.
 - .1 Use complete joint penetration groove welds or splices as indicated by Contractor's Design Expert.

- .3 Submit details of planned use of pile material stock to Departmental Representative for approval prior to start of fabrication.
- .4 Allowable tolerance on axial alignment to be 0.25% as measured by 3 m straight edge.
- .5 Repair defective welds as approved by Departmental Representative.
 - .1 Repairs: to CSA W59.
 - .2 Unauthorized weld repairs may be rejected.
- .6 Repair damaged exterior protective coating of piles.

3.3 PAINTING AND COATING

- .1 Painting requirements include surface preparation of outer surfaces of piling, application of inorganic zinc coating and coal tar epoxy coatings and touch-up after delivery if necessary.
- .2 Do not paint portions of pile, which are to be encased in concrete.
- .3 Paint piles as indicated.
- .4 Surface preparation:
 - .1 Sand or grit blast in accordance with SSPC-SP3.
 - .2 When blasting is completed remove dust by brush or vacuum prior to painting.
 - .3 Remove oil, grease or organic matter, with approved solvents or detergents prior to painting.
 - .4 Apply first coat of paint same day as completion of sand or grit blasting.
- .5 Application:
 - .1 Apply two coats, each in accordance with manufacturer's recommendations.
 - .2 First coat, inorganic zinc: apply to average 75 micrometres dry-film thickness and minimum 65 micrometres thickness.
 - .3 Second coat: coal tar epoxy; apply to average single coat dry-film thickness of 180 micrometres.
 - .4 Painted surfaces to be free from sags and runs.

3.4 INSTALLATION

- .1 Install piling in accordance with Section 31 61 13 - Pile Foundations, General Requirements.
- .2 If approved by Contractor's Design Expert, splice piles in place during installation by welding.
 - .1 To prevent distortion, tack opposite points first and then weld opposite sections for pipe walls thinner than 10 mm weld against a back up ring. Hold members in alignment during splicing operation.
 - .2 Make splice by complete joint penetration groove welds as indicated.
- .3 Perform internal visual inspection of steel pipe, joints and base prior to placing of concrete, if applicable.

- .1 Ensure pipe inside is free from foreign matter.
- .4 Assemble and install reinforcement cages as indicated, if applicable.
- .5 Install concrete in accordance with Section 03 30 00 - Cast-in-Place Concrete, if applicable.
- .6 Fill steel pipe pile with concrete using methods to limit free fall and to prevent segregation. Ensure adequate vibration to completely fill cross section of pipe, if applicable.
 - .1 Ensure adequate vibration to completely fill cross section of pipe.
- .7 Set dowels in concrete in accordance with details as indicated, if applicable.
 - .1 Secure until concrete is set.
- .8 Install pile caps as indicated.
- .9 Install driving shoes as part of field work.
- .10 Touch up scratched or uncoated surfaces with two applications of inorganic zinc coating and coal tar epoxy, as required by Departmental Representative.

3.5 WELDING

- .1 Weld to CSA W59.
- .2 Welding certification of companies: to CSA W47.1.
- .3 Welding certification of companies welding steel reinforcing bars placed in reinforced concrete: in accordance with CSA W186.

END OF SECTION

Partie 1 General

1.1 REQUIREMENTS

- .1 Not Used.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM) ASTM D1505-68, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
- .2 ASTM A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- .3 ASTM C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 General

- .1 Documents produced by the Contractor must be in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Documents include, but not limited to:
 - .1 Design notes.
 - .2 Shop drawings and technical data.
 - .3 General layout drawings of the new upstream safety boom.
 - .4 Manufacturing and installation drawings, including as-built drawings.
 - .5 Specifications (or technical specifications) for all work that are not covered by the various sections of the present specifications.
 - .6 Dimension survey reports, if applicable.
 - .7 Geotechnical survey reports, if applicable.
 - .8 Safety boom installation and removal procedures (upstream and downstream).
 - .9 Maintenance and operation manual.

.2 Design notes

- .1 Every design note submitted must bear the signature of an engineer who is a member of the Ordre des ingénieurs du Québec (OIQ).
- .2 Design notes must clearly present design hypotheses, load diagrams, reactions to restraint and stress calculations for all parts of provision. Notes to include table of contents and section specifying data and hypotheses used for design. Sketches and plans must clearly show proposed layouts and sizes.
- .3 Design notes to be produced using recognized and commonly used design software. All design files associated to notes must be submitted for a comprehensive and easily understood set.
- .4 Design notes become property of Parks Canada once submitted.

- .3 General layout, manufacturing and installation drawings, and specifications.
 - .1 Submit plans and specifications stamped and signed by engineer member of the OIQ.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle material and equipment in accordance with Section 01 61 00 – Common Products Requirements.
- .2 Deliver material and equipment in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Packaging waste management: salvage packaging waste for recycling/reuse in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.5 RESPONSIBILITY

- .1 The purpose of the present document is not to describe in every detail the design and construction and assembly methods of the various structures' components. The Contractor is fully responsible for the design and provision of equipment which shall meet the Departmental Representative's requirements for performance, reliability, and durability and adapt to the site and existing structures.
- .2 While representing installations as accurately as possible, plans attached to the present invitation to tender are not intended to offer the final design of the elements to be provided. The Contractor must carry out final design and required detailed engineering by using these plans, and their standards, as well as the criteria of the present section, as basic concept to be complied with.
- .3 The Contractor must submit to the Departmental Representative design notes, layout drawings, shop drawings and equipment assembly drawings for review and approval before purchasing or manufacturing equipment.

Partie 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Upstream safety boom (new)
 - .1 Seasonal safety boom installed for the navigation period then removed in the fall. The annual installation of the safety boom must be done before the opening of the navigation season (+/- mid-May), often during spring freshet. Installation is carried out by PCA employees equipped with small power boats (2 x 60hp).
 - .2 Safety boom must be safely installed by PCA employees for a high-flow situation (Probability of exceeding of 10%) for the period from May 1st to 15th – reference Appendix A4, Hydraulic study by WSP, Table 4-1 and Figure 4-2.

- .3 PCA's objective is to install safety boom without having to close gates of the Saint-Ours dam. If the closing of the gates is required for more critical river conditions, the Contractor shall demonstrate operation via written document where the followings will be explained:
 - .1 Strategies taken into consideration and chosen as to minimize closing of gates in critical conditions.
 - .2 River conditions for which the installation of safety boom requires closing of one or several gates.
 - .3 Number of gates which should be closed depending on the various river conditions, as well as estimated time of closing.
- .4 New safety boom must be of inverted "V" type as to facilitate safe of boaters and distressed swimmers to shore. A new anchor must be designed and installed at the tip of the "V"; both ends will be anchored to the existing anchor concrete blocks.
- .5 Location of safety boom must comply with what shown on tender drawings.
- .6 Permanent buoys must be installed at the tip of the "V" as to locate the anchor at the bottom of the river and allow installation of the boom the following spring. The buoys and the anchor must withstand loads from ice pressure and various debris floating on the river.
- .7 Bigger and more visible seasonal buoys must be installed at the tip of the "V" for the navigation season.
- .8 Safety boom must be designed to withstand when a distressed or drifting (engine shutdown) "typical boat" leans on the most critical point of the boom. Based on the geometry of the boom and the boat, it is possible that the safety boom will not provide a high and stable enough barrier to withhold the boat. It remains that the boom must be designed to withstand (without breaking) the defined design scenario, while taking into consideration the combination of the following factors:
 - .1 Water velocity: 1.3 m/s.
 - .2 Wind: 95 km/h.
 - .3 Wave: 0.2 m.
 - .4 "Typical boat": +/- 29 feet long, "cruiser", such as one of the following:
 - .1 Searay 280 Sundancer.
 - .2 Cruisers Yachts 298 Bow Rider.
 - .3 Regal 28 Express.
 - .5 In such load conditions, loads must not exceed 90% of the material's yield strength.
- .9 Upstream safety boom must be able to keep up with variations of about 0.6 m of the river's water level. Minimum and maximum water levels of the Richelieu River upstream of the Saint-Ours dam are:
 - .1 Maximum level: 7.2 m.
 - .2 Minimum level: 6.6 m.
- .10 The Contractor must consider in the design that the two existing concrete anchor piles and Darvard Island retaining wall can bear the loads transmitted by the

boom when submitted to conditions defined above. Once they are known, the Contractor shall provide loads to Departmental Representative for assessment of the existing pile resistance before starting manufacture and purchase of material. The boom anchors (permanent) must be able to withstand winter conditions and ice.

- .11 For information on existing anchor piles and existing structures, the Contractor can refer to documents in Appendix A1. However, PCA cannot guarantee accuracy of the information provided. The Contractor is responsible for verifying on site the information used for his design.
- .2 Downstream safety boom (existing relocated boom)
 - .1 Seasonal safety boom installed for the navigation period then removed in the fall. The annual installation of the safety boom must be done before the opening of the navigation season (+/- mid-May), often during spring freshet. Installation is carried out by PCA employees equipped with small power boats (2 x 60hp).
 - .2 Safety boom must be safely installed by PCA employees for a high-flow situation (Probability of exceeding of 10%) for the period from May 1st to 15th – reference Appendix A4, Hydraulic study by WSP, Table 4-1 and Figure 4-2.
 - .3 PCA's objective is to install safety boom without having to close gates of the Saint-Ours dam. If the closing of the gates is required for more critical river conditions, the Contractor shall demonstrate operation via written document where the following will be explained:
 - .1 Strategies taken into consideration and chosen as to minimize closing of gates in critical conditions.
 - .2 River conditions for which the installation of safety boom requires closing of one or several gates.
 - .3 Number of gates which should be closed depending on the various river conditions, as well as estimated time of closing.
 - .4 The downstream safety boom is composed of the existing upstream safety barrier which is relocated downstream of the Saint-Ours dam. The Contractor must modify the ends and shorten the existing safety boom so that it is adapted to the shoreline width and to structures downstream of the dam.
 - .5 Location of safety boom must comply with what shown on tender drawings.
 - .6 No modification to the safety boom is planned other than modification to the ends and to the length of the existing boom, as well as the provision of a new hand-operated hoist to tighten the safety boom.
 - .7 For approximate information on existing safety boom, the Contractor can refer to documents in Appendix A2. However, PCA cannot guarantee accuracy of the information provided. The Contractor is responsible for verifying on site the information used for his design.
 - .8 The Contractor is responsible for the choice of anchor (only for the left bank anchor), and design, manufacture and installation of the new anchor required to secure and anchor the downstream boom. Each anchor point must be designed for a tension of 20 kN. The Contractor must consider in his design a weighting factor of 1.5 on loads – tension- and constraints must not exceed 90% of the

- material's yield strength. Each anchor must be able to withstand winter conditions and ice.
- .9 The Contractor must provide an anchor with concrete blocks located and buried under the access road while observing space constraints. The anchor point of the safety boom to the anchor must be accessible through the riprap. The proposed design must limit, under load, possible surface settlement (under the access road) and any lateral movement. The subgrade's bearing capacity must be assessed. The work method must also be analyzed and detailed (subgrade, soil compaction, etc.) as to limit impacts on the road surface profile. Proceed to the reclamation of the access road once installation work of the anchor is done. If required, the Contractor can refer to results from the geotechnical survey performed on Darvard Island (Fall 2015). The geotechnical survey report is attached in Appendix A3. However, if the Contractor deems that further information is required for the design, he must carry out necessary studies and surveys at his expenses.
 - .10 It is impossible to properly determine the stability and resistance of the left bank anchor for shortage of drawings and information on the existing concrete wall. Therefore, the Contractor must design and develop an anchor system that must be able to take the tension off the boom and prevents additional stress to the existing structure. If the Contractor deems that further information is required for the design, he must carry out necessary studies and surveys at his expenses.
 - .11 The downstream safety boom must be able to keep up with variations of about 2.7 m of the river's water level downstream of the dam. If required, the ends of the existing boom shall be modified accordingly. Minimum and maximum water levels of the Richelieu River downstream of the Saint-Ours dam are:
 - .1 Maximum level: 6.9 m.
 - .2 Minimum level: 4.2 m.
 - .3 All metallic components provided within the scope of this project shall be protected against corrosion. Only the following materials and protections are allowed: aluminum, stainless steel or hot dip galvanized steel.

2.2 EQUIPMENT DESCRIPTION

- .1 Upstream safety boom (new)
 - .1 The boom must be new and have never been used. It must be provided by a manufacturer with at least five (5) years of experience in the manufacturing of waterway barriers designed for the specified use.
 - .2 The equipment manufacturer must provide to the Owner a certificate of resistance which certifies that the boom complies with design criteria.
 - .3 The safety boom's barriers (buoys) must be cylindrical and composed of an UV stabilizer which protects them from prolonged exposure to the environment. They must present hollow longitudinal ribs which offer resistance to impacts and loads.
 - .4 The boom must be of modular design so that each barrier can be transported by two adults.
 - .5 Boom to resist rolling.

- .6 Buoys must have minimum freeboard of 12 inches (30.5 cm) in still waters.
 - .7 Distance between each buoy, when linked to each other, cannot exceed 18 inches (46 cm).
 - .8 Buoys must be yellow in accordance with Transport Canada standard from the U.S Federal Standard for Government Procurement, Colours: Vol. 1, FED-STD-595B, Color Specifications, Yellow #13655.
 - .9 Total weight of one buoy, including all associated elements, must not exceed 70 kg.
 - .10 Boom must consist of an internal structural steel through which all external inter boom connections are attached.
 - .11 The internal structure must be anchored with A325 structural steel bolts and a thick external flat plate. Materials cast-in-place or with tubes and plates through the diaphragm wall are not allowed.
 - .12 Buoys must consist of a solid foam fill preventing immersion. They must be designed to maintain their original buoyancy even if punctured.
 - .13 Boom connections must consist in external galvanized steel assembly plates secured to the internal steel structure thanks to galvanized structural steel bolts which comply with requirements of the ASTM A325 standard.
 - .14 Shackles and other anchoring accessories must be composed of hot-dipped galvanized steel. Shackles must be secured by a hex castle nut and galvanized steel right cotter pin.
 - .15 The manufacturer must present certified test results on the connections load capacity. The manufacturer must provide to the Owner the maximum tension that can be withstood by the shackles and anchoring accessories and must confirm their working load limit.
 - .16 Hot-dipped galvanization must be in accordance with current edition of the following standards: ASTM A 123/A 123M and ASTM A 153/A 153M, depending on cases.
 - .17 Graphic elements on floating units to be: black, block, bold, capital letters, Arial font, in accordance with PCA standards and as presented on tender drawings. Graphic elements must be submitted to the Departmental Representative for approval before manufacture.
 - .18 Graphic elements on the seasonal buoys installed at the tip of the “V” must be as shown on tender drawings. Graphic elements must be submitted to Departmental Representative for approval before manufacture.
 - .19 If required for its installation, the safety boom must be provided with a hand-operated hoist to tighten the barrier.
- .2 Downstream safety boom (existing relocated boom)
- .1 Four (4) new warning panels must be provided and installed on the relocated barrier. They must be as presented on tender drawings. Panels to be composed of aluminum, stainless or galvanized steel and rigid enough to maintain their shape regardless of conditions. Panels must be submitted to the Departmental Representative for approval before manufacture.

- .2 The Contractor must provide a new hand-operated hoist as to tighten the safety barrier.

Partie 3 Execution

3.1 INSTALLATION

- .1 Upstream safety boom (new)
 - .1 Make sure warning message on boom face the upstream. Alternatively place boom units with English and French warning message.
- .2 Downstream safety boom (existing relocated boom)
 - .1 Make sure warning signs installed on the relocated boom face the downstream.

3.2 CONSTRUCTION

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 For installation of anchors, provide sediment control measures acceptable to the Departmental Representative. Do not spill concrete into open water.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspections - Inspect boom floatation units and buoys at time of pick-up for any defects. Notify Departmental Representative immediately of any defects so that they can be replaced if required. Further inspect in conjunction with Departmental Representative on site prior to installation. Any units damaged by contractor during delivery, handling or installation beyond their control are to be replaced by contractor.
- .2 Evidence of units having a lack of buoyancy, or are damaged, as determined by the Departmental Representative, will be cause for rejection.

END OF SECTION

Partie 1 General

1.1 ENVIRONMENTAL REQUIREMENTS

- .1 Machinery circulating or being used less than 30 m away from watercourses must use biodegradable vegetable oil.
- .2 Do not use borrow material from watercourse beds without written authorization from Departmental Representative.
- .3 Dumping excavated fill, waste material, or debris in watercourse or wetland is prohibited.

1.2 REFERENCES

- .1 Not Used.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

Partie 2 Products

2.1 NOT USED

- .1 Not Used.

Partie 3 Execution

3.1 EXISTING CONDITIONS

- .1 Maintain existing flow pattern in natural watercourse systems.
- .2 In natural systems maintain existing riffle pool and step pool patterns.
- .3 In wetland systems, maintain existing hydrological conditions.

3.2 EROSION AND SEDIMENT CONTROL

- .1 Develop and implement an erosion and sediment control plan meant to minimize risks of sedimentation of the water body for all phases of the project. Erosion and sediment control measures must be implemented until disturbed soil is permanently stabilized, suspended matter settles on the watercourse bed or at the bottom of the settling basin, and runoff water is clear. Plan shall include, if applicable:
 - .1 Implementation of efficient erosion and sediment control measures before start of work as to prevent sediment transport towards the water body.
 - .2 Measures to manage water flowing on site, as well as pumped or diverted water off site, so that sediments settle before water reaches the water body. For example, water could be pumped or diverted towards a vegetation zone; a settling basin (or any other filtering device) could be built.

- .3 Measures to seclude the site (e.g. turbidity barriers, turbidity curtains) to contain suspended matter within the area where work in water must be performed (e.g. dredging, installation of underwater cables).
- .4 Regular inspection and maintenance of erosion and sediment devices and structures during construction work.
- .5 Repairs to erosion and sediment control devices and structures in case of damage.
- .6 Removal of non-biodegradable erosion and sediment control material once site is stabilized.

3.3 REVEGETATION AND RIVER BANKS STABILIZATION

- .1 Minimize removal of riparian vegetation: as much as possible, use roads, cleared strips of land, or existing trails as to prevent disturbance to riparian vegetation and avoid soil compaction. Trim or top off vegetation instead of grubbing or uprooting.
- .2 Minimize removal of natural wood debris, rock, sand or other material from banks, shores, or waterbody bed beneath the high-water mark. Material that is removed from waterbody must be kept as to be put back in place once construction work is done.
- .3 Stabilize shores or banks that are disturbed by project activities as to prevent erosion or sedimentation at once, preferably by the installation of native plants.
- .4 Banks and gradient of waterbody bed are to be restored to initial condition. If the restoration of the initial gradient is impossible due to instability, stable gradient which does not block passage of fish shall be prepared.
- .5 If rockfill is required as to strengthen or solidify exposed or eroded areas, make sure rocks are of adequate size and clean, that and rockfill complies with bank and shoreline slope, as well as the natural profile of the watercourse and the shoreline.
- .6 Remove all construction material from site following project completion.

3.4 PROTECTION OF FISH

- .1 Make sure work carried in water, or on structures in water, does not block passage of fish nor reduce width or flow rate of water course.
- .2 Use of explosives or blasting in or near water is prohibited. The use of explosives in or near water produces shock waves likely to damage the fish's air bladder and internal organs. Vibrations caused by blasting can also kill or damage fish eggs and larvae.

3.5 DRAINAGE

- .1 Do not discharge pumped water containing suspended matter in watercourses.

END OF SECTION

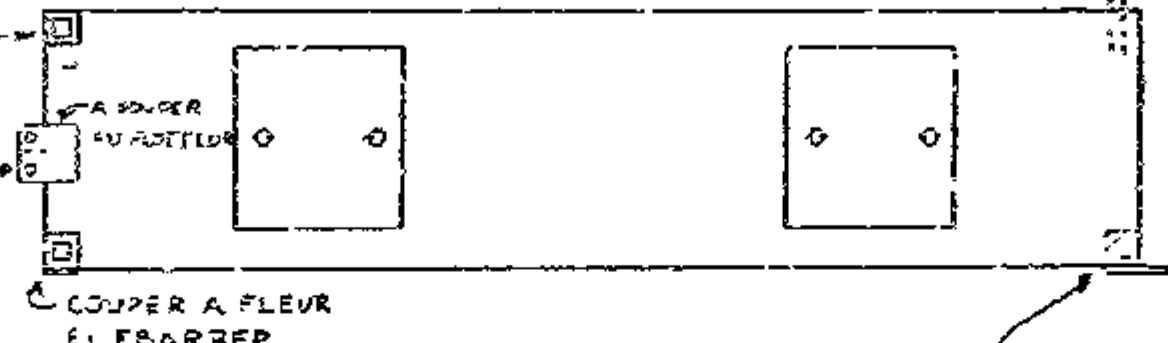
ANNEXE A1

Dessins des piliers d'amarrage et du mur de soutènement île Darvard - estacade d'origine

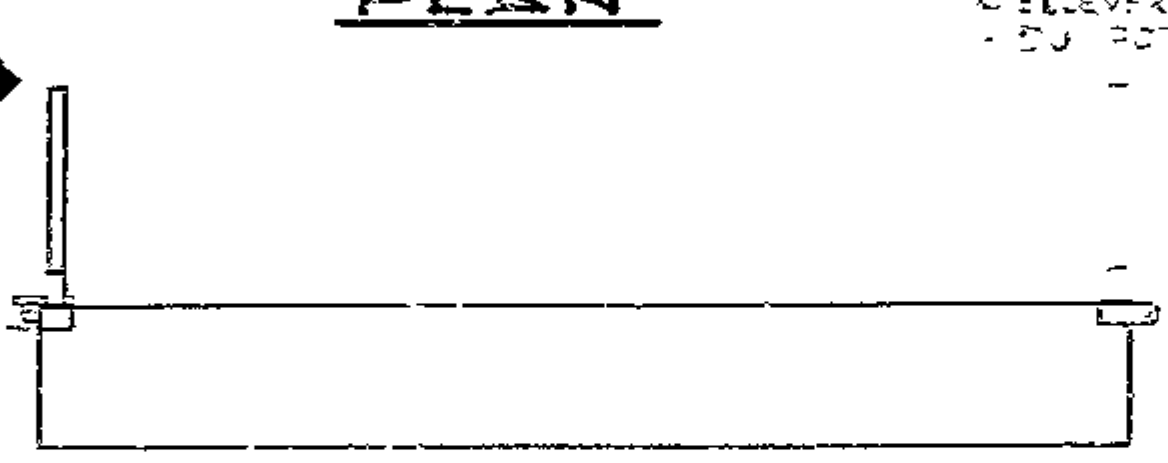
Drawings of Anchoring Piles and Darvard Island Retaining Wall – Existing Safety Boom

SAUPER LA BASE DU POTEAU
ORIENTER LES TROUS POUR
LES BLOCS POUR INSTALLATION
DU POTEAU TEL QUE
MONTRE A COUPE B-B
VOIR DETAIL 1

ENLVER LES SUPPORTS ET EBARBER



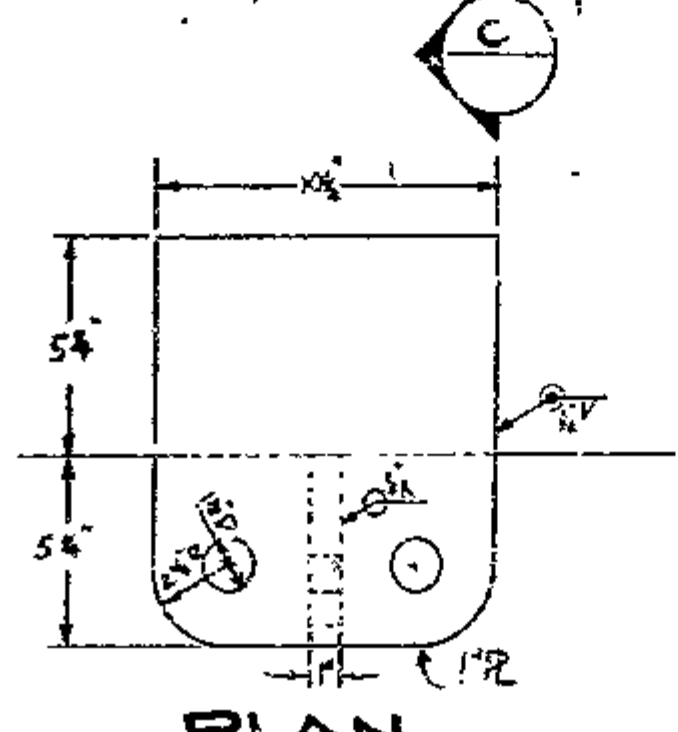
PLAN



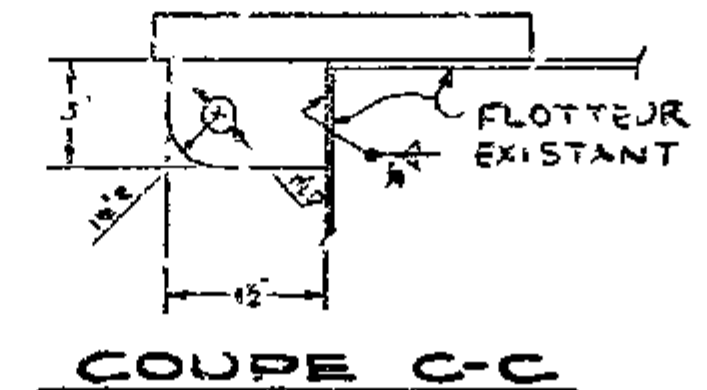
COUPE A-A

POTEAU 'A'
POTEAU 'B' (FLOTTEURS N° 1, 2, 4, 6, 8, 10 ET 12)
POTEAU 'X' (FLOTTEURS N° 3, 5, 7, 9 ET 11)
PERCER LES POTEAUX TEL QUE REQUIS SUIVANT LA NOUVELLE
ORIENTATION

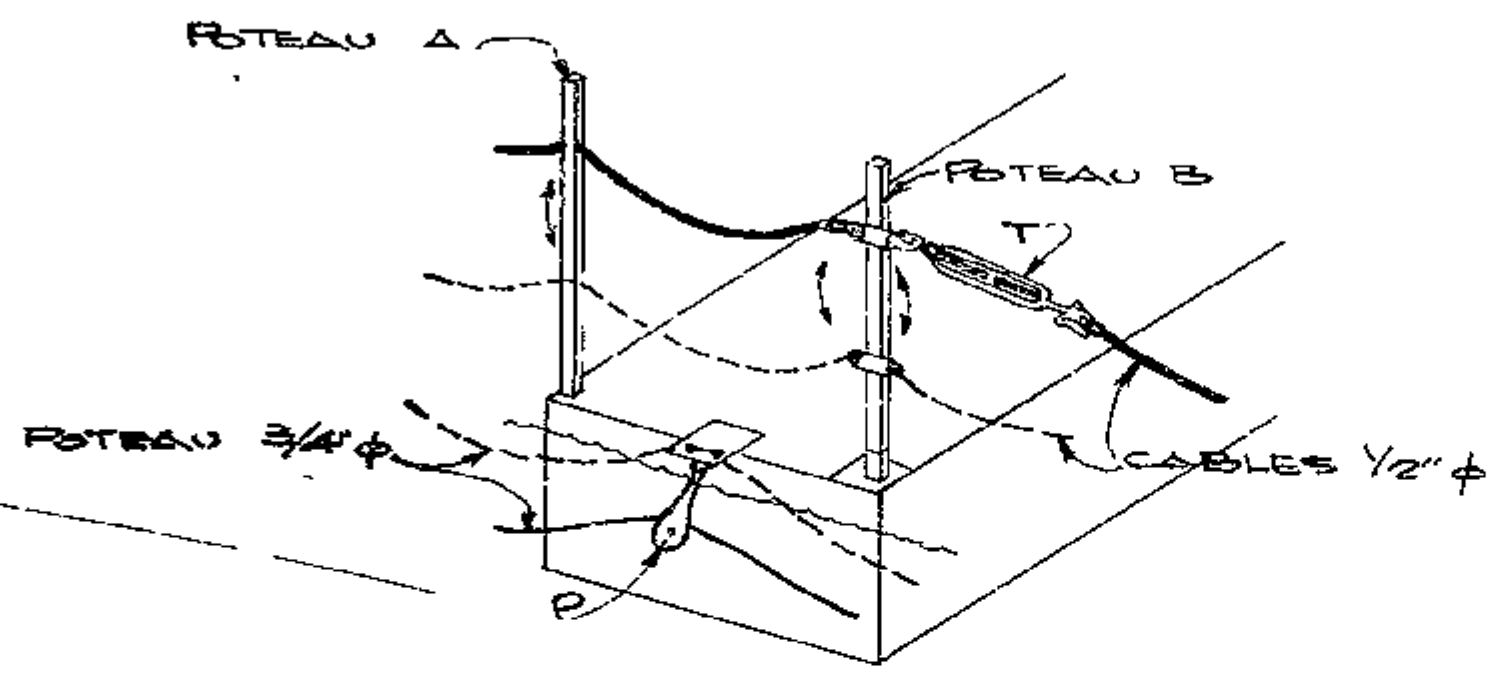
MODIFICATIONS AUX FLOTTEURS
(12 REQUIS)



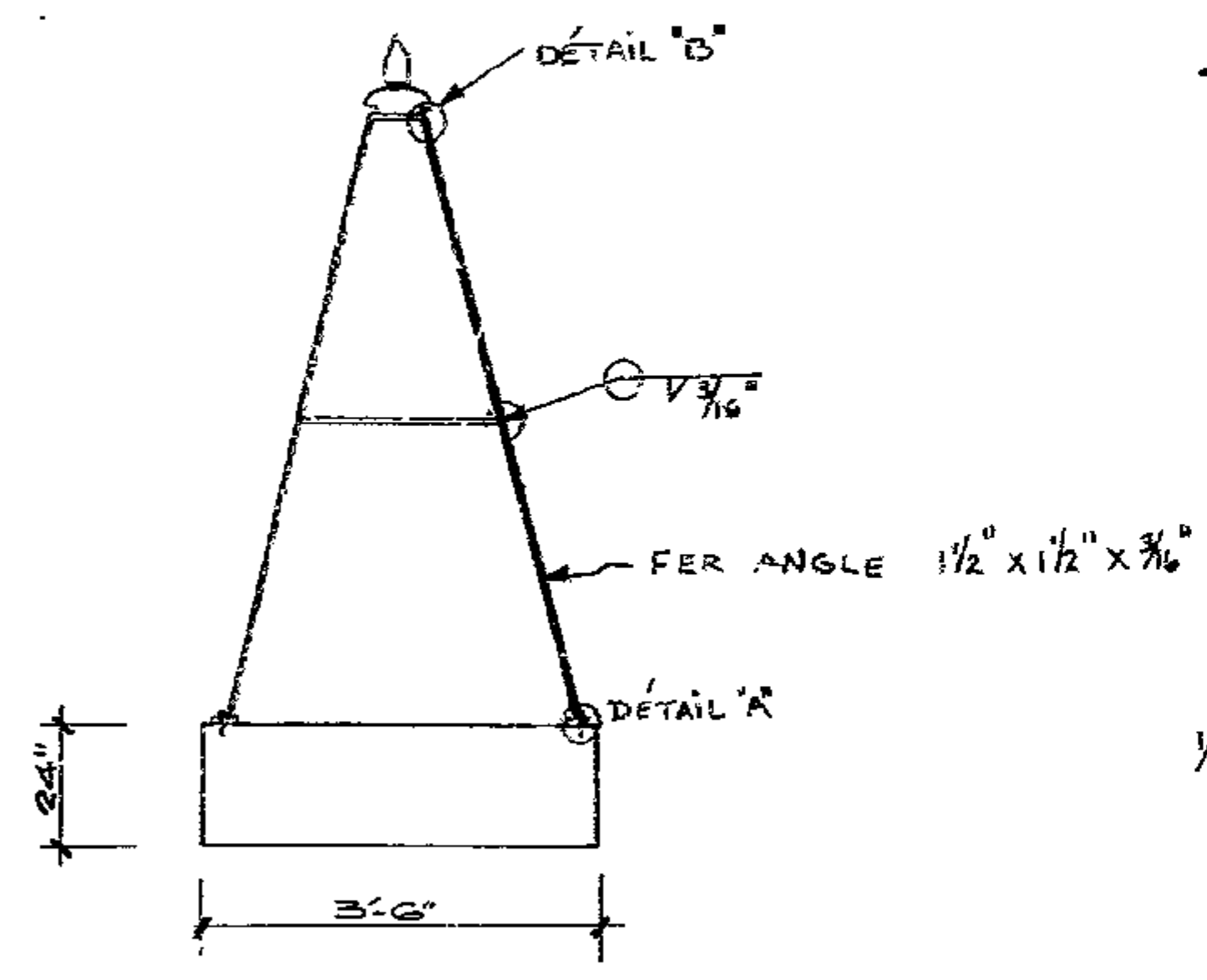
PLAN



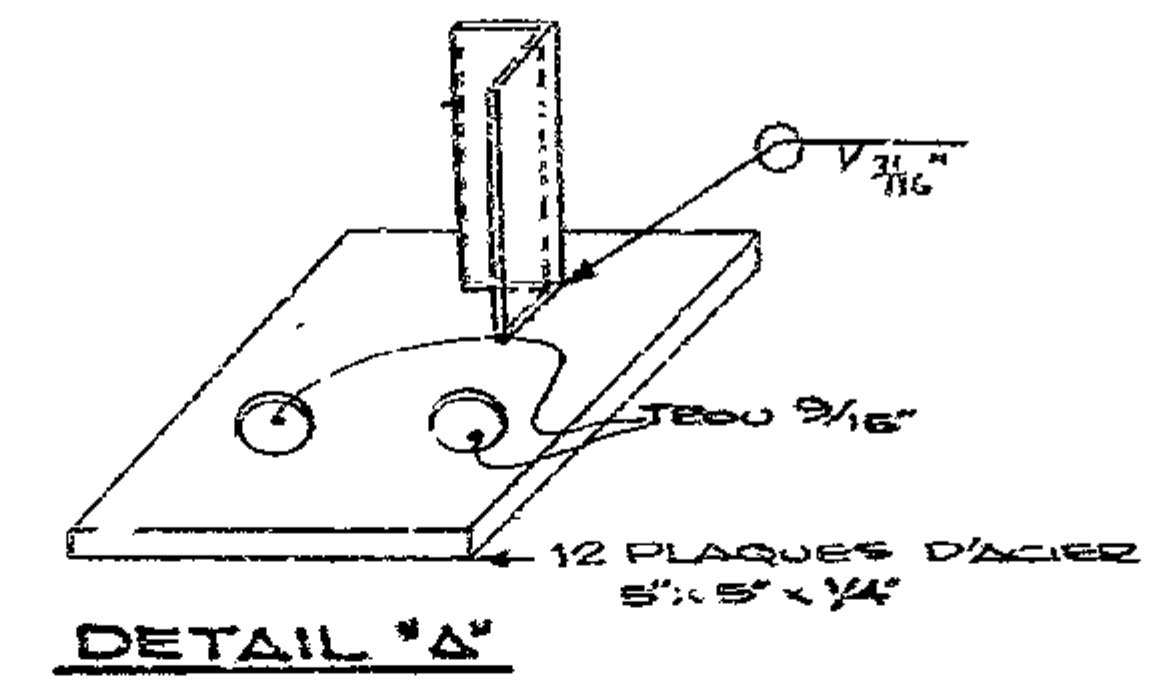
COUPE C-C



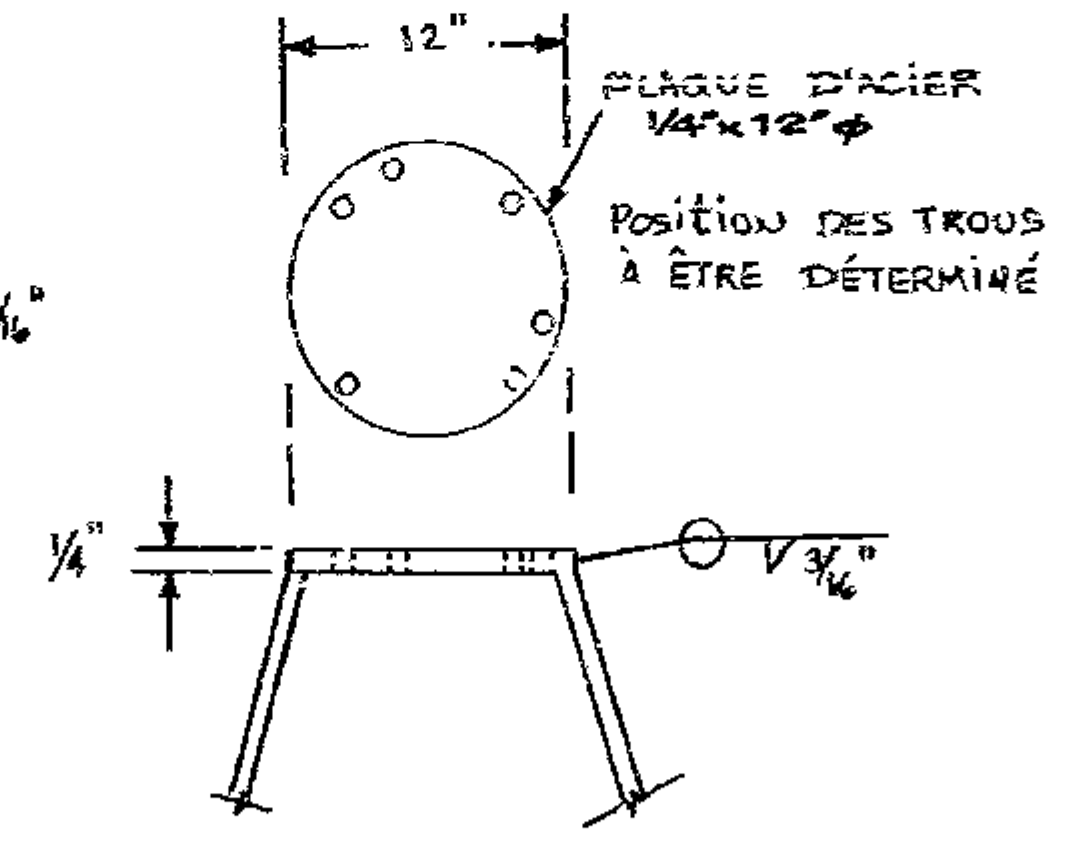
SCHEMA D'ASSEMBLAGE
P.A.E.



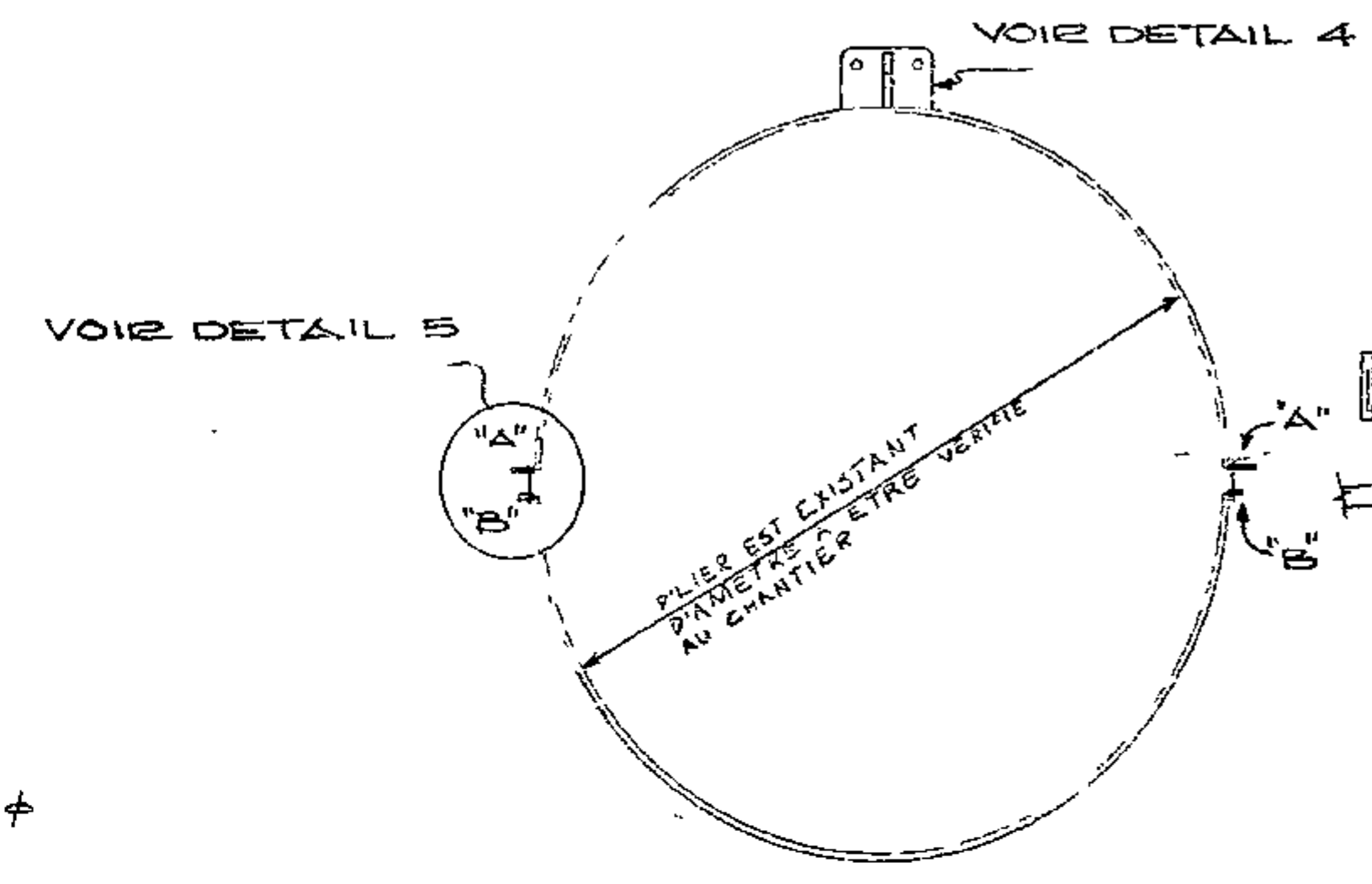
SUPPORTS POUR FEUX SCINTILLANTS
(3 REQUIS)



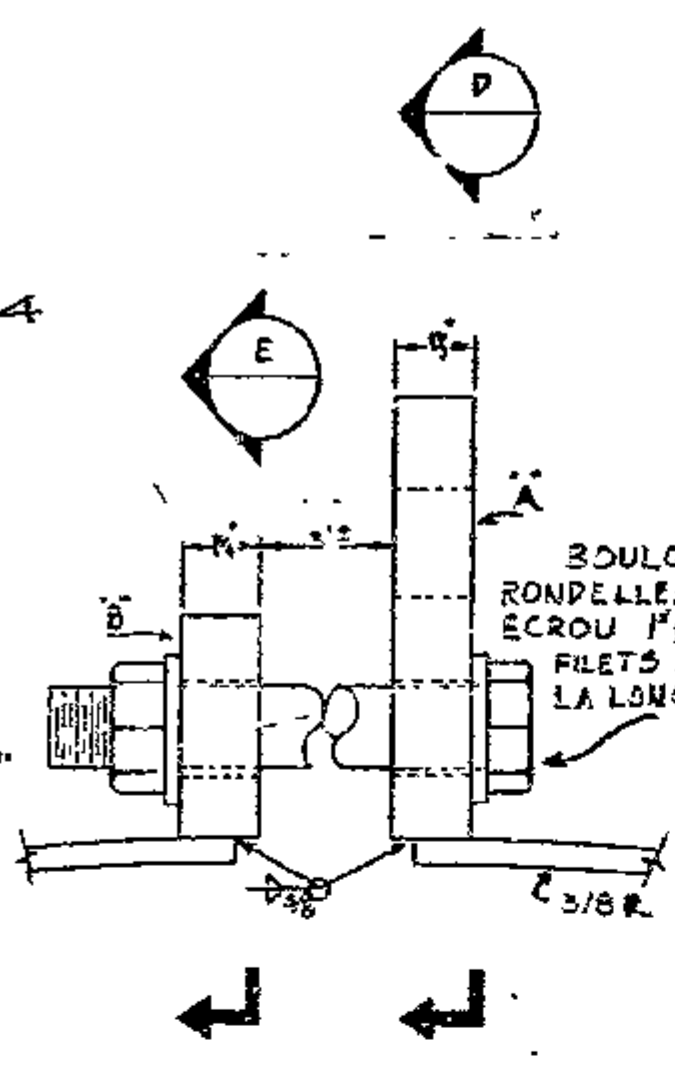
DETAIL 'A'



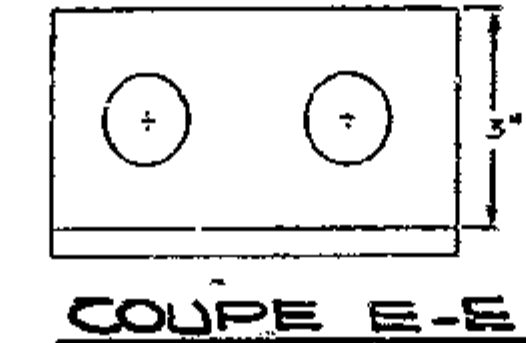
DETAIL 'B'



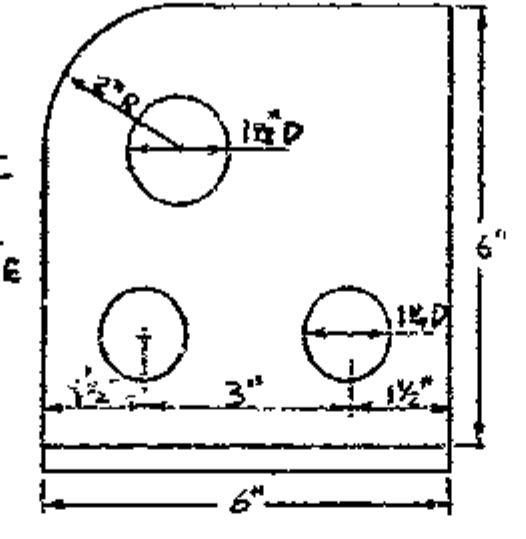
DETAIL 5
ANNEAU DE FIXATION FILIER D'AUCRAGE EST.



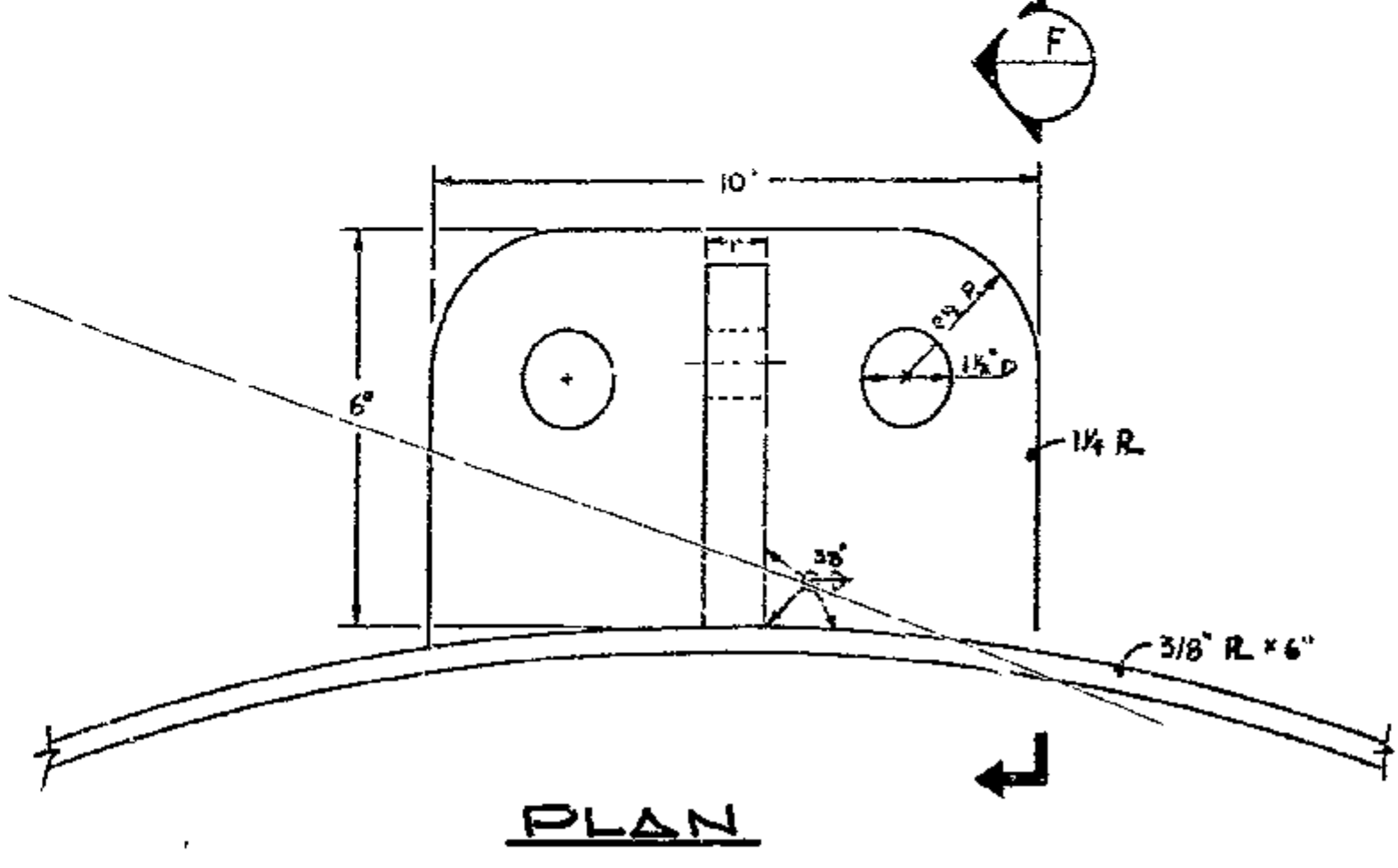
DETAIL 4



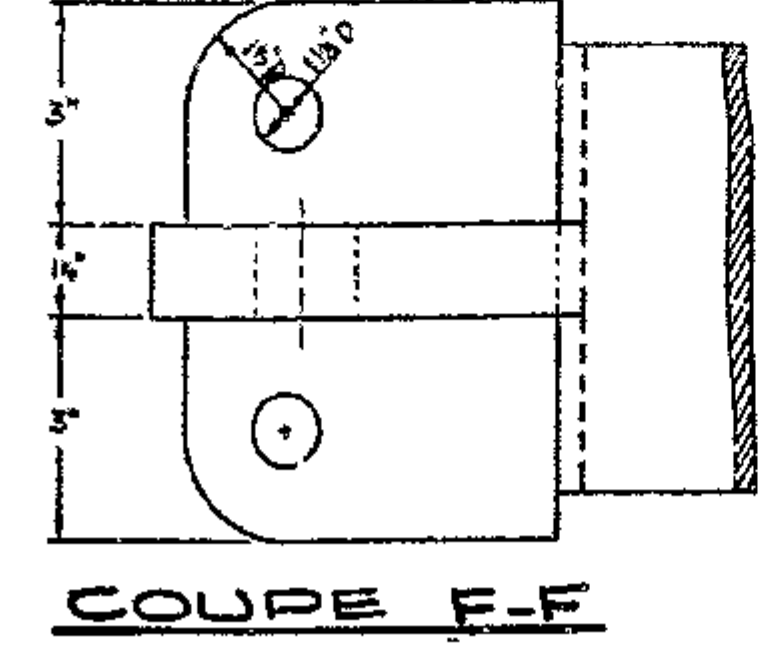
COUPE E-E



COUPE D-D

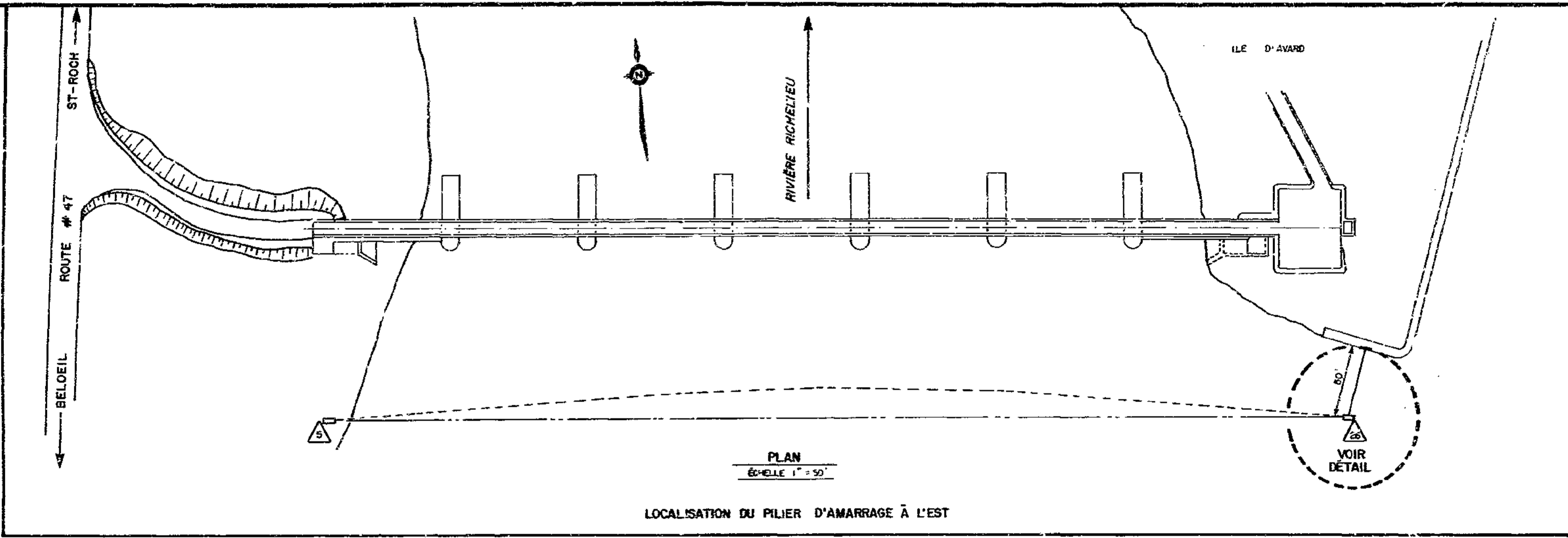
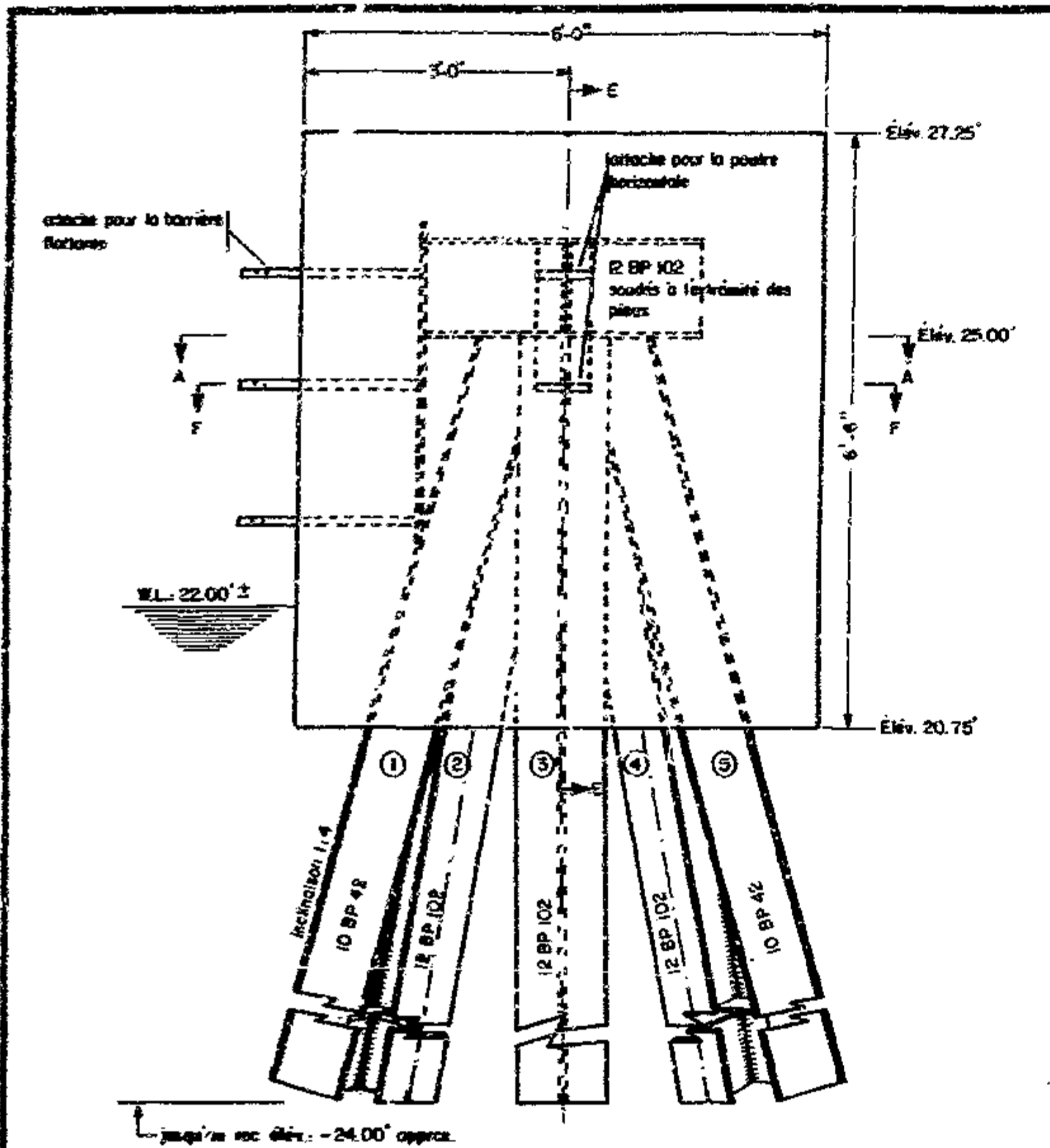


PLAN



COUPE F-F

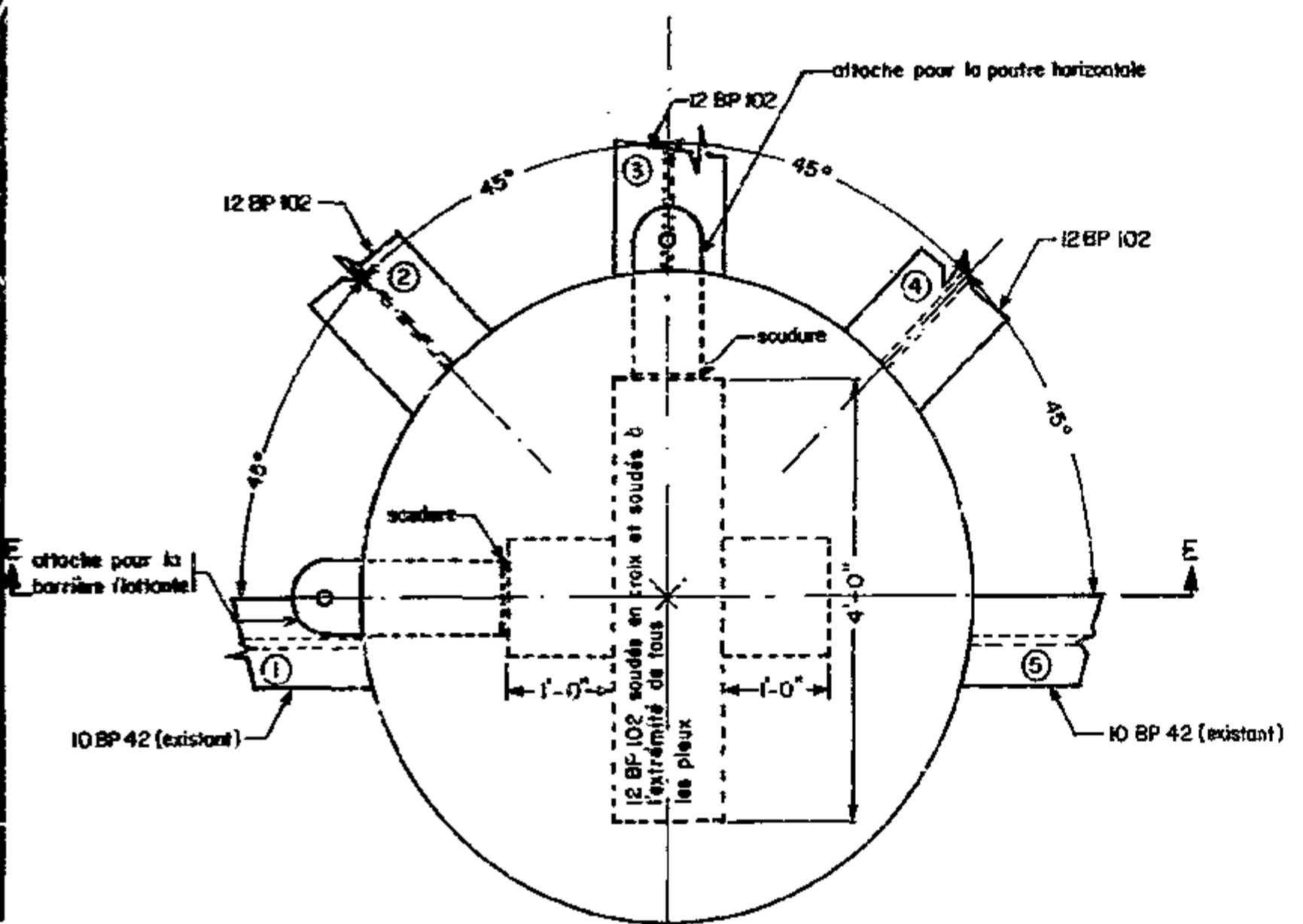
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Surveyor, Manager & Consultant Inc. 1, Concession Desjardins, Montreal, Canada			
CLIENT			
PARCS CANADA			
PROJET/PROJECT			
BARRIERE DE SECURITE BARRAGE DE ST-OURS			
SUJET/SUBJECT			
DETAILS DIVERS			
PROJ. / ISO PROJ.			
ECHELLE / SCALE			
PROJET/DESIGNED BY	DESIGNED BY	DATE/DATE	
H. K.	R.T.	1.1.88	
APP. / CHECKED	APP. / PROJECT	APP. / CLIENT	
CONTR.	NUMERO DE DESSIN / DRAWING NUMBER	REV.	
4469	4100-0001-02	0	
SCHEAU D'ING./ENG. SEAL			



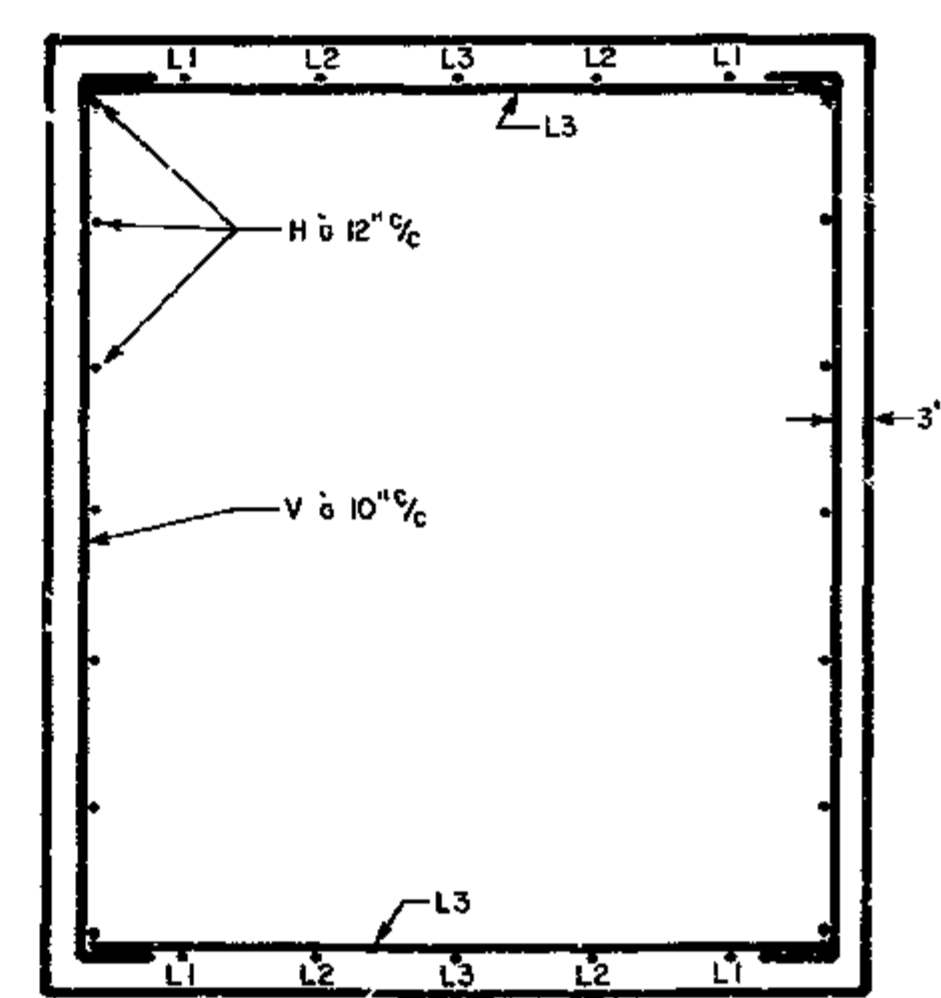
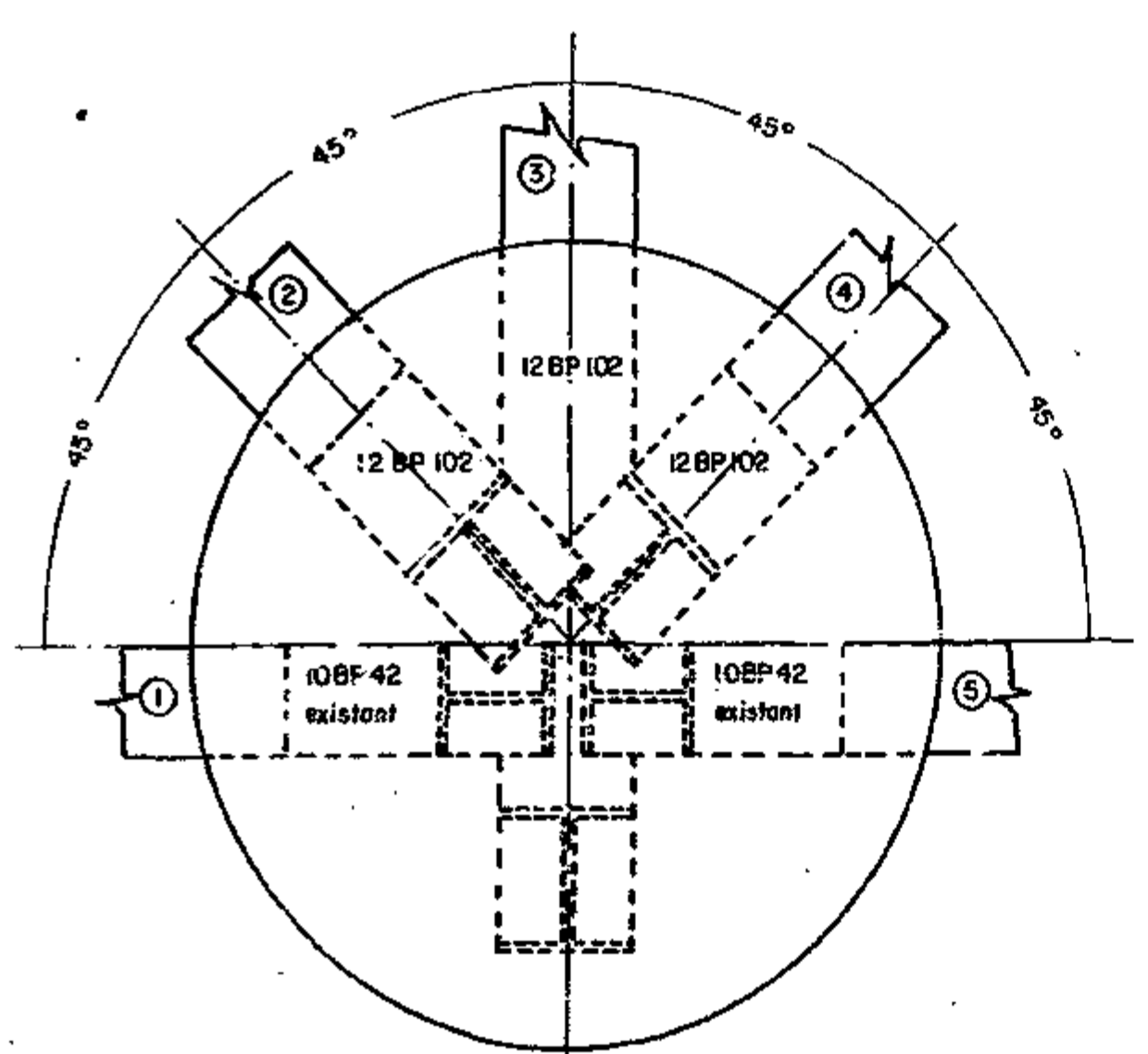
PLAN
ÉCHELLE 1" = 50'
LOCALISATION DU PILIER D'AMARRAGE À L'EST

Les trois piles 12 BP 102 inclinées 1:4 seront disposés sur un demi-cercle à des intervalles de 45°.

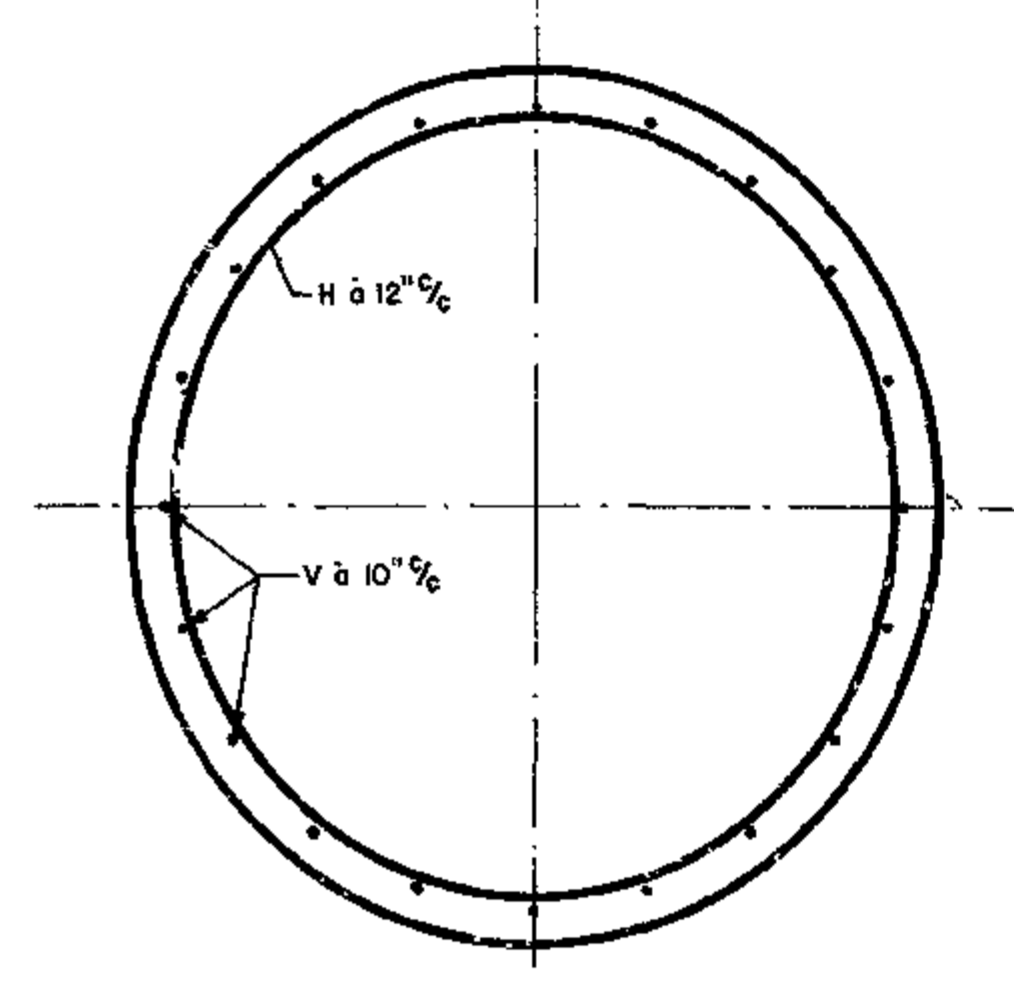
ÉLEVATION FRONTALE



VUE EN PLAN



COUPE VERTICALE "E-E" MONTRANT EXCLUSIVEMENT LA DISPOSITION DE L'ARMATURE.



COUPE HORIZONTALE "F-F" MONTRANT EXCLUSIVEMENT LA DISPOSITION DE L'ARMATURE.

BÉTON
4000 lb_{po}²
AH: 3"
Açq: 1 1/2"
Air: 5%

ACIER
F_y: 40 000 lb_{po}²

BORDEREAU DE L'ARMATURE						
ident.	type	A	B	N°	nombre	pois
H	3	5'-6"	—	7	7	247.3
L1	1	3'-9"	—	7	8	61.3
L2	1	5'-0"	—	7	8	81.8
L3	1	5'-6"	—	7	4	45.0
V	2	6'-0"	0'-6"	6	21	220.8

QUANTITÉS:
BÉTON..... 6.8 yd.
ARMATURE..... 656.2 lbs

TYPES

Les pieux existants seront coupés à l'élevation 25.0'
La membrure horizontale reliant les deux pieux existants sera retirée
COUPE HORIZONTALE "A-A" À L'ÉLEVATION 25.0' MONTRANT EXCLUSIVEMENT LA DISPOSITION DES PIEUX.

A detail no. _____ détail no.
B location disp. no. _____ sur dossier no.
C drawing no. _____ dessin no.

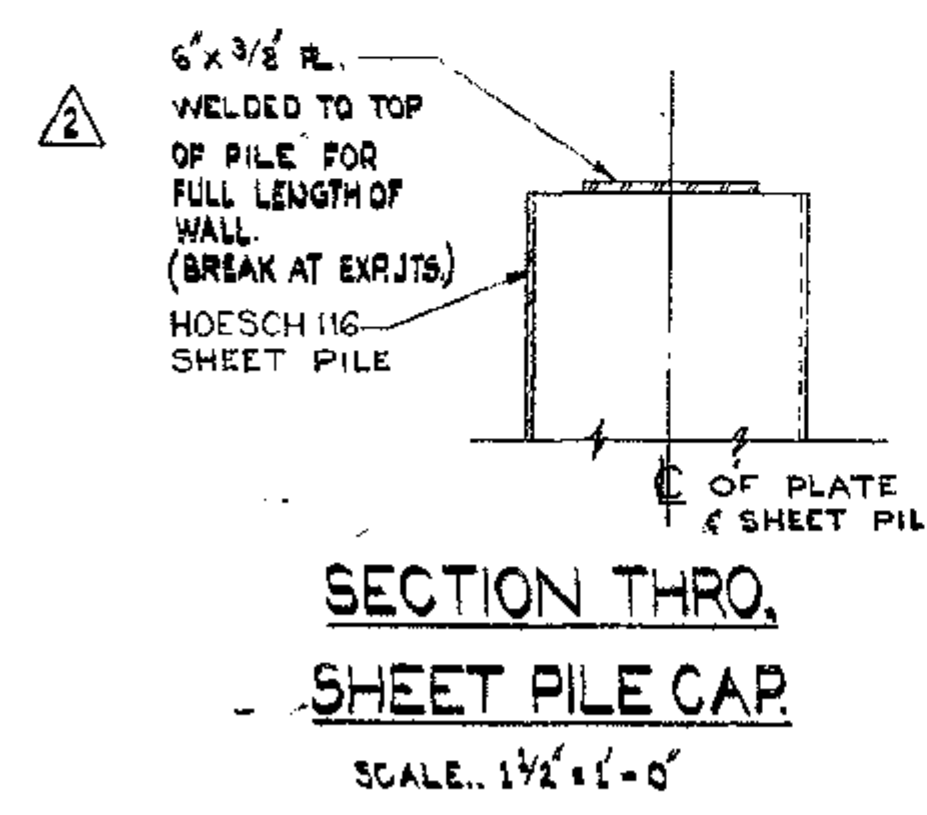
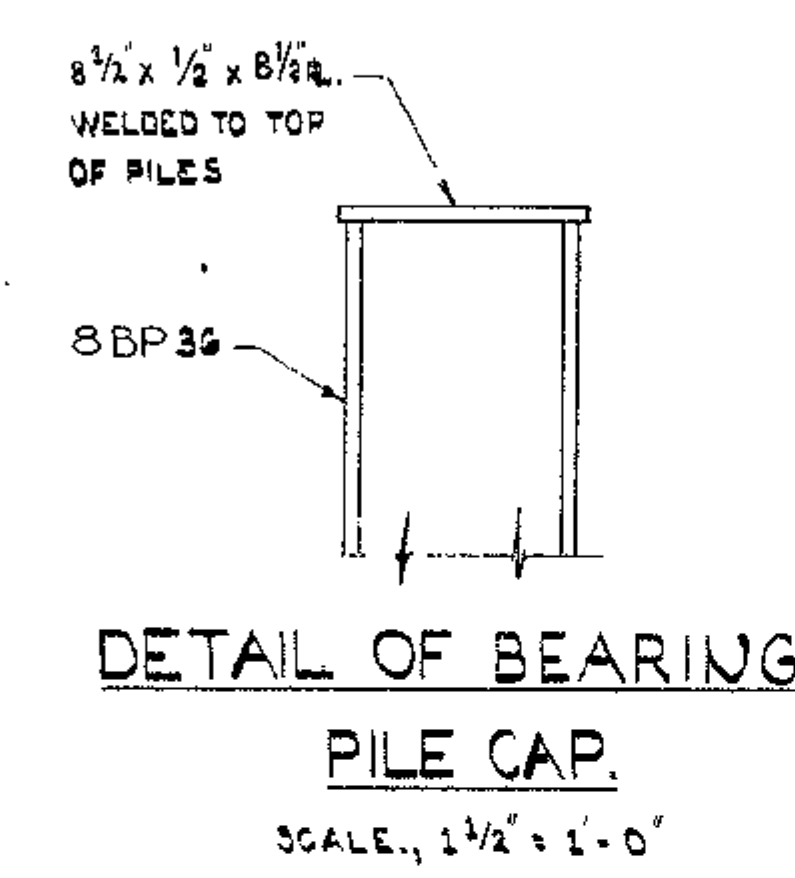
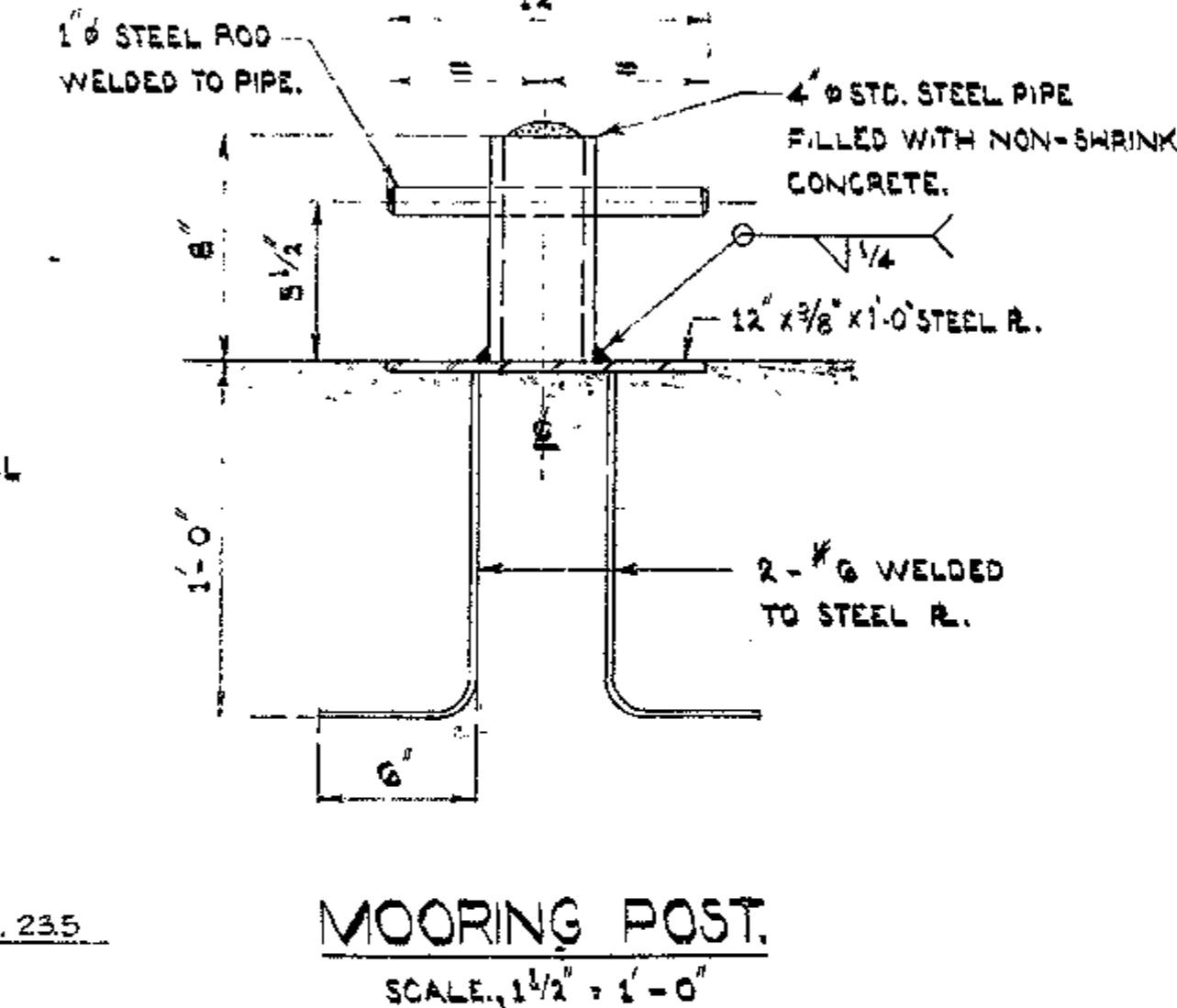
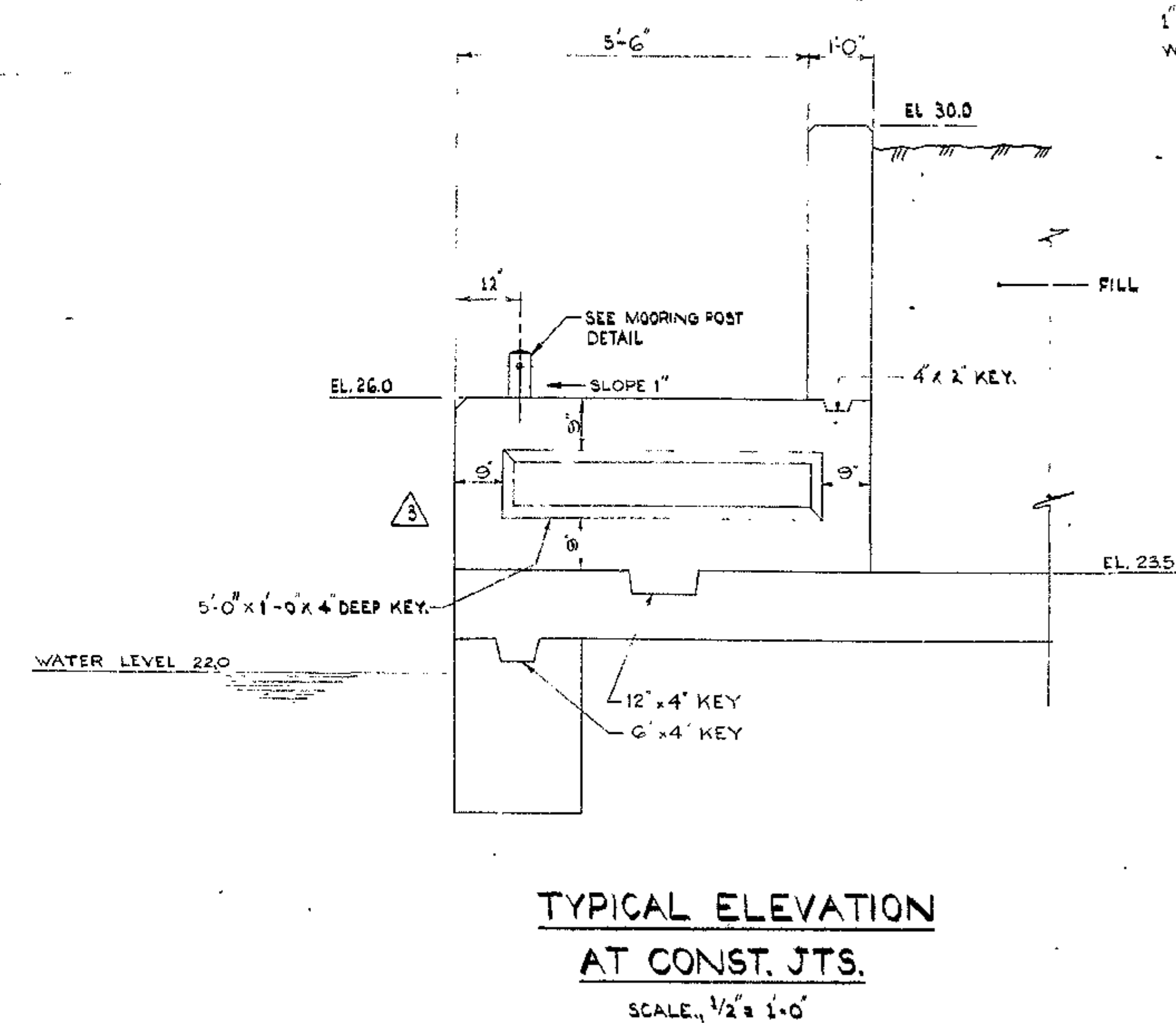
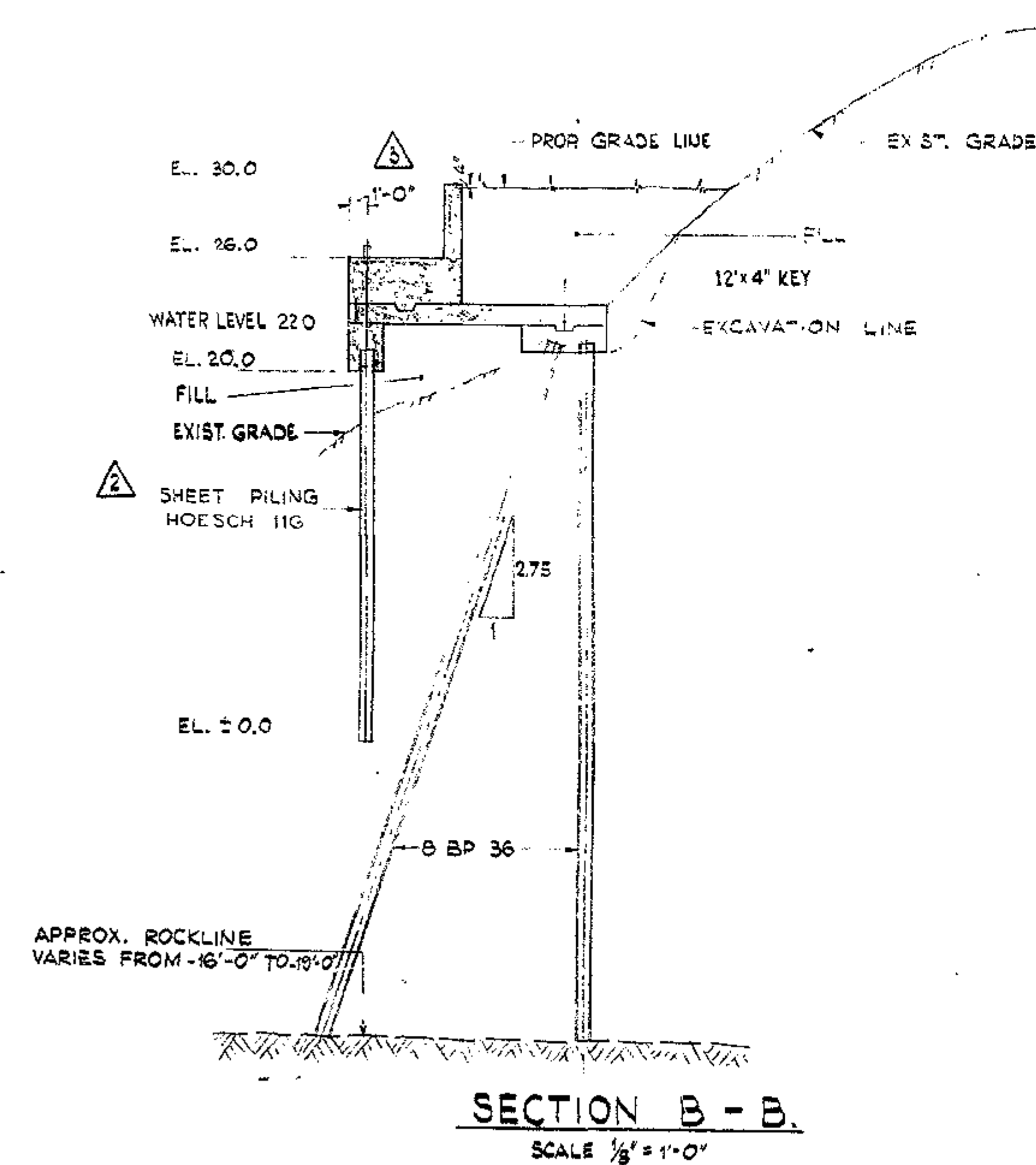
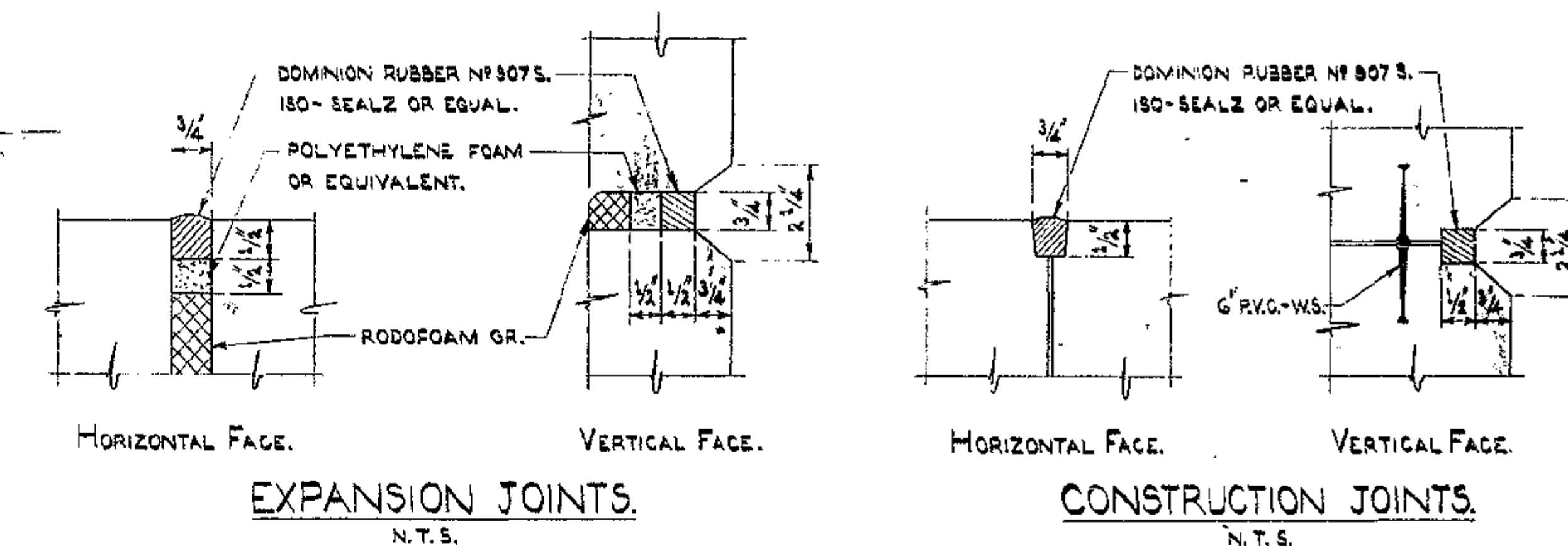
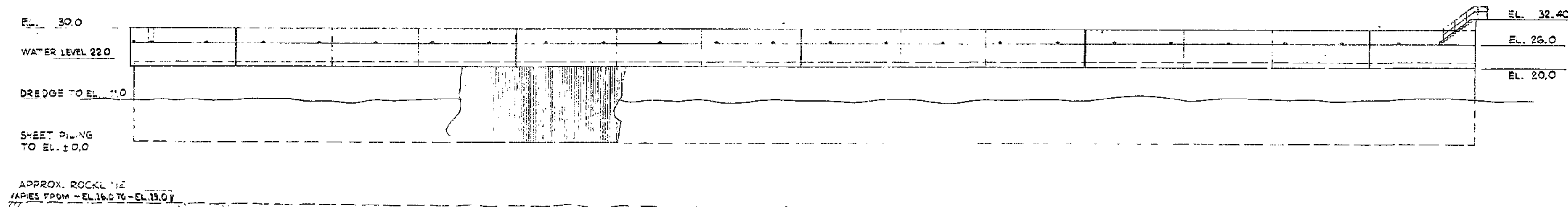
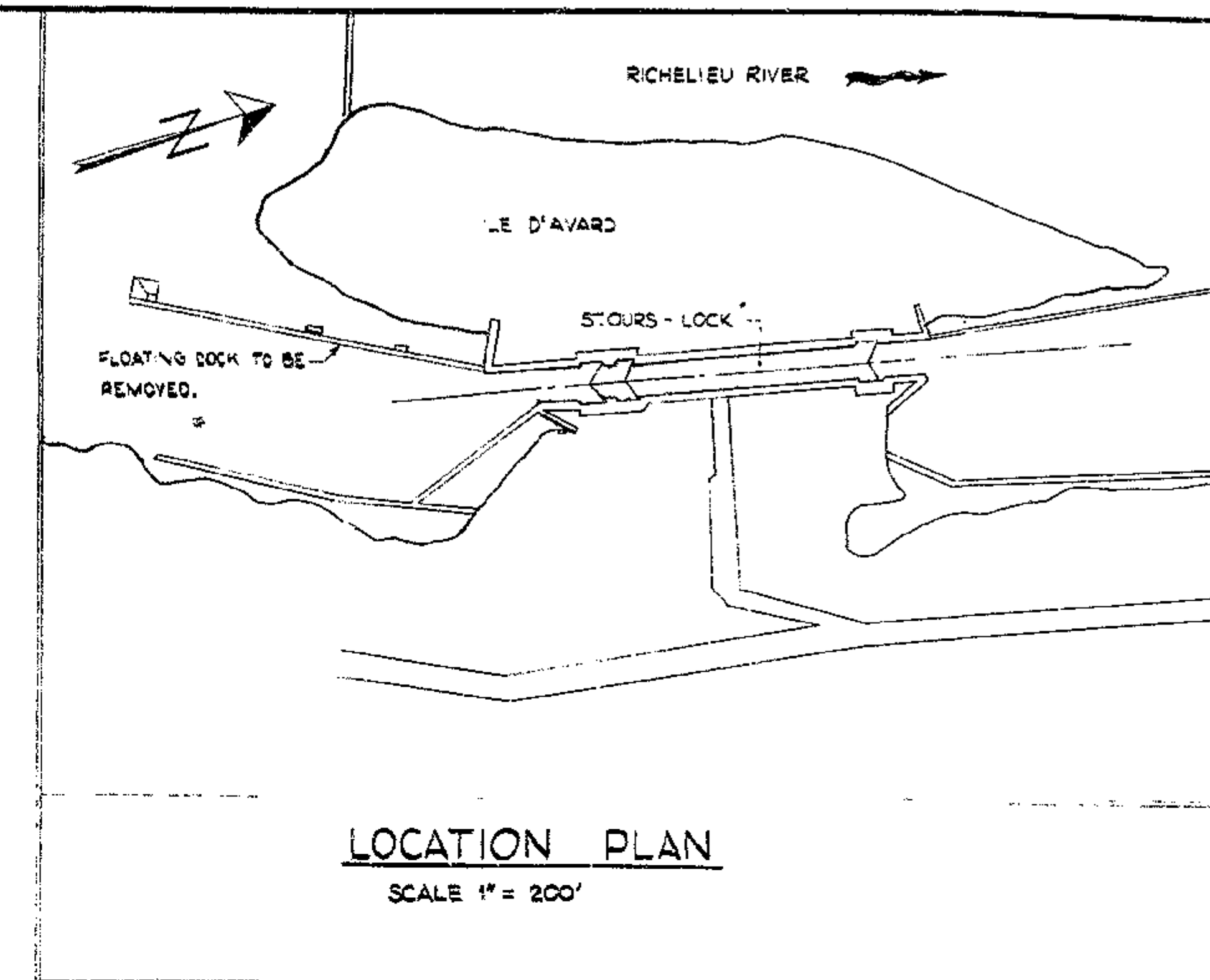
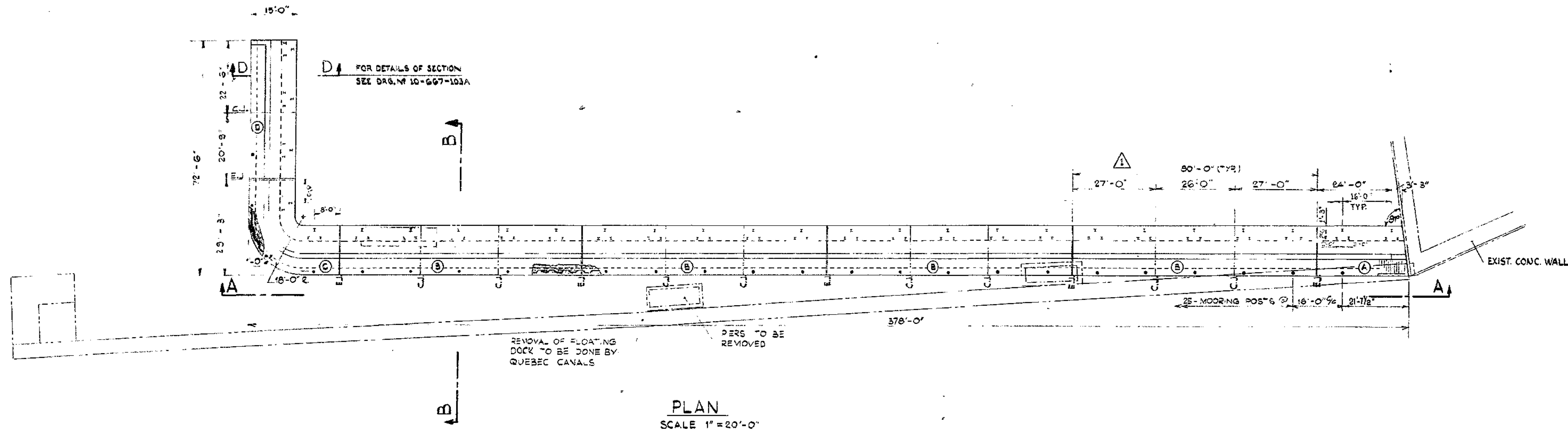
drawn by / tracé par: A.P. B. J.P. scale / échelle: 3/4" = 1'-0"
designed by / établi par: Donald Carter, Inc.
checked by / vérifié par: Donald Carter, Inc.
DONALD CARTER INC. CONS.
Job captain / chef du projet: _____ date: _____
responsible officer / officier responsable: G. Desautels, Ing. date: 75
project title: BARRAGE ST-OURS titre du projet: BARRIÈRE DE SÉCURITÉ

drawing title: _____ titre du dessin: DÉTAILS DES PIEUX POUR

revision no. / no de révision: EUC 75/262
sheet no. / feuille no: 1 de 1



184/00/PA.16



NOTES: (A) DENOTES SIMILARITY IN WALL SECTIONS.
C.J. - CONSTRUCTION JOINTS.
E.J. - EXPANSION JOINTS.
ALL EXPOSED EDGES OF CONCRETE TO HAVE 2" CHAMFER, UNLESS OTHERWISE NOTED.
MINIMUM COVERING FOR REINFORCING STEEL TO BE 3"

DATE	REVISIONS	MADE	CH'CK'D
JAN/68	DOWELS AT E.J. REMOVED	X.SCH.	CM.
JAN/68	WATERSTOPS REMOVED & WALL SECTION ALTERED	I.R.S.	CM.
JAN/68	SHEET PILING ALTERED FROM MPH12 TO HOESCH 116	I.R.S.	CM.
JAN/68	PANEL 'B' INSIDE DIMENSIONS ALTERED	I.R.S.	CM.

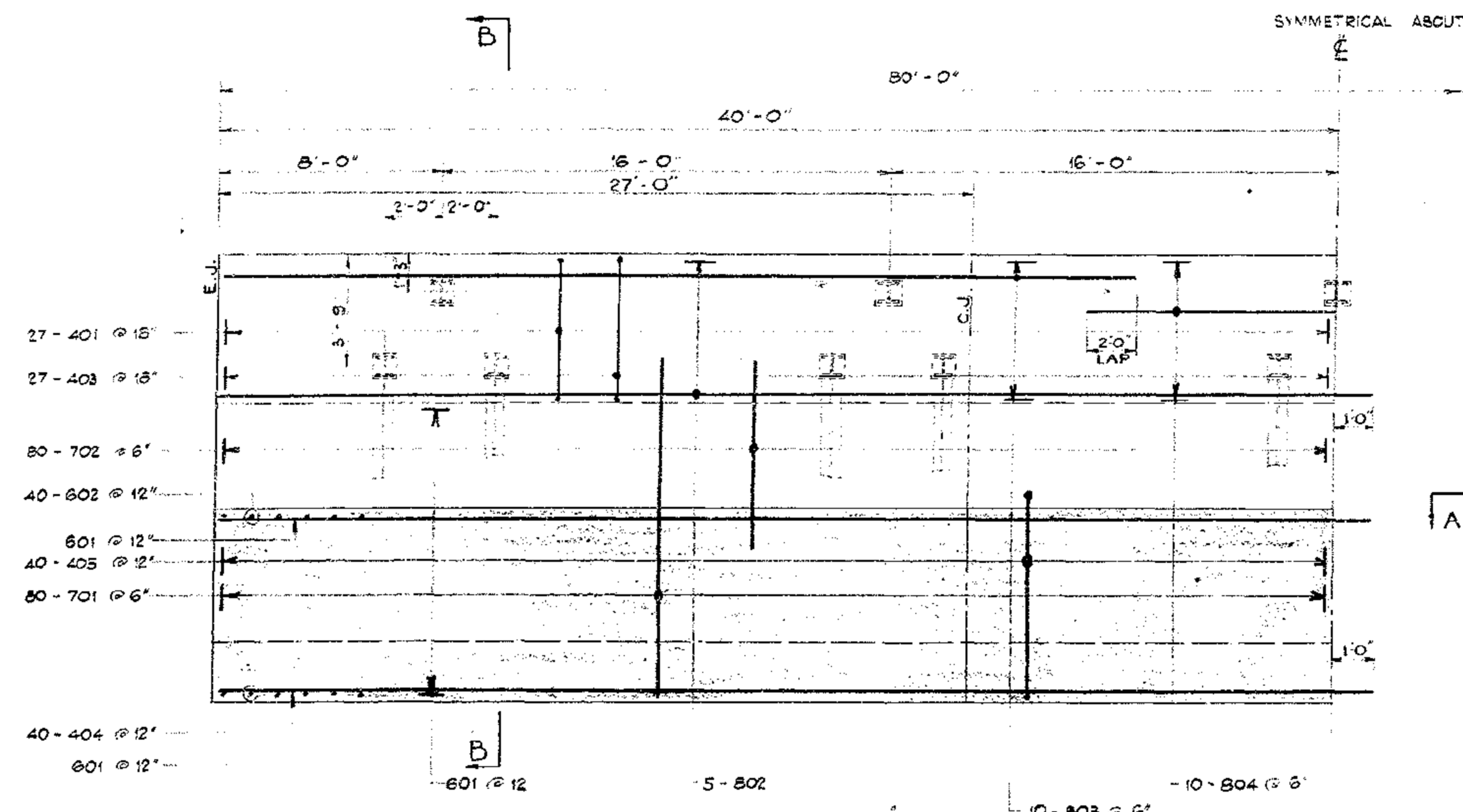
DEPARTMENT OF TRANSPORT
MARINE WORKS
CANALS DIVISION
QUEBEC CANALS
RICHIEU RIVER - ST.OURS LOCK
UPPER ENTRANCE WALL.
DETAILS - 1.

SCALE: AS SHOWN
DESIGN: M.S.G.
DRAWN: X.SCH. & D.W.
CHECKED: CM.

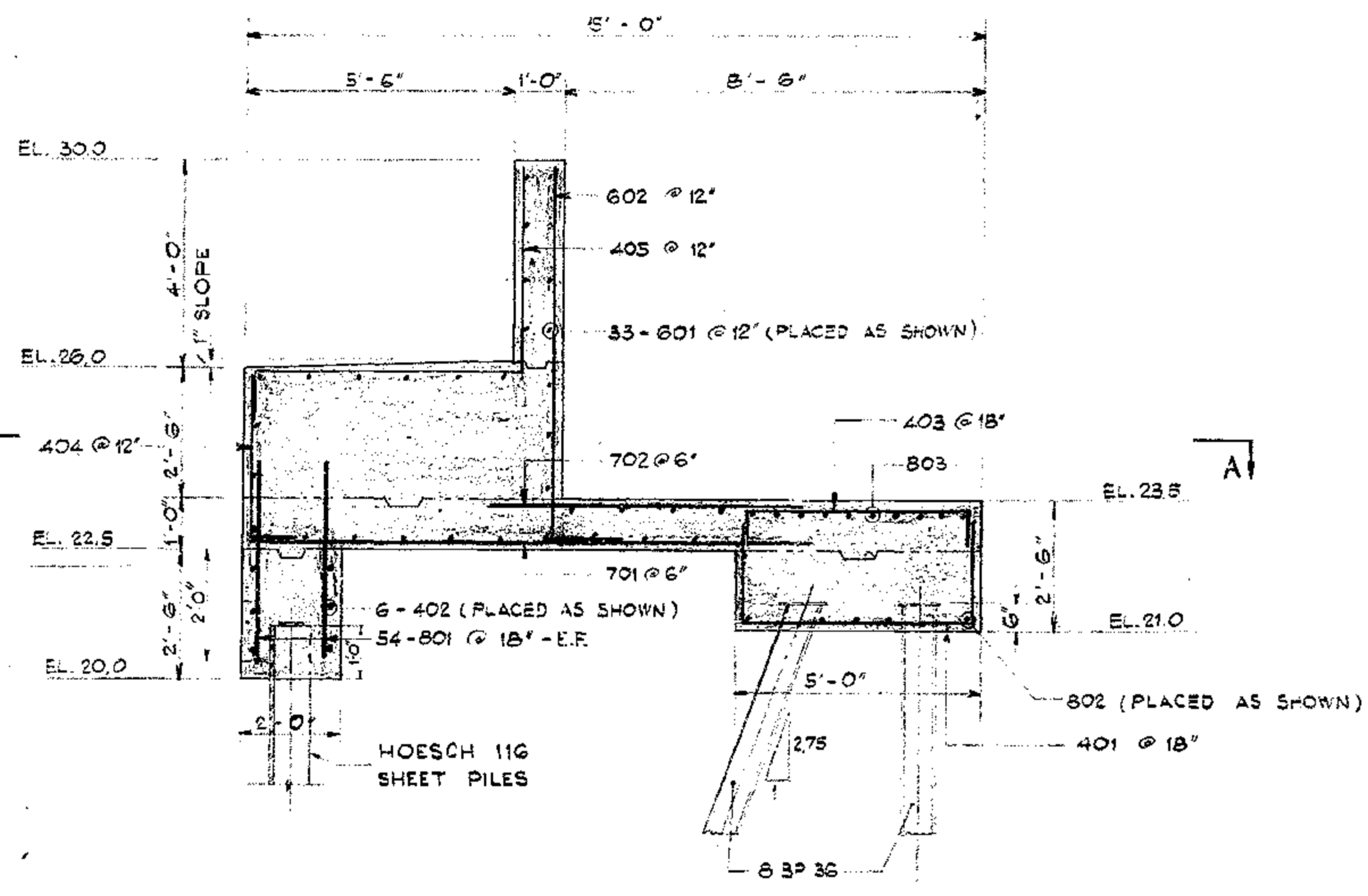
DATE: OCT/67

H. Gagnon, P. Eng.
CHIEF, CANALS DIVISION

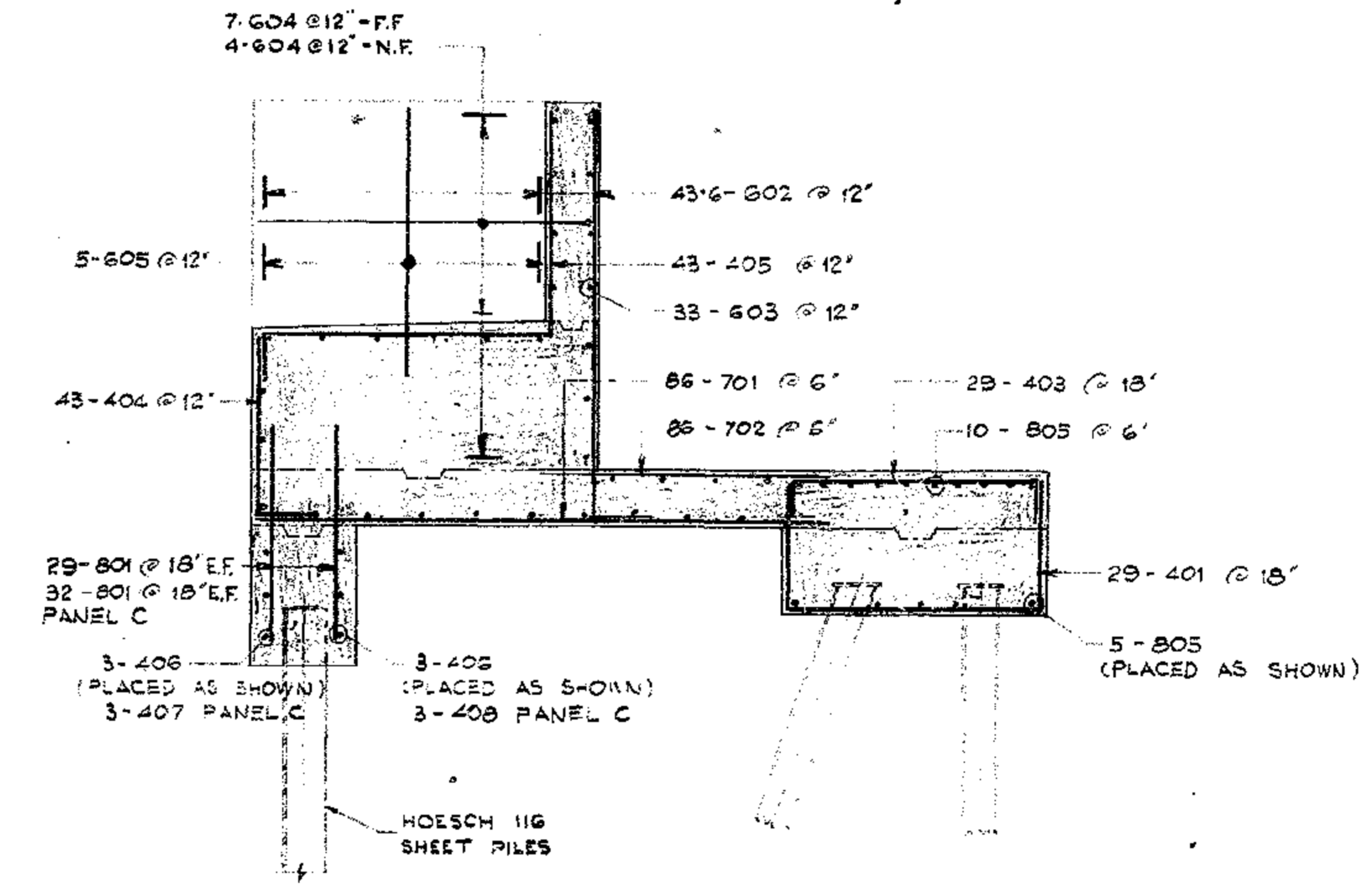
10-667-102



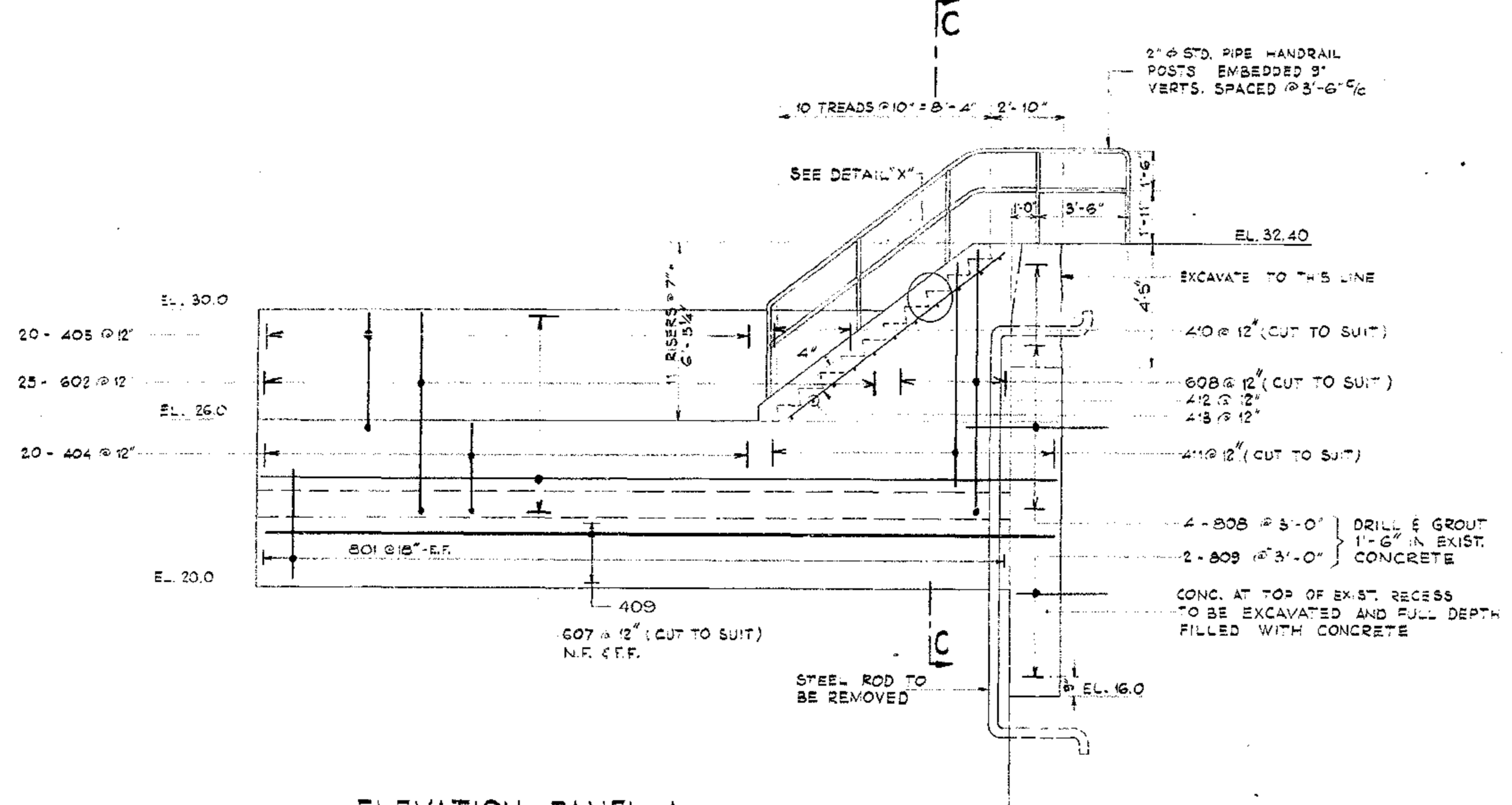
PLAN A-A OF BOTTOM SLAB PANEL B
SCALE 1/4" = 1'-0"



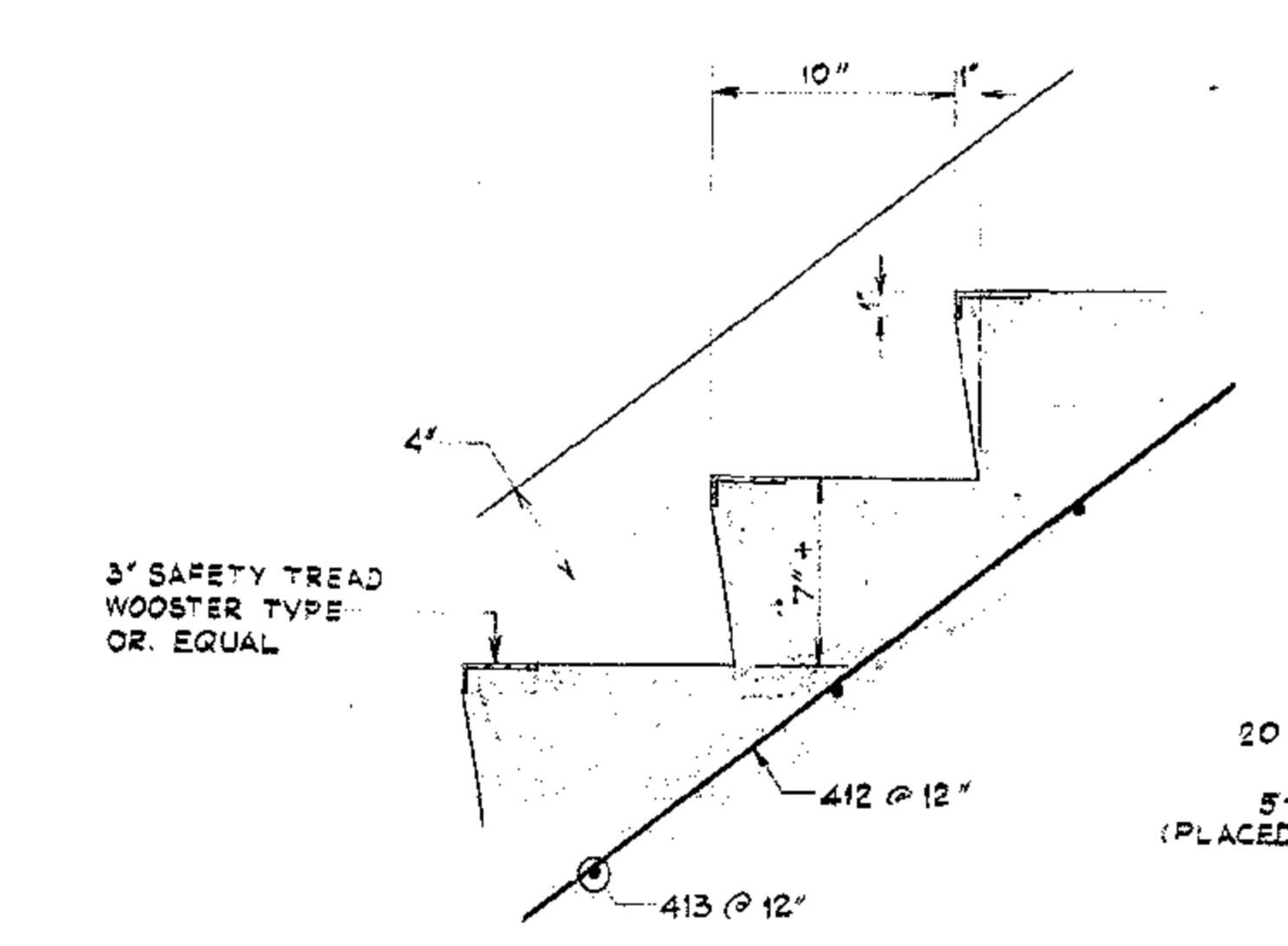
SECTION B-B
SCALE 3/8" = 1'-0"



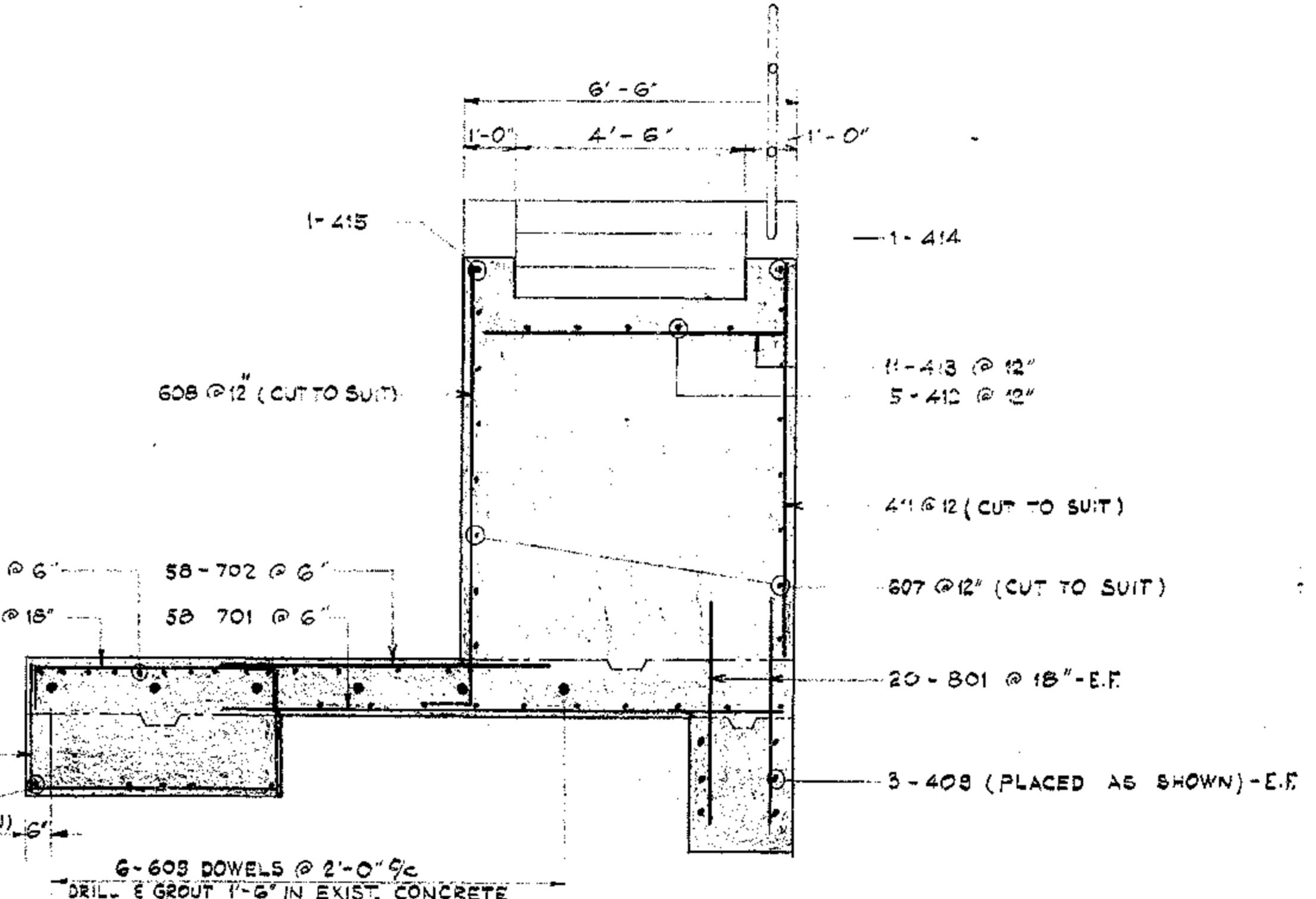
SECTION D-D
SCALE 3/8" = 1'-0"



ELEVATION PANEL A
SCALE 1/4" = 1'-0"

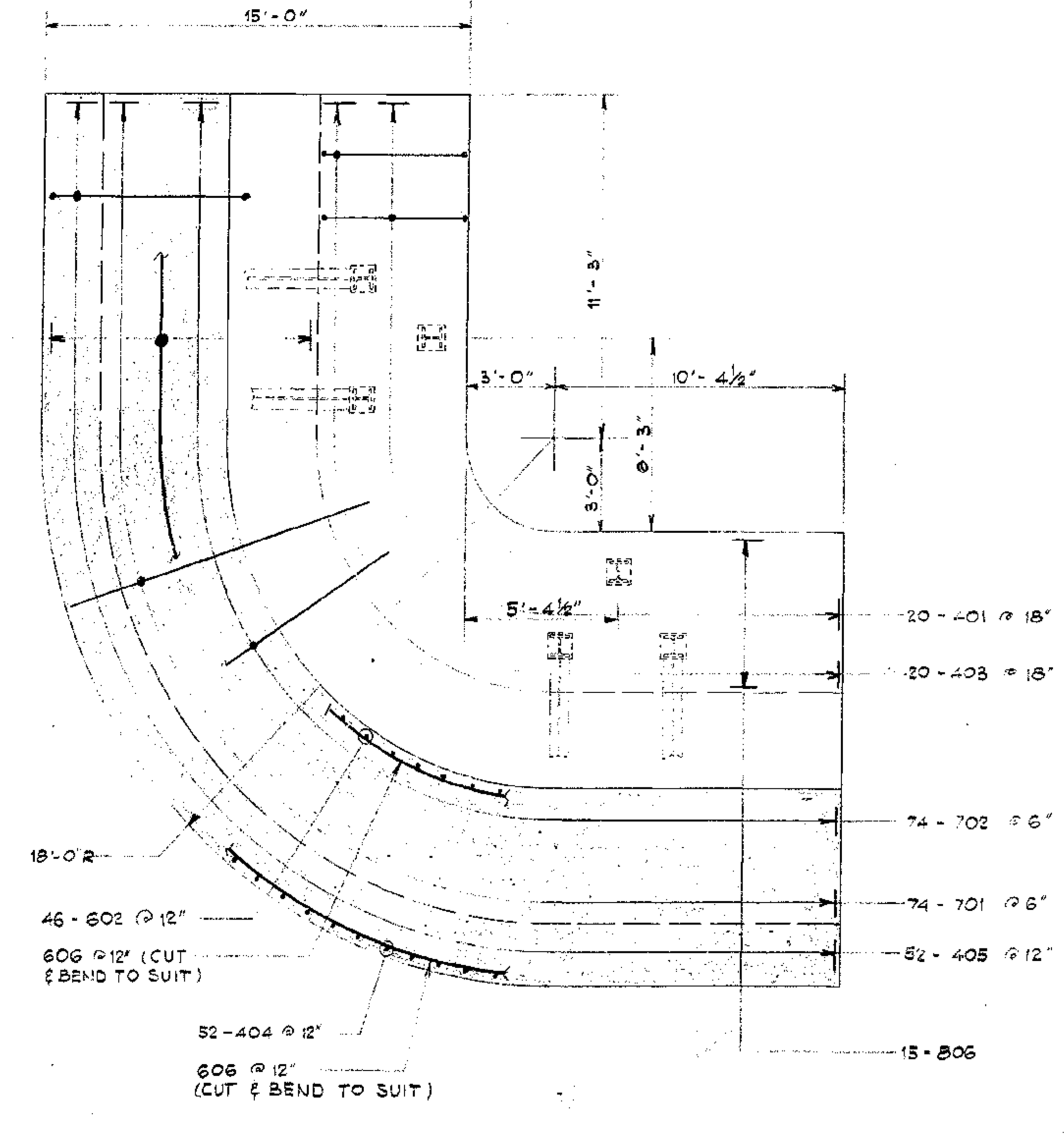


DETAIL "X"
SCALE 1/2" = 1'-0"



SECTION C-C
SCALE 3/8" = 1'-0"

NOTE:- SHEET PILING & BEARING PILES NOT SHOWN



PLAN OF BOTTOM SLAB PANEL C
SCALE 1/4" = 1'-0"

DEPARTMENT OF TRANSPORT
MARINE WORKS
CANALS DIVISION
QUEBEC CANALS
RICHELIEU RIVER - ST. OURS LOCK
UPPER ENTRANCE WALL
DETAILS 2

SCALE: AS SHOWN
DESIGN: H.S.G./C.L.P.
DRAWN: X.S.H.
CHECKED: C.A.
DATE: OCT/67
10-667-103 A

RU-32-104.A.3

MARK	LENGTH	N ^o , REQ D.	DETAILS	REMARKS	MARK	LENGTH	N ^o , REQ D.	DETAILS	REMARKS
401	8'-6"	285		BEARING PILE CAP, BOTTOM ALL PANELS	701	11'-6"	858	STR.	ALL PANELS
402	40'-9"	48	STR.	PANEL B, SHEET PILE CAP	702	6'-6"	858	STR.	ALL PANELS
403	5'-6"	285		BEARING PILE CAP, TOP ALL PANELS					
404	4'-6"	435		N.E. OF WALL, VERT. ALL PANELS	801	4'-0"	554	STR.	DOWELS IN SHEET PILE CAP
405	10'-9"	435		ALL PANELS HOR.	802	40'-9"	40	STR.	PANEL B
406	42'-9"	6	STR.	PANEL D, SHEET PILE CAP, HOR.	803	32'-9"	80	STR.	PANEL B
407	48'-11"	3		PANEL C, SHEET PILE CAP HOR.	804	48'-0"	40	STR.	PANEL B
408	46'-7"	3		PANEL C, SHEET PILE CAP HOR.	805	42'-9"	15	STR.	PANEL D
409	31'-0"	6	STR.	PANEL A, SHEET PILE CAP, HOR.	806	510'	LIN. FT.		PANEL C
410	20'-0"	LIN. FT.	STR. (CUT TO SUIT)	PANEL A	807	26'-2"	15	STR.	PANEL A
411	85'-0"	LIN. FT.	STR. (CUT TO SUIT)	PANEL A	808	5'-0"	4	STR.	DOWELS - PANEL A
412	10'-6"	5	STR.	PANEL A - STAIRS	809	3'-3"	2	STR.	DOWELS - PANEL A
413	6'-0"	11	STR.	PANEL A - STAIRS					
414	10'-0"	1	STR.	TOP OF STAIR CURB					
415	5'-0"	1	STR.	TOP OF STAIR CURB					
601	40'-2"	264	STR.	PANEL B, HOR.					
602	8'-0"	440		BACK OF WALL, VERT.					
603	42'-9"	33	STR.	PANEL D, HOR.					
604	7'-0"	11		PANEL D					
605	3'-0"	5	STR.	PANEL D					
606	1500'	LIN. FT.		PANEL C					
607	1175'	LIN. FT.	STR. (CUT TO SUIT)	PANEL A, HOR.					
608	60	LIN. FT.		PANEL A, VERT.					
609	3'-0"	6	STR.	DOWELS, PANEL A					

DEPARTMENT OF TRANSPORT

MARINE WORKS
CANALS DIVISION
QUEBEC CANALS
RICHELIEU RIVER - ST. OURS LOCK
UPPER ENTRANCE WALL
REINFORCING STEEL TABLE

SCALE: N. T. S. DATE: OCT./67
DESIGN: H.S.G. & C.L.P.
DRAWN: X. SCH.
CHECKED: C.M.
D. D. Allamer, Chief, Canals Division

DATE: REVISIONS: MADE: CH'CK'D:

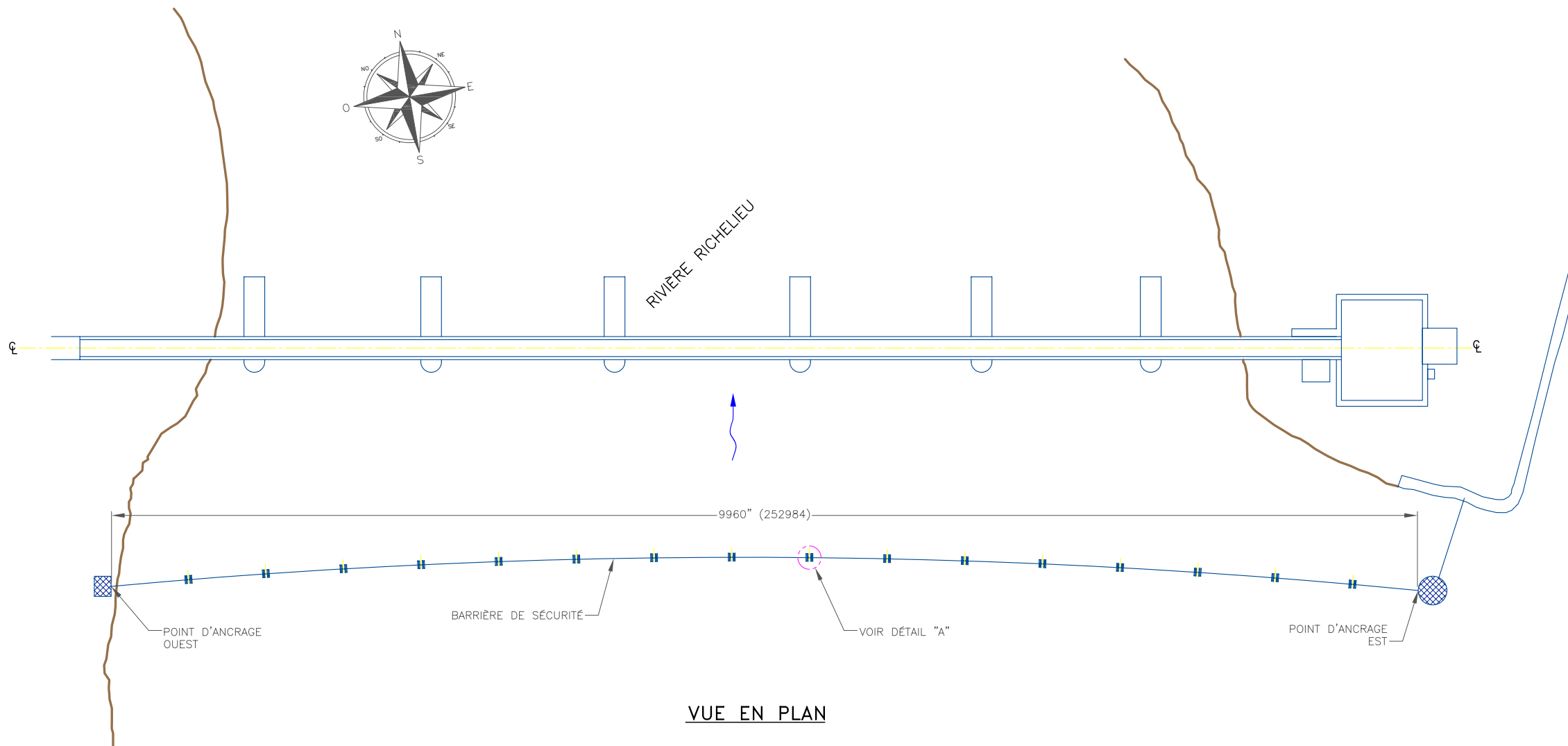
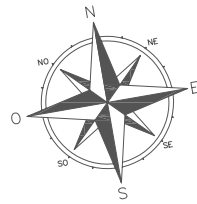
10-667-104 A

RU-23-104A.4

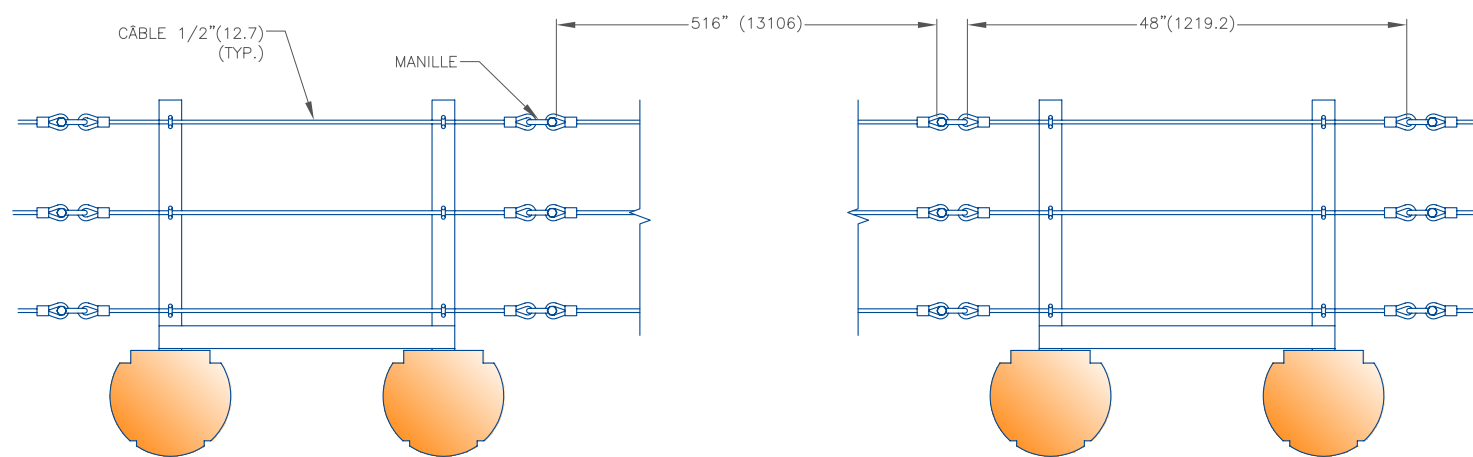
ANNEXE A2

Dessins, photos et procédures d'installation de l'estacade amont existante – SPG Hydro, 2010

Drawings, Photos and Installation Process for the Existing Upstream Safety Boom – SPG Hydro, 2010



VUE EN PLAN



DÉTAIL "A"

		2151, Léonard-de Vinci, suite 101, Ste-Julie, Québec, Canada, J3E 1Z3 Tél.: 450 922-3515, Fax: 922-3510 Internet: www.spghydro.com Courriel: info@spghydro.com	
Client:			
Projet:		FOURNITURE ET INSTALLATION D'UNE BARRIÈRE DE SÉCURITÉ À L'ÉCLUSE DE ST-OURS	
Titre:		PLAN DE LOCALISATION	

NOTES: Ce dessin est une représentation schématisée .

NO. DESSIN	DESSIN DE RÉFÉRENCE	NO.	DATE	RÉVISION	PAR	APP.

Projeté par:		M. Barrette	
Dessiné par:		C. Robitaille dess.	
Véifié par:		M. Barrette	
N. réf.:	08-11362-T-02	V. réf.:	08-0041
Date de relevé:	---	Dessin no.:	08-11362-01
Échelle:	---	Date:	14/01/2010
		Planche:	1 de 1
		Révision:	00



IMPORTANT
Prendre note que les unités de flottaison existantes ne sont pas telles que montrées sur ces photos. Pour plus de stabilité, elles ont été doublées (dos à dos). Ainsi, les flotteurs sont deux fois plus long que montrés sur ces photos.



Float Test BEFORE adding ballast



Float Test AFTER adding ballast

IMPORTANT
Prendre note que les unités de flottaison existantes ne sont pas telles que montrées sur ces photos. Pour plus de stabilité, elles ont été doublées (dos à dos). Ainsi, les flotteurs sont deux fois plus long que montrés sur ces photos.



IMPORTANT

Prendre note que les unités de flottaison existantes ne sont pas telles que montrées sur ces photos. Pour plus de stabilité, elles ont été doublées (dos à dos). Ainsi, les flotteurs sont deux fois plus long que montrés sur ces photos.

Units ready for shipment.



**PARCS CANADA
SERVICE TECHNIQUES**

Procédures
Installation et enlèvement
de la barrière de sécurité
au bief amont du barrage de St-Ours

n° contrat : 08-0041 n. réf. : 09-11362-D

VERSION FINALE

19 MARS 2010

Préparé par :

SPG HYDRO INTERNATIONAL INC.

Consultant en travaux marins et sous-marins
Ingénierie, expertise, environnement, construction, photogrammétrie numérique
2151 Léonard-de Vinci, bureau 101
Sainte-Julie (Québec)
J3E 1Z3
(450) 922-3515, télécopieur: (450) 922-3510
info@spghydro.com



Avant de débiter l'installation ou l'enlèvement de la barrière de sécurité, s'assurer que:

- Les embarcations motorisées sont conformes aux règlements en vigueur s.
- Une embarcation de sauvetage est sur les lieux.
- Chaque conducteur d'embarcation possède les connaissances et les habilités requises pour assumer ses responsabilités de façon sécuritaire.
- Un plan définissant les étapes d'opérations est fait avant le déploiement de la barrière de sécurité flottante.
- Les conducteurs des embarcations ainsi que l'opérateur des vannes du barrage ont un système de communication tout au long de l'intervention.
- Le gilet de sauvetage est porté tout le temps que durent les déplacements sur l'eau ainsi que durant les travaux en rive lorsqu'aucune autre mesure de sécurité ne protège le travailleur contre les chutes à l'eau
- Que toutes autres règles de Transport Canada ainsi que de la CSST sont appliquées.

Durant l'installation et l'enlèvement de la barrière, les vannes du barrage seront totalement et/ou alternativement en position fermées pour sécuriser les opérations de navigation, réduire la tension sur les câbles et les unités flottants.

Le travail doit se faire dans des conditions idéales, c'est-à-dire avec un débit faible (maximum 300 m³/s) et vent pratiquement nul.

Durant l'installation et l'enlèvement faire attention que les câbles ne s'accrochent pas aux palplanches.

Installation de la barrière de sécurité



1. Effectuez la mise à l'eau des unités flottantes le long du mur d'accostage.
 - a) Le côté profilé des flotteurs doit être face au mur d'accostage.
2. Installez un premier câble de nylon pour retenir et faciliter le déplacement des unités flottantes.
3. Déroulez sur le quai les câbles d'acier servant de lien entre les unités flottantes.



4. Installez un câble d'acier au point d'attache inférieur situé sur le côté de chacune des unités flottantes de manière à toutes les relier entre elles à l'aide des manilles prévues à cet effet.
5. Enroulez par la suite l'excédant de câble et les déposer sur les unités flottantes.



6. Déplacez les unités flottantes à l'aide d'une embarcation motorisée.
 - a) Les vannes du côté Est du barrage doivent être fermées afin de minimiser l'influence du mouvement d'eau.
 - b) Afin de conserver la maîtrise de l'embarcation durant cette opération, il est essentiel que le câble de nylon soit attaché au centre de l'axe transversal de l'embarcation.



7. Fixez la première unité flottante au pilier Est à l'aide d'une manille.
 - a) Ne pas oublier de positionner l'avant des unités contre le courant (face contre l'amont)



8. Préalablement au déploiement de la barrière, fixez un second câble de nylon au câble d'acier reliant la dernière unité flottante (côté Ouest).
 - a) Ce câble de nylon sera attaché à l'embarcation afin de permettre la manœuvre de déploiement.
 - b) Aussi, ce dernier aura la propriété de se couper facilement en cas d'urgence.
9. Détachez le premier câble de nylon retenant les unités flottantes entre elles et déployez l'estacade vers l'amont à partir du pilier Est.
 - a) Portez une grande attention à ce que le déploiement s'effectue en condition de fermeture complète des vannes et avec des vents réduit au minimum.
10. Une fois le tout déployé vers l'amont, se déplacer lentement vers le pilier Ouest.



11. Tendre la barrière à l'aide d'un tire-fort ou d'un treuil à partir du pilier Ouest.
12. Fixez les deux autres rangées de câbles à l'aide des manilles.
 - a) À cette étape, seules les vannes côté Est sont ouvertes durant la fixation des deux rangées de câbles du côté Ouest et inversement pour la fixation des rangées de câble du côté Est de la barrière.
 - b) La longueur des câbles de l'extrémité Ouest devra être ajustée avec les serres-câbles prévus à cet effet.



13. L'installation de la barrière de sécurité est terminée.
 - a) L'ouverture complète de toutes les vannes est autorisée si les embarcations motorisées sont en amont de l'estacade.

Enlèvement de la barrière de sécurité



- 1) Débutez le démantèlement de la barrière au pilier Ouest et par le côté amont.
 - a) A cette étape, toutes les vannes du barrage doivent être en position fermée.
- 2) Reprendre la tension aux câbles de la barrière à l'aide d'un tire-fort ou d'un treuil.
- 3) Détachez les trois câbles d'acier à l'extrémité Ouest de la barrière par le démantèlement des manilles.
- 4) Reliez l'extrémité des trois câbles d'acier avec un câble de nylon.
 - a) Ce câble de nylon sera attaché à l'embarcation afin de permettre la manœuvre de déplacement vers l'amont.
 - b) Aussi, ce dernier (câble de nylon) aura la propriété de se couper facilement en cas d'urgence.
 - c) Afin de conserver la maîtrise de l'embarcation durant cette opération, il est essentiel que le câble de nylon soit attaché au centre de l'axe transversal de l'embarcation.



- 5) Procédez au déplacement de la barrière en dirigeant l'embarcation vers l'amont de manière à déplacer la barrière flottante vers le côté Est.



- 6) Déplacez la barrière de sécurité davantage vers l'Est de manière à former le plus grand cercle possible.



- 7) Repliez l'estacade sur elle même une fois que toutes les unités flottantes seront positionnées à l'Est du pilier Est.



- 8) Effectuez un 180 degrés en se dirigeant le long du mur d'accostage à l'endroit où les unités seront retirées de l'eau
- Détachez le câble de nylon relié à l'embarcation motorisée et le rattacher à la rive.
 - Attachez un maximum d'unité flottante l'une à l'autre avec un câble de nylon.



- 9) Démantelez les manilles retenant les câbles à la pile Est et ramenez le reste des unités flottantes le long du mur d'accostage.



- 10) Démantelez les manilles de manière à retirer les câbles reliant les unités flottantes de la barrière.



11) Étendre les câbles d'acier et les enrouler par unité.

12) Retirez les unités flottantes de l'eau et remisez-les à un endroit adéquat.

Listes des équipements

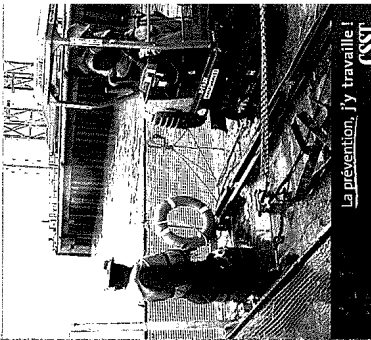
Description	Description	Numéro de pièce	Distributeur	Téléphone
Unité flottant	Worthington	Tuffboom-5 Catamaran	SPG HYDRO	(450) 922-3515
Treuil	Jeamar	GW4400-2	Hercules SLR	(514) 428-5511
Câble	6x 26 ½ x 43'	SA0843.33GT2	Hercules SLR	(514) 428-5511
Câble	6x 26 ½ x 60'	SA0804.33GT1	Hercules SLR	(514) 428-5511
Câble	6x 26 ½ x 52''	SA0804.33GT2	Hercules SLR	(514) 428-5511
Manille	5/8 3 1/4T blue	G213010	Hercules SLR	(514) 428-5511
Serre câble	Crosby ½''	G41408	Hercules SLR	(514) 428-5511
Cosse H.D.	½''	G41408	Hercules SLR	(514) 428-5511

VOUS PLANIFIEZ-DES TRAVAUX SUR DES PLATES-FORMES FLOTTANTES.

VOUS UTILISEZ DES EMBARICATIONS POUR LE TRANSPORT DES TRAVAILLEURS.

VOS TRAVAUX S'EFFECTUENT AU-DESSUS OU À PROXIMITÉ D'UN COURS D'EAU.

PRENEZ TOUS LES MOYENS QU'IL FAUT POUR QUE PERSONNE NE TOMBE À L'EAU!



La prévention, j'y travaille! **CSST**

Bureaux de la CSST

ALBERTA-TERRACONAQUE
Edmonton (416) 243-2437
Calgary (416) 243-2437
Edmonton (416) 243-2437
Edmonton (416) 243-2437
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Québec (418) 648-4342
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SAINT-LAURENT
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Montréal (514) 243-2437
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Val-d'Aulay (418) 648-4342
Val-d'Aulay (418) 648-4342
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Yamaska (418) 648-4342
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QuébecCSST

Transports Canada - Sécurité maritime (Inspection de petits bâtiments)
Montréal (514) 383-3036 Québec (418) 648-4342
2000-1000 (418) 722-3342 Québec (418) 648-4342
Information générale (418) 648-4342
Produit par la Direction de la prévention, inspection de la CSST

Attention!

Mauvais temps en perspective?

Les travaux doivent être interrompus aussitôt que les conditions climatiques rendent dangereux le transport par embarcation.

Visibilité réduite?

Les embarcations doivent être munies de feux de navigation.

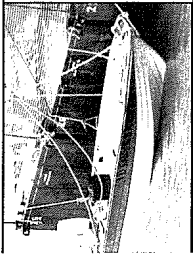
Des travaux en forêt ou en région isolée?

Les embarcations doivent être équipées d'un système de localisation (GPS) ainsi que d'une boussole et d'une carte détaillée des lieux.

Danger d'hypothermie?

Une personne qui tombe dans l'eau froide (moins de 15°C) peut mourir en quelques minutes. Selon le cas, vous pourriez avoir à :

- fournir aux travailleurs un vêtement de protection thermique pendant les déplacements sur l'eau ;
- compter sur au moins un secouriste formé en traitement de l'hypothermie ;
- arrimer une embarcation motorisée et destinée au sauvetage à chacune des embarcations de transport.



Prudence avec les embarcations

- Vérifiez régulièrement l'état des embarcations
- Assurez-vous qu'elles conviennent à la tâche et au plan d'eau
- Respectez l'usage pour lequel elles ont été conçues
- Suivez les recommandations relatives à la capacité de charge

La sécurité des embarcations est des plates-formes de travail

Au cours de la même année, cinq travailleurs ont péri noyés en exécutant des travaux de construction, de foresterie et d'arpentage au-dessus ou à proximité d'un cours d'eau. Pour éviter que de tels accidents se répètent, la CSST vous demande de planifier vos travaux et de vous assurer que vos embarcations et vos plates-formes sont sécuritaires.

Vous devrez préparer une description des travaux, un plan de transport et un plan de sauvetage.

- 1) DESCRIPTION DES TRAVAUX EFFECTUÉS À PROXIMITÉ DE L'EAU :**
- La nature et le type des travaux
 - Le nom du coordonnateur des plans de transport et de sauvetage
 - Le nombre de travailleurs
 - Les horaires de travail
 - Le lieu des travaux
 - Le type de plan d'eau
 - La date de début et de fin des travaux
 - Les moyens prévus pour connaître les conditions climatiques et la température de l'eau
 - Les plates-formes de travail et les embarcations utilisées en précisant leur usage respectif :
 - transport des travailleurs
 - remorquage
 - sauvetage des travailleurs
- 2) PLAN DE TRANSPORT INDIQUANT L'EMPLACEMENT :**
- Des lieux de travail
 - Des aires de repos et de repos
 - Des postes de premiers secours et de premiers soins
 - Des aires d'embarquement des travailleurs
 - Des embarcations destinées au sauvetage des travailleurs
- ET PRÉCISANT :**
- Les noms des conducteurs d'embarcations
 - Les noms des travailleurs connaissant les instructions à suivre en cas d'urgence
 - Le sens et la direction des déplacements des embarcations transportant des travailleurs
- 3) PLAN DE SAUVETAGE LORSQU'IL Y A DES DÉPLACEMENTS SUR L'EAU ET DES RISQUES DE CHUTE DANS L'EAU**
- Ce plan doit comprendre :
- Le type d'embarcation utilisé pour le sauvetage des travailleurs
 - La procédure à suivre pour sauver un travailleur tombé à l'eau
 - Les noms des conducteurs et des secouristes
 - Le code d'appel d'urgence



Le gilet de sauvetage... chacun porte le sien !

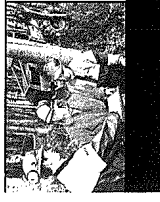
- Tout le temps que durent les déplacements sur l'eau.
- En tout temps lorsque aucune autre mesure de sécurité ne protège le travailleur contre les chutes.

Le gilet de sauvetage doit maintenir la tête de la personne hors de l'eau et lui permettre de flotter sans effort des bras. Il doit être conforme à la norme CMC/CSRS-657-1488 ou, pour quelques exceptions, être accepté par Transports Canada.

Le conducteur d'embarcation

L'employeur doit démontrer que chaque conducteur d'embarcation possède les connaissances et les habiletés requises pour assumer ses responsabilités de façon sécuritaire. La CSST pourrait aussi exiger que le conducteur ait suivi une formation.

- L'employeur doit également s'assurer que le conducteur :
- utilise les installations et les amarrs prévues pour l'embarquement et le débarquement ;
 - transmet aux travailleurs les consignes de sécurité à suivre en cas de sauvetage, de naufrage et d'incendie ;
 - voit à ce que chaque passager porte un gilet de sauvetage et reste assis tout le temps que durent les déplacements sur l'eau.



- La description des travaux, le plan de transport et le plan de sauvetage doivent être :
 - intégrés au programme de prévention
 - mis à la disposition de la CSST
 - affichés sur les lieux de travail
- Tous les travailleurs devront connaître ces informations avant le début des travaux.

ANNEXE A3

Étude géotechnique, île Darvard – WSP, 2015

Geotechnical Study, Darvard Island – WSP, 2015

PARCS CANADA

INSTALLATION DE TENTES oTENTIKS

ÉTUDE GÉOTECHNIQUE

SAINT-OURS (QC)

No projet : 131-21559-10

NOVEMBRE 2015

INSTALLATION DE TENTES OTENTIKS
ÉTUDE GÉOTECHNIQUE
SAINT-OURS (QC)
Parcs Canada

No projet : 131-21559-10
Novembre 2015

Rapport (version finale)

—
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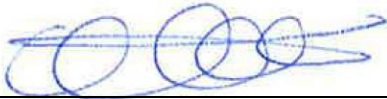


HISTORIQUE DES RÉVISIONS

Version	Date	Description
1	6/11/2015	Version préliminaire
2	25/11/2015	Version finale

SIGNATURES

PRÉPARÉ PAR



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Référence à citer :

WSP 2015. *Installation de tentes oTENTIKS | Étude géotechnique, Saint-Ours (QC)*. Rapport produit pour Parcs Canada. No projet : 131-21559-10. 21 pages et annexes.

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ÉNONCÉ DE RESPONSABILITÉ

Ce rapport a été préparé par WSP Canada Inc. (WSP) uniquement pour Parcs Canada, tous les autres intervenants sont des tierces parties.

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TABLE DES MATIÈRES

1	INTRODUCTION	1
1.1	CONTEXTE ET OBJECTIF	1
2	DESCRIPTION DU SITE ET DES STRUCTURES PROJETÉES	3
3	MÉTHODE DE RECONNAISSANCE.....	5
3.1	LOCALISATION DES INFRASTRUCTURES SOUTERRAINES	5
3.2	FORAGE AVEC PRÉLÈVEMENT D'ÉCHANTILLONS	5
3.3	TUBE MUNI D'UNE CRÉPINE	6
3.4	PROGRAMME DE LABORATOIRE.....	6
4	NATURE ET PROPRIÉTÉS DES SOLS.....	7
4.1	TERRE VÉGÉTALE.....	7
4.2	ENROBÉE BITUMINEUX	7
4.3	REMBLAI	7
4.4	SOL NATUREL	8
4.4.1	DÉPÔT ARGILEUX.....	8
4.4.2	DÉPÔT SABLE SILTEUX	9
5	NAPPE D'EAU SOUTERRAINE	11
6	INDICE PÉTROGRAPHIQUE	13
7	RECOMMANDATIONS GÉOTECHNIQUES.....	15
7.1	PROFONDEUR DE PÉNÉTRATION DU GEL	15
7.2	EXCAVATION ET DRAINAGE	15
7.3	BÂTIMENT DE SERVICE (TOURISTIQUE).....	16
7.3.1	FONDATION	16
7.3.1.1	ÉTAT LIMITE ULTIME (ÉLU).....	16

7.3.1.2	ÉTAT LIMITE DE TENUE EN SERVICE (ÉLTS)	17
7.4	BÂTIMENT DE SERVICE (TECHNIQUE)	17
7.4.1	FONDATION	17
7.4.1.1	MISE EN PLACE DU RADIER	18
7.4.1.2	ÉTATS LIMITES DE TENUE EN SERVICE (ELTS).....	18
7.5	TENTES OTENTIKS	19
7.5.1	FONDACTIONS PROFONDES (PIEUX BATTUS)	19
7.5.1.1	GÉNÉRALITÉS POUR LES PIEUX BATTUS	ERREUR ! SIGNET NON DEFINI.
7.5.1.2	CONCEPTION DES PIEUX	ERREUR ! SIGNET NON DEFINI.
7.6	RECOMMANDATIONS GÉNÉRALES	19
8	RÉFÉRENCES BIBLIOGRAPHIQUES	21

TABLEAUX

TABLEAU 1	COORDONNÉES, ÉLÉVATIONS ET PROFONDEURS DU FORAGE	6
TABLEAU 2	ANALYSES GÉOTECHNIQUES EFFECTUÉES	6
TABLEAU 3	PROFONDEURS (M) DES SOLS AU DROIT DE CHAQUE FORAGE	7
TABLEAU 4	RÉSULTATS DES ESSAIS EN LABORATOIRES POUR DÉTERMINER LES LIMITES D'ATTERBERG	8
TABLEAU 5	RÉSULTATS DES ESSAIS EN LABORATOIRES POUR DÉTERMINER LA RÉSISTANCE AU CISAILLEMENT	8
TABLEAU 6	DONNÉES PIÉZOMÉTRIQUES DE L'EAU SOUTERRAINE	11
TABLEAU 7	PARAMÈTRES GÉOTECHNIQUES – CALCUL À L'ÉTAT LIMITE ULTIME	17

PHOTO

PHOTO 1	PHOTO PRISE LORS DU DÉROULEMENT DE LA CAMPAGNE DE FORAGES	3
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ANNEXES

ANNEXE A	LIMITATIONS
ANNEXE B	PLAN DE LOCALISATION DES FORAGES
ANNEXE C	RAPPORTS DE FORAGES
ANNEXE D	RÉSULTATS DES ESSAIS DE LABORATOIRE

1 INTRODUCTION

1.1 CONTEXTE ET OBJECTIF

Dans le cadre d'un projet d'installation de tentes oTENTIKS et de la construction de deux bâtiments de service, Parcs Canada a mandaté la firme WSP Canada Inc. (WSP) en novembre 2015. Le mandat consistait à réaliser une étude géotechnique qui avait pour objectif l'identification de la nature et des propriétés des dépôts meubles et de la profondeur de la nappe d'eau souterraine. Le tout dans le but d'émettre des recommandations géotechniques concernant le système de fondation à préconiser.

Ce rapport présente, dans l'ordre : une brève description du site et du projet, la méthode de reconnaissance utilisée, la nature et les propriétés physiques et mécaniques des sols en place, les conditions de la nappe d'eau souterraine, ainsi que les recommandations géotechniques s'appliquant au projet.

Le contexte général de l'étude et ses limitations sont décrits à l'Annexe A. À l'Annexe B, le lecteur pourra consulter le plan illustrant l'emplacement des forages. De plus, l'Annexe C présente les rapports de forages et l'Annexe D, les résultats détaillés des essais de laboratoire.

2 DESCRIPTION DU SITE ET DES STRUCTURES PROJETÉES

Le site à l'étude est localisé sur l'île Darvard dans la municipalité de Saint-Ours. Ce lieu historique, nommé canal de Saint-Ours, est la propriété de l'organisme gouvernemental Parcs Canada. Le secteur est dédié aux activités récréotouristiques. Le relief du secteur est plutôt plat et l'élévation moyenne est d'environ 10 m. Un plan montrant l'emplacement du site et des différents forages est inséré à l'Annexe B. Les structures projetées sur le site à l'étude sont des tentes oTENTIKS ainsi que deux bâtiments qui serviront respectivement aux utilisateurs du site et aux services techniques.

Photo 1 Photo prise lors du déroulement de la campagne de forages



3 MÉTHODE DE RECONNAISSANCE

3.1 LOCALISATION DES INFRASTRUCTURES SOUTERRAINES

Préalablement à la réalisation des travaux, une demande de repérage des infrastructures souterraines présentes sous la surface du site à l'étude a été effectuée auprès d'entreprises membres du service Info-Excavation. L'entreprise suivante a été contactée par ce service : Télébec. De plus, la compagnie Promark Télécon s'est présentée sur le site préalablement aux travaux afin de localiser les infrastructures souterraines.

3.2 FORAGE AVEC PRÉLÈVEMENT D'ÉCHANTILLONS

Les travaux de forages ont été réalisés le 14 et 15 octobre 2015. Cinq (5) forages allant de 6 m de profondeur à 7,30 m, identifiés F-01 à F-05, ont été effectués à l'emplacement projeté des futures installations tel que présenté à l'annexe B. Le forage F-01, F-02 et F-04 se trouve à l'emplacement des futures tentes oTENTIKS tandis que les forages F-03 et F-05 sont localisés à l'emplacement projeté des bâtiments de service qui serviront aux visiteurs du site et au personnel technique. De plus, un carottage, identifié F-03A, a été effectué dans les fondations existantes du bâtiment de service localisé au forage F-03.

L'implantation des forages, le prélèvement des échantillons de sols ainsi que la supervision des travaux ont été effectués par un membre du personnel de WSP. Les forages ont été réalisés à l'aide d'une foreuse conventionnelle de marque Diedrich D-90 sur camion opéré par un foreur et un aide-foreur de la compagnie Forages Goulet Inc. à titre de sous-traitant de WSP.

Les forages ont été avancés dans les dépôts meubles par rotation et par lavage d'un train de tubages de calibre NW (diamètre extérieur : 89 mm). Lors de l'exécution des forages, des échantillons de sol ont été récupérés en continu ou à intervalle régulier (0,76 m), en utilisant une cuillère fendue standard de calibre B (diamètre extérieur de 51 mm et une longueur de 610 mm). L'échantillonneur à la cuillère fendue permet d'obtenir des informations précises sur la composition des couches de sol traversées ainsi que de leurs niveaux de compacité, en obtenant des valeurs de pénétration appelées indices « N », correspondant à l'essai de pénétration standard « SPT » de la norme ASTM D1586. Dans ce cas, les échantillons sont remaniés. De plus, lors de la présence de dépôt de sols cohésifs, des échantillons intacts ont été prélevés à l'aide de tubes minces pour déterminer la résistance au cisaillement du dépôt. Finalement, suite à la fin de l'échantillonnage, un test de pénétration dynamique a été effectué au droit des forages F-01, F-02 et F-05 afin de déterminer la profondeur du socle rocheux probable.

Les coordonnées et les profondeurs atteintes dans les sondages sont indiquées au Tableau 1 suivant. Les coordonnées des forages ont été relevées par WSP le 13 octobre 2015.

Tableau 1 Coordonnées, élévations et profondeurs du forage

SONDAGES	NORD (MTM NAD83)	EST (MTM NAD83)	ÉLÉVATIONS (m)	PROFONDEURS ÉCHANTILLONAGE ATTEINTE (m)	PROFONDEURS DU TEST DE PÉNÉTRATION DYNAMIQUE (m)
F-01	5080674,593	332155,148	8,07	5,95	15,80
F-02	5080609,963	332142,779	7,76	6,10	12,78
F-03	5080566,333	332205,753	10,66	6,10	-
F-04	5080509,499	332192,739	11,04	6,10	-
F-05	5080433,785	332184,592	10,22	7,30	7,80

3.3 TUBE MUNI D'UNE CRÉPINE

Suite à l'échantillonnage des sols, un tube PVC a été installé au fond du trou des forages F-03 et F-05 afin de permettre la lecture du niveau de l'eau souterraine.

3.4 PROGRAMME DE LABORATOIRE

L'ensemble des échantillons a été soumis à une inspection visuelle par le personnel de WSP. Le Tableau 2 ci-dessous indique les échantillons sélectionnés ainsi que les analyses effectuées. Les analyses de résistance au cisaillement et de limites d'Atterberg ont été réalisées aux laboratoires de WSP tandis que l'échantillon 03A a été envoyé au laboratoire exp. afin de déterminer l'indice pétrographique.

Tableau 2 Analyses géotechniques effectuées

FORAGES ET ÉCHANTILLON (PROFONDEUR (m))	ANALYSES EFFECTUÉES
F-04 / TS-07 (3,66 à 4,27m)	Résistance au cisaillement
F-03 / TS-04 (1,83 à 2,44m)	Limites d'Atterberg et résistance au cisaillement
F-03 / TS-08 (4,27 à 4,88m)	Résistance au cisaillement
F-04 / CF-03 (1,22 à 1,83m)	Limites d'Atterberg
Échantillon 03A	Indice pétrographique

4 NATURE ET PROPRIÉTÉS DES SOLS

Les forages F-01 à F-05 ont permis de déterminer la stratigraphie en place. L'ensemble des unités stratigraphiques est décrit dans cette section. Un résumé de la stratigraphie est présenté dans le Tableau 3 ci-dessous. La description détaillée de la stratigraphie est présentée sur le rapport de forage à l'Annexe C.

Tableau 3 Profondeurs (m) des sols au droit de chaque forage

FORAGE	TERRE VÉGÉTALE	ENROBÉE BITUMINEUX	REMBLAI	SOL NATUREL	
				DÉPÔT D'ARGILE	SABLE SILTEUX
F-01	0,00 à 0,05	-	0,05 à 1,22	1,22 à 5,95	-
F-02	-	0,00 à 0,04	0,04 à 2,44	2,44 à 5,49	5,49 à 6,10
F-03	0,00 à 0,05	-	0,05 à 1,22	1,22 à 6,10	-
F-04	0,00 à 0,10	-	0,10 à 0,61	0,61 à 4,94	-
F-05	0,00 à 0,03	-	0,03 à 6,10	6,10 à 7,30	-

- : couche non interceptée

4.1 TERRE VÉGÉTALE

À la surface des forages F-01 et F-03 à F-05, une couche de terre végétale a été rencontrée sur une épaisseur variant 50 mm à 100 mm.

4.2 ENROBÉE BITUMINEUX

À la surface du forage F-02, une couche d'enrobée bitumineux a été rencontrée sur une épaisseur de 40 mm.

4.3 REMBLAI

Dans tous les forages, sous la terre végétale ou l'enrobée bitumineux, des sols de remblai ont été rencontrés jusqu'à une profondeur variant de 0,61 à 6,10 m. Pour les forages F-01, F-03 et F-04, un seul type de remblai a été intercepté. La composition de cette couche variait de silt, un peu de sable à sableux à sable silteux avec des proportions variables inférieures à 20 % de gravier. Des traces de débris (briques, bois) et de matières organiques (racines) étaient présentes dans cette couche de remblai.

Pour le forage F-02, étant donné la présence d'une couche de surface d'enrobée bitumineux, une sous-fondation a été interceptée sur une profondeur de 0,04 à 1,83 m. La composition de cette sous-fondation variait de sable graveleux à sable et gravier. De plus, la présence d'un bloc d'environ 600 mm de diamètre a été notée. Par la suite, un changement dans la nature du remblai a été observé. Cette nouvelle couche rencontrée jusqu'à une profondeur de 2,44 m était composée de sable silteux avec un

peu de gravier. Au forage F-02, de la matière organique composée de racines et de bois a été retrouvée jusqu'au terrain naturel.

Finalement, le remblai au forage F-05 s'étendait sur une profondeur de 0,03 à 6,10 m. La première couche rencontrée sur une épaisseur de 0,03 à 0,61 était composée de silt avec des traces de sable et de gravier. Par la suite, jusqu'au terrain naturel, une couche de remblai composée de sable avec un peu de gravier à graveleux a été interceptée. Au forage F-05, des briques et de la matière organique ont été retrouvées jusqu'à une profondeur 1,22 m. Le remblai à cet endroit est plutôt homogène et la valeur moyenne des indices « N » est d'environ 20; le sol en place est donc compact.

4.4 SOL NATUREL

4.4.1 DÉPÔT ARGILEUX

L'ensemble des forages réalisés a intercepté un dépôt de sols cohésifs, composé de silt et un peu d'argile à argile silteuse, directement sous les sols de remblai.

Deux échantillons ont été soumis à des essais en laboratoire afin de déterminer les limites d'Atterberg. Le Tableau 4 ci-dessous présente les résultats des essais réalisés en laboratoire sur des échantillons jugés représentatifs.

Tableau 4 Résultats des essais en laboratoires pour déterminer les limites d'Atterberg

FORAGE	ÉCHANTILLON	PROFONDEUR (M)	TENEUR EN EAU w	LIMITE LIQUIDE w_{Lc}	LIMITE PLASTIQUE w_p	INDICE DE PLASTICITÉ I_p	CLASSIFICATION UNIFIÉE (ASTM D-2487)
F-03	TS-04	1,83 à 2,44	53,9	63	36	28	MH
F-04	CF-03	1,22 à 1,83	62	63	41	22	MH

De plus, trois échantillons ont été soumis à des essais en laboratoire afin de déterminer la résistance au cisaillement. Le Tableau 5 ci-dessous présente les résultats des essais réalisés en laboratoire pour les échantillons jugés représentatifs.

Tableau 5 Résultats des essais en laboratoires pour déterminer la résistance au cisaillement

FORAGE	ÉCHANTILLON	PROFONDEUR (M)	ÉTAT INTACT c_u	ÉTAT REMANIER c_{ur}	SENSIBILITÉ S_r	TENEUR EN EAU w
F-03	TS-04	1,83 à 2,44	46	2	28	53,9
F-03	TS-08	4,27 à 4,88	46	10	5	53,6
F-04	TS-07	3,66 à 4,27	85	12	7	69,7

L'essai au cône suédois a permis de déterminer la résistance au cisaillement des échantillons intacts envoyés au laboratoire. Les valeurs de c_u obtenues sont de 46 kPa pour le forage F-03 tandis qu'une

valeur de 85 kPa a été observée au forage F-04. De plus, des essais de résistance au cisaillement du sol à l'état remanié (c_{ur}) ont été effectués. Des valeurs variant de 2 kPa à 10 kPa ont été obtenues au forage F-03 tandis qu'une valeur de 12 kPa a été observée au forage F-04. Les valeurs de sensibilité ont donc pu être déterminées. Au forage F-03, on retrouve une argile ferme avec une sensibilité variant de forte à argile sensible tandis qu'au forage F-04, on note la présence d'un dépôt argileux raide avec une sensibilité forte.

4.4.2 DÉPÔT SABLE SILTEUX

Dans le forage F-02, sous l'horizon de sol fin, un dépôt de sable silteux a été rencontré jusqu'à une profondeur de 6,10 m, soit la fin de l'échantillonnage. Dans ce dépôt, l'indice « N » moyen est de 7 ce qui indique une compacité lâche.

5 NAPPE D'EAU SOUTERRAINE

La profondeur du sommet de la nappe d'eau souterraine a été mesurée le 29 octobre 2015, à l'endroit de chacun des tubes ouverts aménagés sur le terrain.

Les niveaux d'eau mesurés se situent entre 5,35 et 5,42 mètres sous la surface du sol.

Tableau 6 Données piézométriques de l'eau souterraine

FORAGE	NIVEAU D'EAU PAR RAPPORT AU SOL (m)	ÉLÉVATION PAR RAPPORT AU NIVEAU MOYEN DE LA MER (m)
F-03	5,42	5,24
F-05	5,35	4,87

Il convient de mentionner que ce relevé n'est représentatif que de la période à laquelle il a été effectué. En effet, la nappe d'eau souterraine peut fluctuer selon les saisons, étant habituellement basse durant l'hiver et l'été, et haute au printemps et à l'automne.

6 INDICE PÉTROGRAPHIQUE

Lors des travaux, le carottage de la dalle de fondation du bâtiment de service localisé près du forage F-03 a été effectué. Nommé F-03A, ce carottage avait comme objectif de prélever un échantillon de fondation granulaire sous la dalle afin de mesurer l'indice pétrographique de celle-ci. Cette donnée permet de déterminer la probabilité de gonflement du remblai qui pourrait éventuellement faire fissurer la dalle en place. Le résultat de l'analyse présente un indice pétrographique de 12. Cet indice signifie une probabilité de gonflement faible.

7 RECOMMANDATIONS GÉOTECHNIQUES

Selon les informations disponibles, le projet prévoit l'installation de tentes oTENTIKS au droit des forages F-01, F-02 et F-05. À l'emplacement du forage F-03, un bâtiment de service servant aux utilisateurs du site sera reconstruit, si nécessaire, tandis que le forage F-05 se situe à l'emplacement projeté du nouveau bâtiment de service servant au soutien technique. Cette section présente les recommandations géotechniques en tenant compte de la stratigraphie rencontrée au droit de ces forages.

7.1 PROFONDEUR DE PÉNÉTRATION DU GEL

La méthode préconisée dans le Manuel canadien d'ingénierie des fondations 4^e Édition (2013), a été utilisée ici pour estimer la profondeur de pénétration du gel dans la région de Saint-Ours. Cette méthode fait intervenir l'équation de Bergrenn modifiée suivante, décrite par Aldrich (1956), Sanger (1963) et Johnston (1981) :

$$X = \lambda \frac{\sqrt{2k_f I_s}}{I_s}$$

Avec :

X = profondeur de pénétration du gel

I_s = indice de gel en surface

k_f = conductivité thermique du sol gelé

L_s = chaleur latente volumique du sol

λ = coefficient sans unité

Selon les normales climatiques fournies par le gouvernement du Canada, l'indice de gel en surface pour la région de Saint-Ours est de 1185 °C-jours. Nous sommes d'avis que les installations soient protégées des effets du gel sous réserve que les bases soient installées à une profondeur supérieure ou égale à 1,70 m sous le niveau fini du terrain.

7.2 EXCAVATION ET DRAINAGE

Nous sommes d'avis que les excavations requises pour rejoindre le niveau d'implantation des fondations peuvent se faire en tranchées ouvertes. Comme il s'agit de pentes temporaires, l'entrepreneur est responsable de leur stabilité ainsi que de la sécurité des travailleurs, de l'ouvrage à construire et des structures avoisinantes quand cette sécurité dépend de la stabilité des pentes temporaires.

Les excavations doivent être réalisées en respectant les exigences de la CSST en la matière. Si des excavations sans soutènement des terres restent ouvertes pour des périodes prolongées, il est recommandé que des inspections quotidiennes soient effectuées par un personnel spécialisé en géotechnique afin de déceler les risques de glissement et de déterminer les mesures à prendre pour corriger toute anomalie.

Il est recommandé de ne pas stationner les véhicules lourds en crête du talus à une distance inférieure à la profondeur des excavations. Il est également recommandé d'éviter la circulation des véhicules en crête des excavations, et ce, à l'intérieur d'une distance inférieure à la profondeur des excavations afin de minimiser les vibrations.

Il sera aussi important de s'assurer de garder une distance au moins égale à la profondeur de l'excavation entre le sommet du talus et la base des tas de matériaux entreposés au chantier. Cette condition doit être respectée en tout temps à moins que des études particulières ne soient effectuées pour chaque cas spécifique.

Pour assurer la stabilité des pentes, l'entrepreneur doit excaver les parois à des inclinaisons permettant leur stabilité durant toute la durée des travaux de chantier.

Le niveau de l'eau souterraine est retrouvé à environ 5,38 m du niveau du sol. Il est donc peu probable que lors des travaux de construction le niveau de l'eau souterraine soit atteint. Par contre, des eaux peuvent provenir de la surface (pluie, ruissellement). Ainsi, un système de pompage adéquat et efficace devra être utilisé si nécessaire. L'eau devra être évacuée au fur et à mesure de son infiltration dans les excavations dans le but de réaliser les travaux dans un environnement sec.

7.3 BÂTIMENT DE SERVICE (TOURISTIQUE)

7.3.1 FONDATION

Un bâtiment de service existant est présentement localisé près du forage F-03. Dans le cadre de la reconstruction de ce bâtiment, une fondation conventionnelle reposant sur le dépôt argileux peut être utilisée.

Les recommandations pour les fondations sont fournies dans cette section et sont données conformément aux directives du « Code national du bâtiment, 2005 » (CNB 2005). La sous-section 4.1.3 du CNB exige que le calcul des fondations soit réalisé selon la méthode aux états limites.

Les états limites demandés dans le CNB, ainsi que ceux calculés dans le cadre de ce site, sont les suivants :

- l'état limite ultime (ÉLU);
- l'état limite de tenue en service (ÉLTS).

L'état limite ultime porte principalement sur les mécanismes d'effondrement de la structure et porte donc sur la sécurité, tandis que l'état limite de tenue en service correspond aux mécanismes qui limitent ou empêchent l'usage prévu de la structure, comme, par exemple, les tassements totaux et différentiels.

7.3.1.1 ÉTAT LIMITE ULTIME (ÉLU)

La résistance géotechnique à l'état limite ultime est calculée à partir de l'équation suivante :

$$q_u = c \cdot N_c \cdot S_c \cdot d_c + q' \cdot N_q \cdot S_q \cdot d_q + \frac{1}{2} \cdot \gamma \cdot B \cdot N_\gamma \cdot S_\gamma \cdot d_\gamma$$

Les paramètres géotechniques présentés au Tableau 7 peuvent être utilisés aux fins de calcul à l'état limite ultime pour des fondations reposant sur les unités indiquées à même le tableau.

Tableau 7 Paramètres géotechniques – Calcul à l'état limite ultime

PARAMÈTRES	DÉPÔT D'ARGILE SILTEUSE
Poids unitaire effectif, γ' (kN/m ³)	17
Angle effectif de frottement interne, Φ' (°)	0
Pression effective des terres au niveau de la fondation, q' (kPa)	17
Cohésion (c_u)	45
Coefficient de portance pour la cohésion, N_c	5,1
Coefficient de portance pour la portance des terres, N_q	1
Coefficient de portance pour le poids du sol, N_γ	0

Donc, à partir de ces données, en considérant les contraintes de consolidation de l'argile à ne pas excéder pour une charge non excentrée, la valeur d'ÉLU pouvant être utilisée pour des semelles conventionnelles de 1,5 m de largeur et reposant à 1,7 m de profondeur sur le dépôt argileux **est de 120 kPa**.

7.3.1.2 ÉTAT LIMITE DE TENUE EN SERVICE (ÉLTS)

Toujours en tenant compte que l'assise des semelles soit sur le dépôt d'argile silteuse la valeur de pression de tenue en service limite pouvant être appliquée est de 100 kPa pour une semelle n'excédant pas 1,5 m de largeur.

7.3.2 DALLE SUR SOL

Dans ce cas, une dalle sur sol conventionnel peut être utilisée. Cette dernière devra reposer sur un remblai contrôlé construit conformément aux recommandations de la section 6.3.1 du présent rapport.

Par contre, quel que soit le matériau utilisé pour le remblayage, nous recommandons de placer immédiatement sous la dalle au sol un coussin de 100 mm d'épaisseur de pierre nette ou de gravier concassé. La proportion de particules passant le tamis 4 mm doit être inférieure à 10 %. Ce matériau doit être mis en place à 95 % de la valeur maximale de la densité sèche mesurée en laboratoire, lors d'un essai à énergie de compactage modifiée (Proctor modifié).

Les matériaux utilisés pour le remblayage ne doivent pas contenir de shale ou de matériaux argileux, sujets aux réactions d'oxydation pyritique, et doivent être certifiés « DB » selon les exigences de la Norme NQ 2560-510.

7.4 BÂTIMENT DE SERVICE (TECHNIQUE)

7.4.1 FONDATION

Le bâtiment de service qui sera dédié aux services techniques de Parcs Canada sera localisé au droit du forage F-05. À cet endroit, on retrouve un remblai homogène sur une profondeur de 6,10 m. La valeur moyenne des indices « N » est d'environ 20, le sol en place est donc compact. Pour cette raison, il est recommandé d'utiliser une fondation de type radier.

Avec les informations disponibles, le bâtiment de service a été évalué à une dimension de 7 x 7 m. De plus, étant donné que la charge du bâtiment n'est pas connue, un tassement maximal de 50 mm sera retenu comme critère de conception.

7.4.1.1 MISE EN PLACE DU RADIER

Pour la région de Saint-Ours, les sols d'infrastructure doivent être protégés du gel au moyen d'une couverture de sol équivalente à 1,7 m d'épaisseur. À l'emplacement du radier, les matériaux en place étant gélifs, ils devront donc être excavés et remplacés par un remblai contrôlé non gélif. La construction du remblai contrôlé devra être effectuée de la façon suivante :

- Excaver tous les sols de remblai en place jusqu'à une profondeur de 1,7 m.
- Procéder à une épreuve de roulage de la surface ainsi exposée, afin de vérifier la présence de zone molle et flexible. Excaver les zones molles et flexibles puis les remblayer au moyen de matériaux granulaires bien compactés.
- Remblayer l'emprise de la base au moyen de matériaux granulaires non gélifs, compactés en couche de 300 mm à la fois, jusqu'à une densité équivalente à 95% du Proctor modifié;
- Prévoir la mise en place d'une couche de 150 mm de pierre concassée compactée à 95 % du Proctor modifié immédiatement sous le radier. Ces matériaux devront être certifiés -matériaux DB- selon la méthodologie de caractérisation du potentiel de gonflement des matériaux granulaires.

7.4.1.2 ÉTATS LIMITES DE TENUE EN SERVICE (ELTS)

La fondation sur radier consiste en une dalle de béton armé de grande dimension sur laquelle reposent les charges de la structure. Le radier répartit ainsi la charge de la structure via l'ensemble de sa surface.

La réaction géotechnique aux états limites de tenue en service est donc représentée à l'aide d'un paramètre représentant l'interaction entre les sols en place et la structure prévue, le module de réaction k_s , évalué à l'aide de l'équation suivante :

$$k_s = \frac{q}{\Delta h} \quad \text{où} \quad \Delta h = q \times B' \times \frac{1-\mu^2}{E_s} \times m \times I_s \times I_f$$

q est la charge appliquée sur le radier, engendrant un tassement Δh . Étant donné qu'aucune charge n'a été fournie par le concepteur, on considère un tassement maximal autorisé de 50 mm.

où :

B : représente la largeur du radier égale à 7 m

B' : $B/2$

μ : coefficient de poisson : 0,3

E_s : le module de déformation élastique : 31,2 MPa sur le remblai contrôlé

m : nombre de coins contribuant à l'application de la charge, soit $m = 1$ près d'un coin du radier, et $m = 4$ au centre du radier

I_s et I_f sont des facteurs de forme dépendant de la géométrie du radier ainsi que de sa profondeur d'encastrement. Il est recommandé de se référer aux équations 5-16a et 5-16b, au tableau 5-2 et à la figure 5-7 présentés dans l'ouvrage de J.E. Bowles « *Foundation Analysis and Design* », 5^{ème} édition

datée de 1988, pour évaluer la valeur de ces paramètres. À l'aide des données disponibles (largeur du radier de 7 m, longueur du radier de 7 m et la profondeur du radier de 0 m) et celles obtenues lors de nos investigations géotechniques, on calcule les valeurs de I_s et I_f .

Basé sur l'ensemble des données, un module de réaction maximale de 19,3 MPa/m est recommandé. Le tassement maximal autorisé de 50 mm est provoqué par cette charge. Cette valeur de tassement présuppose en outre que les surfaces d'assise au niveau des fondations seront libres de toute boue et de tout sol remanié avant de procéder au bétonnage des fondations.

7.5 TENTES oTENTIKS

7.5.1 FONDATIONS PROFONDES

Selon les informations disponibles les fondations prévues pour les tentes oTENTIKS sont des pieux visés. Les tableaux qui suivent donnent les paramètres géotechniques à utiliser pour la conception de ces derniers

Tableau 1 : Paramètres géotechniques pour la conception des pieux

TYPE DE SOL	POIDS VOLUMIQUE (γ) [kN/m ³]	POIDS VOLUMIQUE DÉJAUGÉ (γ') [kN/m ³]
Remblai granulaire : Sable et silt	20	10
Dépôt argileux	16	6

Tableau 2 : Paramètres géotechniques pour la conception des pieux (2)

PARAMÈTRES	VALEUR RECOMMANDÉE
Paramètre β	
Remblai granulaire : Sable et silt	0,5
Dépôt argileux	0,3
Paramètre N_t	
Dépôt argileux	20
Dépôt dense sous-jacent au dépôt argileux	100

7.6 RECOMMANDATIONS GÉNÉRALES

Lors des travaux de construction, un inspecteur en géotechnique devra être sur place à des fins de contrôle de qualité des matériaux de construction et afin de vérifier l'état du fond des excavations avant l'installation des structures projetées.

8 RÉFÉRENCES BIBLIOGRAPHIQUES

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- SOCIÉTÉ CANADIENNE DE GÉOTECHNIQUE. 2013. Manuel canadien d'ingénierie des fondations. 4e édition. BiTech Publishers, Richmond, B.C., 476 pages.

Annexe A

LIMITATIONS

LIMITES ET CONDITIONS GÉNÉRALES – ÉTUDE GÉOTECHNIQUE

Utilisation du rapport

Les données factuelles, les interprétations et les recommandations contenues dans ce rapport se rapportent à un projet spécifique tel que décrit dans ledit rapport et ne s'appliquent à aucun autre projet ni à aucun autre site. Si le projet est modifié du point de vue de la conception, de l'emplacement ou de l'élévation ou encore, si le projet n'est pas amorcé dans les dix-huit mois suivant la date d'émission du rapport, WSP devra être consultée de façon à réviser la validité des recommandations données dans le présent rapport.

Les recommandations données dans ce rapport ne servent qu'à guider l'ingénieur concepteur. Les entrepreneurs soumissionnaires ou exécutant les travaux devront compter sur leurs propres interprétations des résultats factuels des sondages pour déterminer de quelle manière les conditions géotechniques, hydrogéologiques et géologiques peuvent affecter leurs travaux.

Pour conserver l'intégrité de ce rapport et permettre son interprétation avec pertinence, aucune donnée, valeur ou résultat ne peut en être partiellement retiré. Le présent rapport ne doit être utilisé qu'aux fins pour lesquelles il a été préparé.

Suivi de l'étude et des travaux

Certains ou tous les détails de conception et de construction peuvent ne pas être connus au moment de la parution du rapport de WSP. Il est donc essentiel que les services de WSP soient retenus lors de l'étape finale de conception pour réviser les dessins de conception et les devis se rapportant aux fondations, aux terrassements, aux ouvrages de retenue des terres et au drainage. Cette révision sert à vérifier si la conception corrobore les données et les recommandations géotechniques du rapport de WSP.

Il est recommandé que les services de WSP soient retenus pendant la construction, d'abord pour vérifier et confirmer que les conditions géotechniques, hydrogéologiques et géologiques présentes sur l'ensemble du chantier ne diffèrent pas de celles indiquées dans le rapport de WSP. Ensuite, il est essentiel de certifier que les travaux de construction n'ont pas d'effets défavorables sur les recommandations du rapport.

Conditions des sols et du roc

Les descriptions des sols et du roc inscrites dans ce rapport proviennent de méthodes de classification et d'identification communément acceptées et utilisées en pratique géotechnique. La classification et l'identification des sols et du roc nécessitent un jugement d'un ingénieur de WSP, qui ne garantit pas que les descriptions soient exactes.

Cependant, WSP applique une description convenant à la nomenclature communément utilisée en pratique géotechnique.

Les conditions des sols et du roc décrites dans ce rapport sont celles observées au moment de l'étude. À moins d'indication contraire, ces conditions représentent les fondements qui ont amené à établir les recommandations du rapport. Les conditions des sols et du roc peuvent cependant être sensiblement modifiées par les travaux de construction (circulation d'équipements, excavation, fonçage de pieux, dynamitage, etc.) sur le site ou sur les sites voisins. Une excavation peut exposer les sols à des

changements de propriétés provoqués par l'humidité, le séchage ou le gel. Sauf indication contraire, les sols et le roc doivent être protégés contre l'effet dommageable de ces changements ou du remaniement pendant la construction.

Rapports de forage et interprétation des conditions observées

Les dépôts meubles et le massif rocheux sont de nature et de propriété variables sur une plus ou moins grande superficie et aussi en profondeur. Les rapports de forages ne fournissent que des conditions approximatives et ponctuelles de ces formations géologiques à l'emplacement des forages et des sondages. Les contacts entre les différentes couches indiquées sur les rapports peuvent être difficiles à distinguer. En effet, la nature des sols peut changer progressivement avec la profondeur, de sorte que le contact entre deux couches peut être imprécis et correspondre plutôt à une zone de transition. La précision de la stratigraphie rencontrée dépend de la méthode de forage, de la fréquence et de la méthode d'échantillonnage puis de l'homogénéité des sols rencontrés. L'espacement entre les forages, la fréquence d'échantillonnage et le type de forage dépendent des considérations budgétaires et des délais d'exécution, tous deux établis avant le début des travaux.

Les conditions géotechniques, hydrogéologiques et géologiques entre les emplacements des forages font l'objet d'une interprétation par interpolation ou encore, elles dépendent du jugement de l'ingénieur géotechnicien. En réalité, la stratigraphie peut varier sensiblement, de sorte que l'interprétation des résultats de l'étude doit être faite avec précaution par le lecteur du rapport.

Les niveaux de l'eau souterraine indiqués dans ce rapport sont uniquement ceux observés à l'endroit et à la date des relevés, tels que présentés dans le rapport. Ces conditions peuvent varier selon les saisons ou à la suite de travaux de construction sur le site ou sur les sites voisins.

Changement des conditions observées

Lorsque les conditions géotechniques, hydrogéologiques ou géologiques rencontrées sur le site diffèrent de celles indiquées au rapport, soit à cause de la nature hétérogène des sols et du roc ou encore, parce que des changements sont survenus à la suite de travaux de construction (ou pour toute autre raison), le client doit, comme condition d'utilisation du rapport, prévenir WSP du changement des conditions et fournir à WSP l'opportunité de réviser les recommandations émises dans ce rapport. Reconnaître un changement des conditions des sols et du roc requiert une certaine expérience; il est donc recommandé qu'un ingénieur géotechnicien expérimenté soit dépêché sur le site pour prendre position sur les changements des conditions rencontrées.

Drainage

Le drainage de l'eau souterraine est souvent requis aussi bien pour des ouvrages temporaires que pour des ouvrages permanents. La conception ou l'exécution impropre d'un système de drainage peut entraîner de sérieuses conséquences. WSP ne peut en aucun cas endosser la responsabilité des dommages causés par un système inadéquat de drainage, à moins que WSP n'ait été spécifiquement impliquée à la fois dans la conception détaillée et le suivi continu au chantier, lors de la construction du système de drainage.


Annexe B

PLAN DE LOCALISATION DES FORAGES





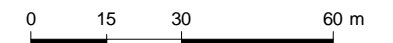
Fichier : 131_21559_10_ECAB_locSondages_151020.mxd

SAINT-OURS

 Limite municipale

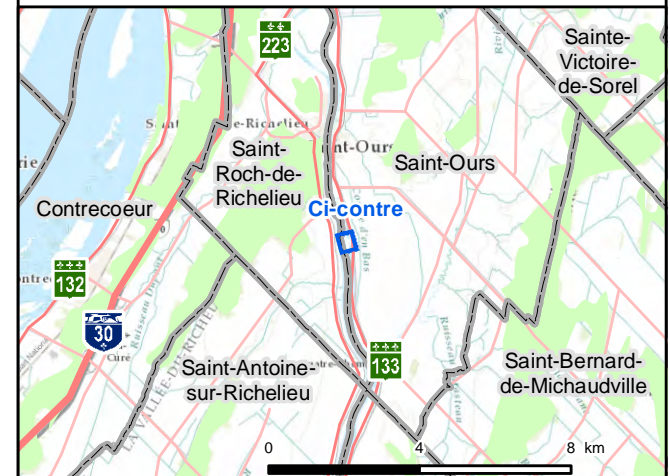
Sondages (WSP, 2015)

-  Carottage
-  Forage



1 : 1 500

Projection : NAD83, MTM fuseau 8



	Parcs Canada	ÉTUDE GÉOTECHNIQUE
		Mise en place de tentes oTENTIKs, Canal de Saint-Ours, Saint-Ours, Qc

Annexe B

Plan de localisation des sondages

Sources :
Arpentage: WSP (2015-10-13),
fichier: rel (13-10-2015)sc.dwg
Orthophoto: MERN,
009028_703_30CM_F08.TIF

Préparée par : A. Duval-Courchesne
Dessinée par : V. Verne
Approuvée par : M.-N. Côté


20 octobre 2015

131-21559-10








Annexe C

RAPPORTS DE FORAGES

Nom du consultant: 	Nom du client : Parcs Canada	RAPPORT DE FORAGE	
		Sondage N°	F-01
Nom du projet : Étude géotechnique - Installation de tentes oTENTiks	Coordonnées géodésiques MTM Québec (NAD-1983)		X: 332155,148 Y: 5080674,593 Z: 8,07
Nom du requérant : Parcs Canada	No. de projet : 131-21559-10		
Localisation civile : Canal Saint-Ours	Plan de localisation No. :		
Entrepreneur en forage : Forages Goulet	Date du début du sondage : 2015-10-14		
Type de forage : Tarière	Inclinaison : Azimut :	Profondeur du sondage : 15,80	
Diamètre du forage : 200 mm	Diamètre du carottier :		
Préparé par : Amélie Duval Courchesne	Vérifié par : Marie-Noël Côté		

TYPE D'ÉCHANTILLON	TERMINOLOGIE	INDICE DE QUALITÉ DU ROC	COMPACTITÉ	INDICE "N"	NIVEAU D'EAU
CF Cuillère fendue		% RQD	Très lâche	0-4	
CD Échantillon par forage au diamant	"traces"	<25	Lâche	4-10	
EM Manuel	"un peu"	25-50	Compact	10-30	Date:
TA Tarière	adjectif (...eux)	50-75	Dense	30-50	Prof.:
TE Tube d'échantillonnage	"et"	75-90	Très dense	>50	
TM Tube à paroi mince		90-100			

ÉTAT DE L'ÉCHANTILLON	SYMBOLES	CLASSIFICATION (SYSTÈME UNIFIÉ)	CONSISTANCE	RÉSISTANCE AU CISAILLEMENT (Cu)
 Remanié	N: Indice de pénétration standard R: Refus (N > 100) R.Q.D: Indice de qualité du roc (Rock Quality Designation) % R.Q.D = \sum Carottes > 4 po. (10 cm) longueur forée	Argile < 0,002 mm Silt 0,002 à 0,075 mm Sable 0,075 à 4,75 mm Gravier 4,75 à 75 mm Cailloux 75 à 300 mm Blocs > 300mm	Très molle Molle Ferme Raide Très raide Dure	<12 kPa 12-25 kPa 25-50 kPa 50-100 kPa 100-200 kPa >200 kPa

PROFONDEUR (m)	STRATIGRAPHIE				ÉCHANTILLONS				COUPS/15cm FRAGMENTATION (mm)	GRAPHIQUE	INSTALLATION	ESSAIS
	PROF - pi	NIVEAU (m)/ PROFONDEUR	DESCRIPTION DU SOL ET DU ROC	SYMBOLES	TYPE NO	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION				
		8,07	Niveau									
		0,00 8,02 0,05	Terre végétale. Remblai : Silt sableux, traces de gravier, gris-brun, sec, compact. Présence de traces de débris (brique, bois), de racines et d'oxydations.		CF-1	X	50	13	5-7-6-8			
1		6,85 1,22	Terrain naturel : Silt, un peu d'argile à argileux, gris rosacé, humide, ferme.		CF-2	X	21	14	5-5-9-8			
5					CF-3	X	67	13	6-6-7-7			
2					CF-4	X	100	6	3-3-3-4			
3					CF-5	X	100	7	3-3-4-4			
4					CF-6	X	100	6	2-3-3-4			
4		4,26 3,81	Argile silteuse, grise, humide à saturée, molle.		CF-7	X	100	4	1-2-2-2			
15					CF-8	X	100	3	1-1-2-2			
5					CF-9	X	100	2	0-1-1-1			
6		2,74 5,33	Devenant avec traces de sable et saturée.									
6		2,12 5,95	Fin de l'échantillonnage.									
								1				
								2				

Remarque(s):

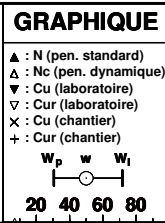


RAPPORT DE FORAGE

Sondage N°

F-01


PROFONDEUR (m)	PROF. - pi	STRATIGRAPHIE		ÉCHANTILLONS					COUPS/15cm FRAGMENTATION (mm)	GRAPHIQUE	INSTALLATION	ESSAIS
		NIVEAU (m)/ PROFONDEUR	DESCRIPTION DU SOL ET DU ROC	SYMBOLES	TYPE NO	SOUS - ÉCH.	ÉTAT	RÉCUPÉRATION				
8												
9												
10												
11												
12												
13												
14												
15												
16	15,80		Fin du forage sur refus à l'essai de pénétration au cône dynamique.									
17												
18												
19												







- INSTALLATION**
- ESSAIS**
- AG : analyse granulométrique
 - AC : analyse chimique
 - Wl : limite liquide
 - Wp : limite plastique
 - w : teneur en eau
 - Cu : cisaillement non drainé
 - Cur : cisaillement remanié
 - Pc : préconsolidation
 - Cc : coeff. de consolidation
 - k : perméabilité
 - Dup : éch. duplicata prélevé

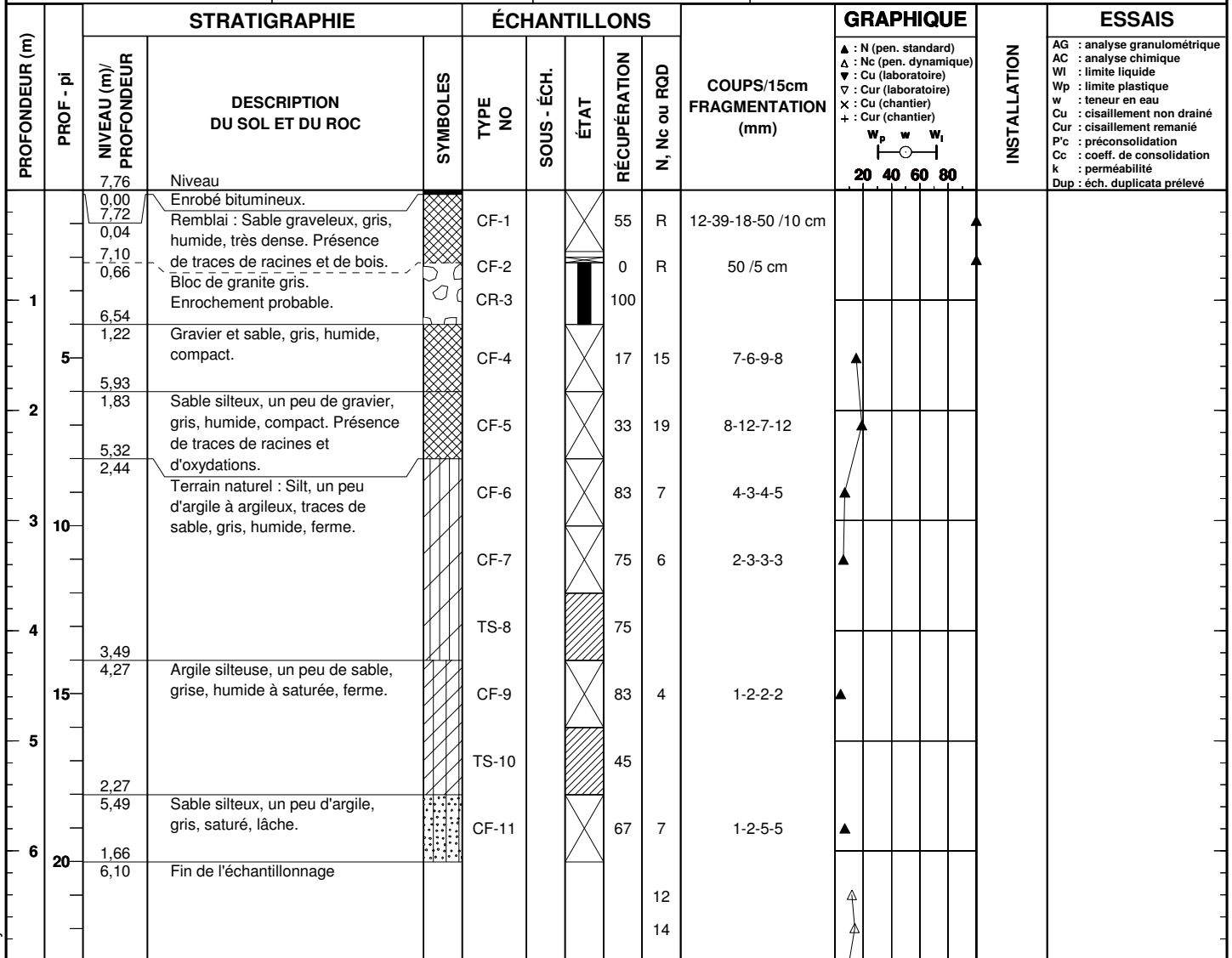
100 /25 cm

WSP_modèle de base.sty

Nom du consultant: 	Nom du client : Parcs Canada	RAPPORT DE FORAGE	
		Sondage N°	F-02
Nom du projet: Étude géotechnique - Installation de tentes oTENTiks	Coordonnées géodésiques X: 332142,779 MTM Québec (NAD-1983) Y: 5080609,963 Z: 7,76		No. de projet : 131-21559-10
Nom du requérant : Parcs Canada	Plan de localisation No. :		Date du début du sondage : 2015-10-15
Localisation civile : Canal Saint-Ours	Profondeur du sondage : 12,78		
Entrepreneur en forage : Forage Goulet Inc.	Inclinaison :	Azimut :	
Type de forage : Forage au diamant	Diamètre du forage: 90 mm	Diamètre du carottier:	
Préparé par : Amélie Duval Courchesne	Vérifié par : Marie-Noël Côté		

TYPE D'ÉCHANTILLON	TERMINOLOGIE	INDICE DE QUALITÉ DU ROC	COMPACTITÉ	INDICE "N"	NIVEAU D'EAU
CF Cuillère fendue		% RQD	Très lâche	0-4	
CD Échantillon par forage au diamant	"traces"	<25	Lâche	4-10	
EM Manuel	"un peu"	25-50	Compact	10-30	Date: Date:
TA Tarière	adjectif (...eux)	50-75	Dense	30-50	Prof.: Prof.:
TE Tube d'échantillonnage	"et"	75-90	Très dense	>50	
TM Tube à paroi mince		90-100	Excellent		

ÉTAT DE L'ÉCHANTILLON	SYMBOLES	CLASSIFICATION (SYSTÈME UNIFIÉ)	CONSISTANCE	RÉSISTANCE AU CISAILLEMENT (Cu)
 Remanié	N: Indice de pénétration standard	Argile < 0,002 mm	Très molle	<12 kPa
 Intact (tube à paroi mince)	R: Refus (N > 100)	Silt 0,002 à 0,075 mm	Molle	12-25 kPa
 Perdu	R.Q.D: Indice de qualité du roc (Rock Quality Designation)	Sable 0,075 à 4,75 mm	Ferme	25-50 kPa
 Forage au diamant	% R.Q.D = \sum Carottes > 4 po. (10 cm) longueur forée	Gravier 4,75 à 75 mm	Raïde	50-100 kPa
		Cailloux 75 à 300 mm	Très raïde	100-200 kPa
		Blocs > 300mm	Dure	>200 kPa



Remarque(s):

Date de production 2015-11-09



PROFONDEUR (m)	PROF. - pi	STRATIGRAPHIE		ÉCHANTILLONS					COUPS/15cm FRAGMENTATION (mm)	GRAPHIQUE	INSTALLATION	ESSAIS
		NIVEAU (m)/ PROFONDEUR	DESCRIPTION DU SOL ET DU ROC	SYMBOLES	TYPE NO	SOUS - ÉCH.	ÉTAT	RÉCUPÉRATION		N, Nc ou RQD		▲ : N (pen. standard) △ : Nc (pen. dynamique) ▼ : Cu (laboratoire) ▽ : Cur (laboratoire) × : Cu (chantier) + : Cur (chantier)
8												
9												
10												
11												
12												
13	12,78		Fin du forage au refus à l'essai de pénétration au cône dynamique.									28 cm
14												
15												
16												
17												
18												
19												

Nom du consultant:


Nom du client :
Parcs Canada

RAPPORT DE FORAGE
 Sondage N° **F-03**

Nom du projet : **Étude géotechnique - Installation de tentes oTENTiks**

Nom du requérant : **Parcs Canada**

Localisation civile : **Canal Saint-Ours**

Entrepreneur en forage : **Forage Goulet Inc.**

Type de forage : **Forage au diamant**

Diamètre du forage : **90 mm**

Préparé par : **Amélie Duval Courchesne**

Inclinaison : Azimut :

Diamètre du carottier :

Vérifié par : **Marie-Noël Côté**





Coordonnées géodésiques X: **332205,753**
 Y: **5080566,333**
 Z: **10,66**

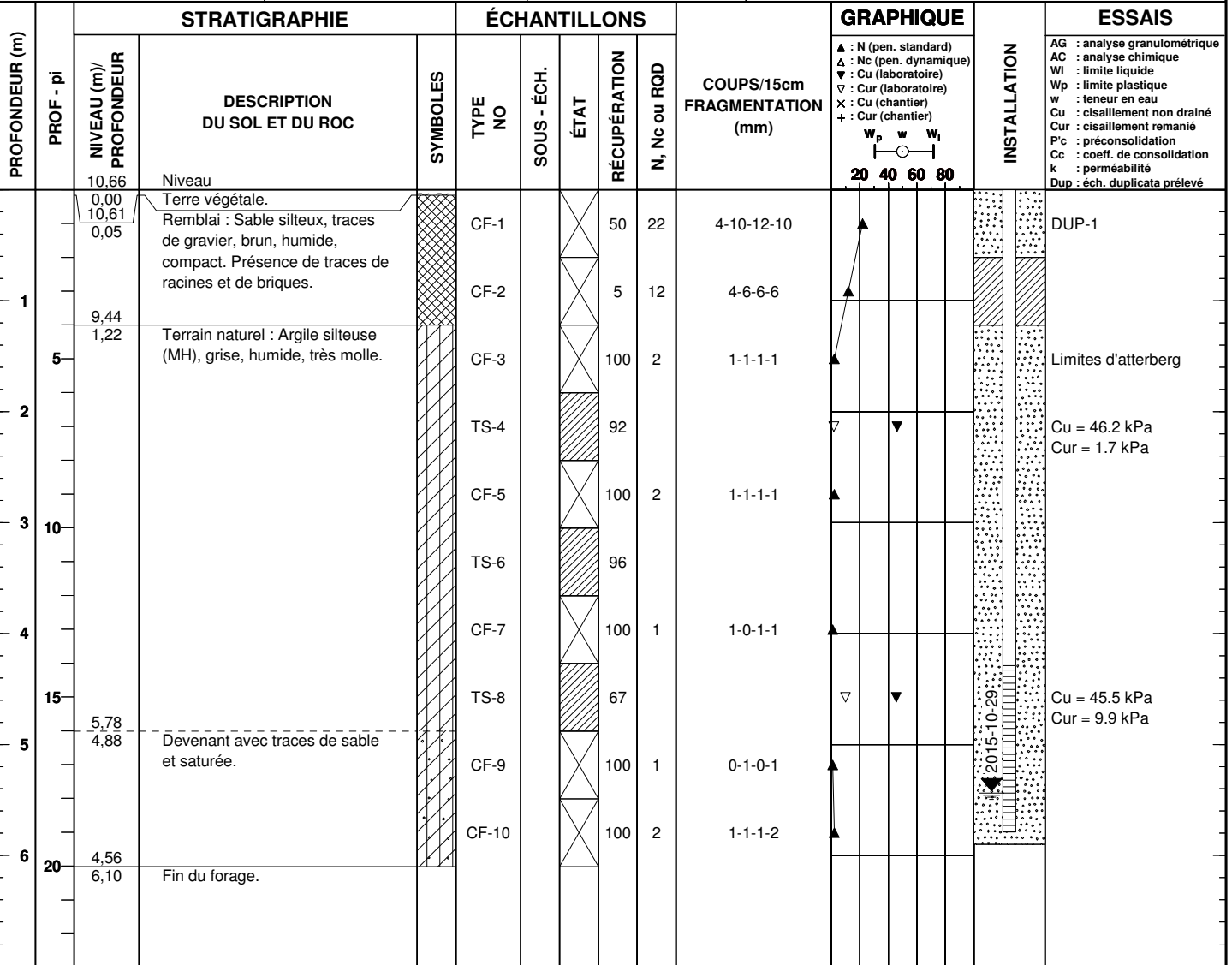
No. de projet : **131-21559-10**

Plan de localisation No. :

Date du début du sondage : **2015-10-15**

Profondeur du sondage : **6,10**


TYPE D'ÉCHANTILLON		TERMINOLOGIE		INDICE DE QUALITÉ DU ROC		COMPACITÉ		INDICE "N"		NIVEAU D'EAU	
CF	Cuillère fendue	"traces"	1-10%	% RQD	QUALIFICATIF	Très lâche	0-4				
CD	Échantillon par forage au diamant	"un peu"	10-20%	<25	Très pauvre	Lâche	4-10				
EM	Manuel	adjectif (...eux)	20-35%	25-50	Pauvre	Compact	10-30			Date: 2015-10-29 Date:	
TA	Tarière	"et"	35-50%	50-75	Passable	Dense	30-50			Prof.: 5,42 Prof.:	
TE	Tube d'échantillonnage			75-90	Bon	Très dense	>50				
TM	Tube à paroi mince			90-100	Excellent						
ÉTAT DE L'ÉCHANTILLON		SYMBOLES		CLASSIFICATION (SYSTÈME UNIFIÉ)		CONSISTANCE		RÉSISTANCE AU CISAILLEMENT (Cu)			
	Remanié	N: Indice de pénétration standard		Argile	< 0,002 mm	Très molle	<12 kPa				
	Intact (tube à paroi mince)	R: Refus (N > 100)		Silt	0,002 à 0,075 mm	Molle	12-25 kPa				
	Perdu	R.Q.D: Indice de qualité du roc (Rock Quality Designation)		Sable	0,075 à 4,75 mm	Ferme	25-50 kPa				
	Forage au diamant	% R.Q.D = Σ Carottes > 4 po. (10 cm) longueur forée		Gravier	4,75 à 75 mm	Raide	50-100 kPa				
				Cailloux	75 à 300 mm	Très raide	100-200 kPa				
				Blocs	> 300mm	Dure	>200 kPa				




Remarque(s):


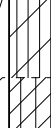


Date de production 2015-11-09

WSP_modèle de base.sty

Nom du consultant: 		Nom du client : Parcs Canada		RAPPORT DE FORAGE	
				Sondage N° F-04	
Nom du projet: Étude géotechnique - Installation de tentes oTENTiks				Coordonnées géodésiques X: 332192,739 MTM Québec (NAD-1983) Y: 5080509,499 Z: 11,04	
Nom du requérant : Parcs Canada				No. de projet : 131-21559-10	
Localisation civile : Canal Saint-Ours				Plan de localisation No. :	
Entrepreneur en forage : Forage Goulet Inc.				Date du début du sondage : 2015-10-15	
Type de forage : Forage au diamant				Profondeur du sondage : 6,10	
Diamètre du forage: 90 mm		Inclinaison : Azimut :			
Préparé par : Amélie Duval Courchesne		Vérifié par : Marie-Noël Côté			

TYPE D'ÉCHANTILLON	TERMINOLOGIE	INDICE DE QUALITÉ DU ROC	COMPACTITÉ	INDICE "N"	NIVEAU D'EAU
CF Cuillère fendue		% RQD	Très lâche	0-4	
CD Échantillon par forage au diamant	"traces"	<25	Lâche	4-10	
EM Manuel	"un peu"	25-50	Compact	10-30	Date: Date:
TA Tarière	adjectif (...eux)	50-75	Dense	30-50	Prof.: Prof.:
TE Tube d'échantillonnage	"et"	75-90	Très dense	>50	
TM Tube à paroi mince		90-100			
		QUALIFICATIF			
		Très pauvre			
		Pauvre			
		Passable			
		Bon			
		Excellent			

ÉTAT DE L'ÉCHANTILLON	SYMBOLES	CLASSIFICATION (SYSTÈME UNIFIÉ)	CONSISTANCE	RÉSISTANCE AU CISAILLEMENT (Cu)
 Remanié	N: Indice de pénétration standard R: Refus (N > 100) R.Q.D: Indice de qualité du roc (Rock Quality Designation) % R.Q.D = $\sum \text{Carottes} > 4 \text{ po. (10 cm) longueur forée}$	Argile < 0,002 mm Silt 0,002 à 0,075 mm Sable 0,075 à 4,75 mm Gravier 4,75 à 75 mm Cailloux 75 à 300 mm Blocs > 300mm	Très molle Molle Ferme Raide Très raide Dure	<12 kPa 12-25 kPa 25-50 kPa 50-100 kPa 100-200 kPa >200 kPa

PROFONDEUR (m)	STRATIGRAPHIE				ÉCHANTILLONS				COUPS/15cm FRAGMENTATION (mm)	GRAPHIQUE	INSTALLATION	ESSAIS
	PROF - pi	NIVEAU (m)/ PROFONDEUR	DESCRIPTION DU SOL ET DU ROC	SYMBOLES	TYPE NO	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION				
	11,04	Niveau										
1	0,00 10,94 0,10 10,43 0,61	Terre végétal.e Remblai : Silt, un peu de sable et gravier, brun, humide. Présence de traces de racines et d'oxydations.		CF-1		X	42	22	7-11-11-11			
	9,82 1,22	Terrain naturel : Silt argileux (MH), gris, humide, raide. Devenant argile silteuse et saturé		CF-2		X	100	9	4-5-4-4			
5				CF-3		X	100	2	1-1-1-1			Limites d'atterberg
2				CF-4		X	100	1	0-1-0-1			
3	10			CF-5		X	100	0	0-0-0-0 /PM			
				CF-6		X	100	0	0-0-0-0 /PM			
4				TS-7			75					Cu = 84,9 kPa Cur = 12,1 kPa
5	15			CF-8		X	100	0	0-0-0-0 /PM			
				TS-9			88					
6	20	4,94 6,10	Fin du forage.	CF-10		X	100	1	1-0-1-1			

Remarque(s): PM : Poids du marteau

Nom du consultant:


Nom du client :
Parcs Canada

RAPPORT DE FORAGE
 Sondage N° **F-05**

Nom du projet : **Étude géotechnique - Installation de tentes oTENTiks**

Nom du requérant : **Parcs Canada**

Localisation civile : **Canal Saint-Ours**
 Entrepreneur en forage : **Forage Goulet Inc.**
 Type de forage : **Tarière**
 Diamètre du forage : **90 mm**
 Préparé par : **Amélie Duval Courchesne**

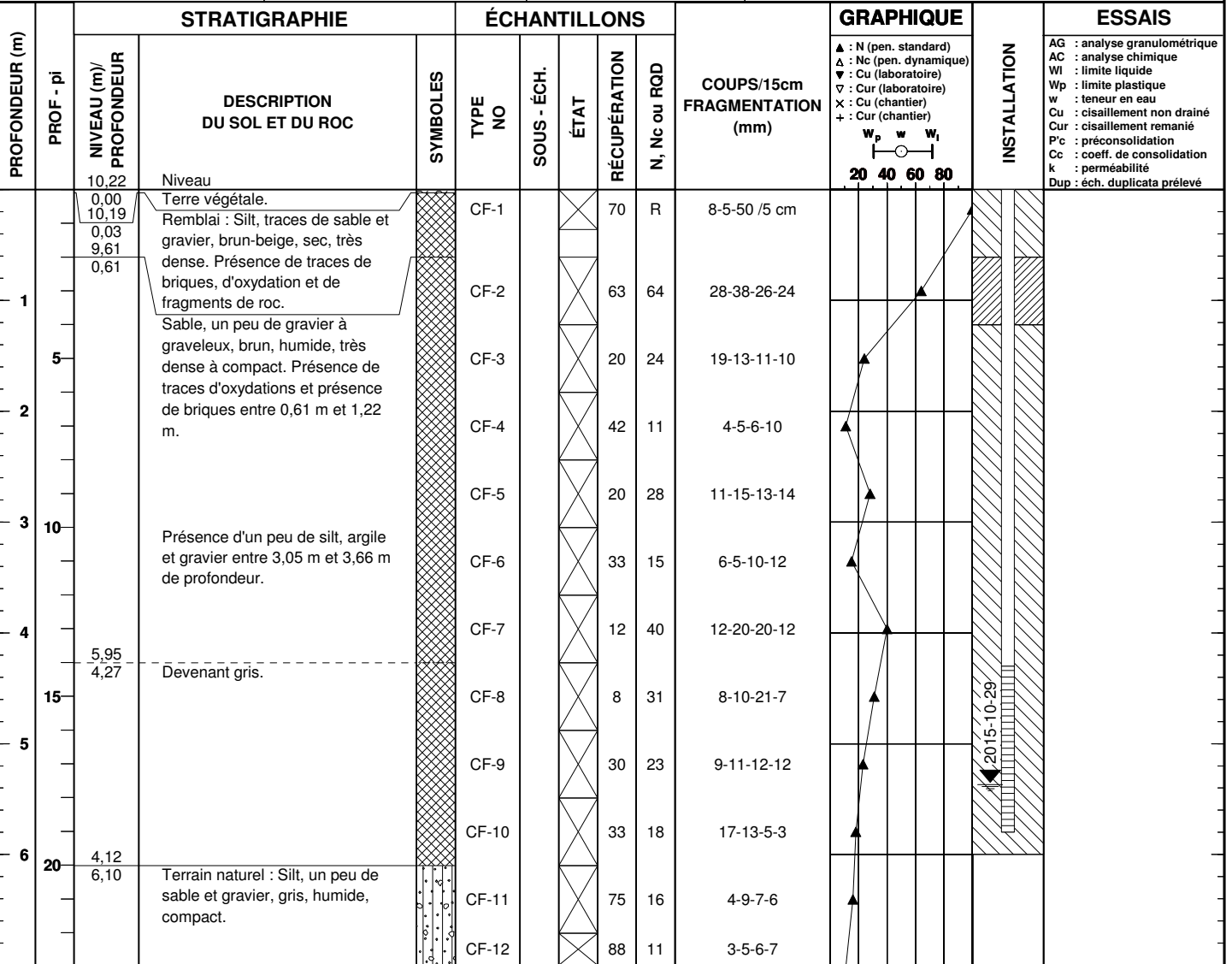
Inclinaison : Azimut :
 Diamètre du carottier:
 Vérifié par : **Marie-Noël Côté**

Coordonnées géodésiques X: **332184,592**
 Y: **5080433,785**
 Z: **10,22**

No. de projet : **131-21559-10**
 Plan de localisation No. :
 Date du début du sondage : **2015-10-14**
 Profondeur du sondage : **7,80**

TYPE D'ÉCHANTILLON		TERMINOLOGIE	INDICE DE QUALITÉ DU ROC	COMPACTITÉ	INDICE "N"	NIVEAU D'EAU
CF	Cuillère fendue	"traces"	% RQD	Très lâche	0-4	Date: 2015-10-29 Prof.: 5,35
CD	Échantillon par forage au diamant	"un peu"	<25	Lâche	4-10	
EM	Manuel	adjectif (...eux)	25-50	Compact	10-30	
TA	Tarière	"et"	50-75	Dense	30-50	
TE	Tube d'échantillonnage		75-90	Très dense	>50	
TM	Tube à paroi mince		90-100	Excellent		

ÉTAT DE L'ÉCHANTILLON		SYMBOLES	CLASSIFICATION (SYSTÈME UNIFIÉ)	CONSISTANCE	RÉSISTANCE AU CISAILLEMENT (Cu)
	Remanié	N: Indice de pénétration standard R: Refus (N > 100) R.Q.D: Indice de qualité du roc (Rock Quality Designation) % R.Q.D = Σ Carottes > 4 po. (10 cm) longueur forée	Argile < 0,002 mm Silt 0,002 à 0,075 mm Sable 0,075 à 4,75 mm Gravier 4,75 à 75 mm Cailloux 75 à 300 mm Blocs > 300mm	Très molle Molle Ferme Raide Très raide Dure	<12 kPa 12-25 kPa 25-50 kPa 50-100 kPa 100-200 kPa >200 kPa



Remarque(s):

Date de production 2015-11-09

WSP_modèle de base.sty



PROFONDEUR (m)	PROF. - pi	STRATIGRAPHIE		ÉCHANTILLONS				COUPS/15cm FRAGMENTATION (mm)	GRAPHIQUE	INSTALLATION	ESSAIS
		NIVEAU (m)/ PROFONDEUR	DESCRIPTION DU SOL ET DU ROC	SYMBOLES	TYPE NO	SOUS - ÉCH.	ÉTAT				
8	2,92								▲ : N (pen. standard) △ : Nc (pen. dynamique) ▼ : Cu (laboratoire) ▽ : Cur (laboratoire) × : Cu (chantier) + : Cur (chantier) 		AG : analyse granulométrique AC : analyse chimique WI : limite liquide Wp : limite plastique w : teneur en eau Cu : cisaillement non drainé Cur : cisaillement remanié P'c : préconsolidation Cc : coeff. de consolidation k : perméabilité Dup : éch. duplicata prélevé
	7,30	Fin de l'échantillonnage.		CF-12		×	88	11			
8	7,80		Fin du forage au refus à l'essai de pénétration au cône dynamique.								18 cm
9	30										
10											
11	35										
12	40										
13											
14	45										
15	50										
16											
17	55										
18	60										
19											

WSP_modèle de base.sty

Annexe D

RÉSULTATS DES ESSAIS DE LABORATOIRE

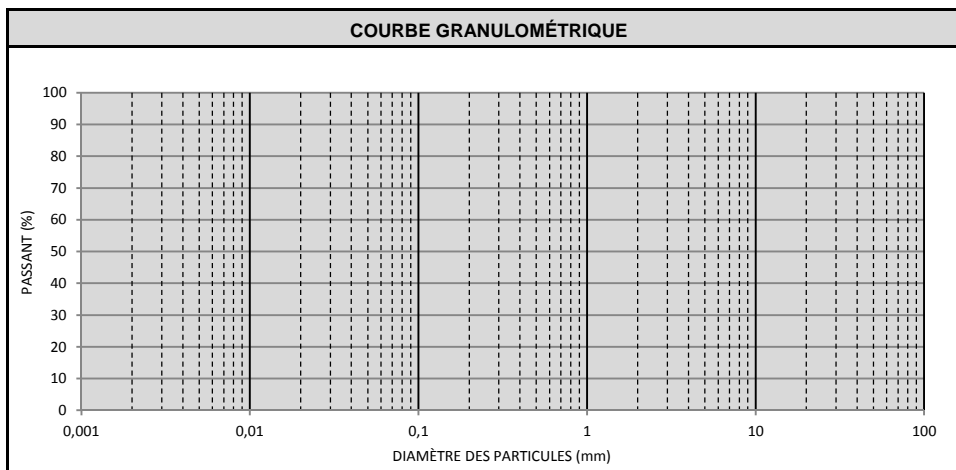


ESSAIS SUR SOLS ET MATÉRIAUX GRANULAIRES

CLIENT : Parcs Canada	No. PROJET : 131-21559-10
SITE : Canal Saint-Ours	No. D'ÉCHANTILLON LABORATOIRE : 269
	DATE D'ÉMISSION : 2015-10-27

MATÉRIEL			
Matériau : Sol	Provenance : Forage		
Calibre :	Localisation : F-03 / TS-4		
Usage :	(1,83 - 2,44 m)		
Prélevé par : Amélie D.Courchesne	Date : 15-10-2015	Reçu le : ---	

ANALYSE GRANULOMÉTRIQUE				
PAR TAMISAGE				
Tamis (mm)	Passant (%)	Exigences		N. Conf.
		Min	Max	
112				
80				
56				
40				
31,5				
20				
14				
10				
5				
2,5				
1,25				
0,630				
0,315				
0,160				
0,080				



DESCRIPTION		
Cailloux : 0 %	D ₁₀ :	Classification unifiée :
Gravier : 0 %	D ₃₀ :	Description :
Sable : 0 %	D ₆₀ :	
Silt : %	C _c :	
Argile : %	C _u :	

PAR SÉDIMENTOMÉTRIE (BNQ 2501-025)	
Diamètre (mm)	Passant (%)

ESSAIS DIVERS			
ESSAIS	RÉSULTATS	EXIGENCES	
Limites d'Atterberg	BNQ2501-092		
-Limite liquide (w _{LC})	63%		
-Limite plastique (w _P)	36%		
-Indice de plasticité (IPC)	28%		
Teneur en eau naturelle	BNQ2501-170	53,9%	
Résistance au cisaillement	BNQ2501-110		
-État intact (C _u)	46,2 KPa		
-État remanié (C _r)	1,7		
-Sensibilité (S _t)	28		

ESSAI PROCTOR (NQ2501-255)	
Méthode :	
Masse volumique maximale :	
Teneur en eau optimale :	

REMARQUES :

Préparé par : O.Y Vérifié par : Nicolas Ouellet

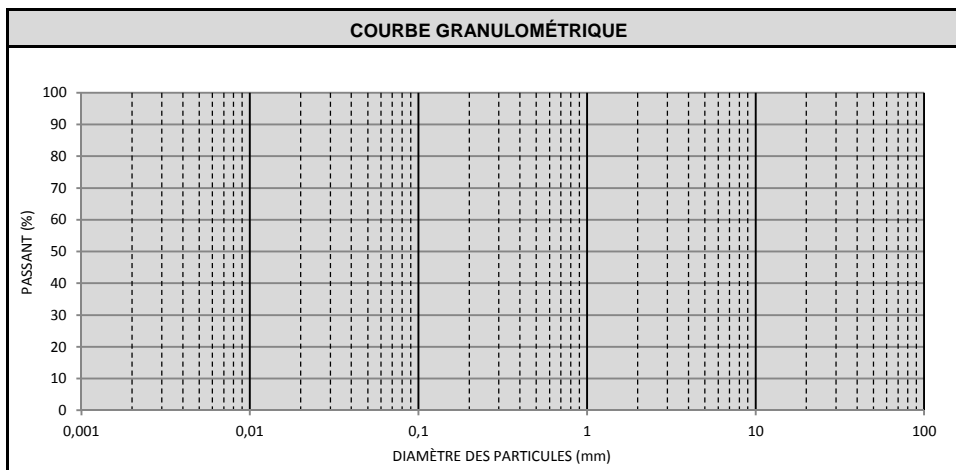


ESSAIS SUR SOLS ET MATÉRIAUX GRANULAIRES

CLIENT : Parcs Canada	No. PROJET : 131-21559-10
SITE : Canal Saint-Ours	No. D'ÉCHANTILLON LABORATOIRE : 270
	DATE D'ÉMISSION : 2015-10-27

MATÉRIEL			
Matériau : Sol	Provenance : Forage		
Calibre :	Localisation : F-03 / TS-8		
Usage :	(4,27 - 4,88 m)		
Prélevé par : Amélie D.Courchesne	Date : 15-10-2015	Reçu le : ---	

ANALYSE GRANULOMÉTRIQUE				
PAR TAMISAGE				
Tamis (mm)	Passant (%)	Exigences		N. Conf.
		Min	Max	
112				
80				
56				
40				
31,5				
20				
14				
10				
5				
2,5				
1,25				
0,630				
0,315				
0,160				
0,080				



DESCRIPTION		
Cailloux : 0 %	D ₁₀ :	Classification unifiée :
Gravier : 0 %	D ₃₀ :	Description :
Sable : 0 %	D ₆₀ :	
Silt : %	C _c :	
Argile : %	C _u :	

PAR SÉDIMENTOMÉTRIE (BNQ 2501-025)	
Diamètre (mm)	Passant (%)

ESSAIS DIVERS			
ESSAIS		RÉSULTATS	EXIGENCES
Résistance au cisaillement		BNQ2501-110	
-État intact (C _u)		45,5 KPa	
-État remanié (C _r)		9,9 KPa	
-Sensibilité (S _t)		5	
Teneur en eau naturelle		BNQ2501-170	53,6%

ESSAI PROCTOR (NQ2501-255)	
Méthode :	
Masse volumique maximale :	
Teneur en eau optimale :	

REMARQUES :

Préparé par : O.Y Vérifié par :

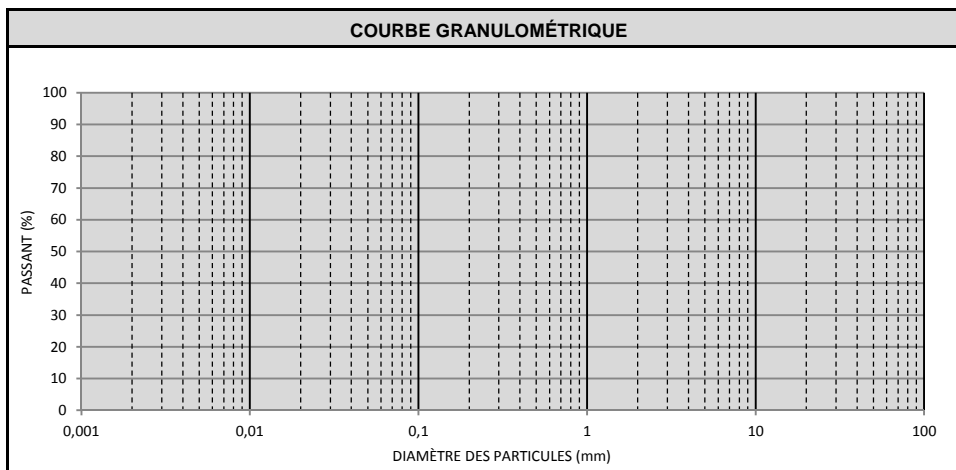


ESSAIS SUR SOLS ET MATÉRIAUX GRANULAIRES

CLIENT : Parcs Canada	No. PROJET : 131-21559-10
SITE : Canal Saint-Ours	No. D'ÉCHANTILLON LABORATOIRE : 271
	DATE D'ÉMISSION : 2015-10-27

MATÉRIEL		
Matériau : Sol	Provenance : Forage	
Calibre :	Localisation : F-04 / CF-3	
Usage :	(1,22 - 1,83 m)	
Prélevé par : Amélie D.Courchesne	Date : 15-10-2015	Reçu le : ---

ANALYSE GRANULOMÉTRIQUE				
PAR TAMISAGE				
Tamis (mm)	Passant (%)	Exigences		N. Conf.
		Min	Max	
112				
80				
56				
40				
31,5				
20				
14				
10				
5				
2,5				
1,25				
0,630				
0,315				
0,160				
0,080				



DESCRIPTION		
Cailloux : 0 %	D ₁₀ :	Classification unifiée : Description :
Gravier : 0 %	D ₃₀ :	
Sable : 0 %	D ₆₀ :	
Silt : %	C _c :	
Argile : %	C _u :	

PAR SÉDIMENTOMÉTRIE (BNQ 2501-025)	
Diamètre (mm)	Passant (%)

ESSAIS DIVERS			
ESSAIS	RÉSULTATS	EXIGENCES	
Limites d'Atterberg		BNQ2501-092	
-Limite liquide (w _{LC})	63		
-Limite plastique (w _P)	41		
-Indice de plasticité (IPC)	22		
Teneur en eau naturelle	62,0%	BNQ2501-170	

ESSAI PROCTOR (NQ2501-255)	
Méthode :	
Masse volumique maximale :	
Teneur en eau optimale :	

REMARQUES :

Préparé par : O.Y Vérifié par : Nicolas Ouellet

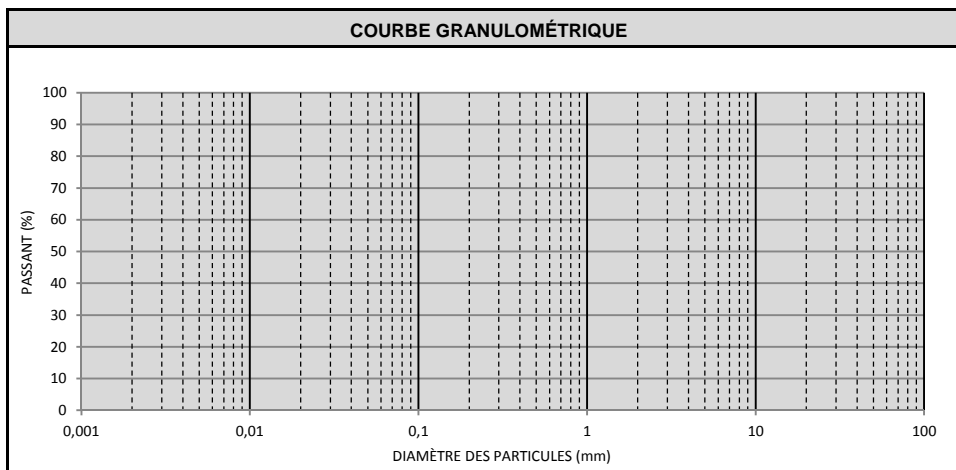


ESSAIS SUR SOLS ET MATÉRIAUX GRANULAIRES

CLIENT : Parcs Canada	No. PROJET : 131-21559-10
SITE : Canal Saint-Ours	No. D'ÉCHANTILLON LABORATOIRE : 272
	DATE D'ÉMISSION : 2015-10-27

MATÉRIEL		
Matériau : Sol	Provenance : Forage	
Calibre :	Localisation : F-04 / TS-7	
Usage :	(3,66 - 4,27 m)	
Prélevé par : Amélie D.Courchesne	Date : 15-10-2015	Reçu le : ---

ANALYSE GRANULOMÉTRIQUE				
PAR TAMISAGE				
Tamis (mm)	Passant (%)	Exigences		N. Conf.
		Min	Max	
112				
80				
56				
40				
31,5				
20				
14				
10				
5				
2,5				
1,25				
0,630				
0,315				
0,160				
0,080				



DESCRIPTION		
Cailloux : 0 %	D ₁₀ :	Classification unifiée : Description :
Gravier : 0 %	D ₃₀ :	
Sable : 0 %	D ₆₀ :	
Silt : %	C _c :	
Argile : %	C _u :	

PAR SÉDIMENTOMÉTRIE (BNQ 2501-025)	
Diamètre (mm)	Passant (%)

ESSAIS DIVERS			
ESSAIS	RÉSULTATS	EXIGENCES	
Résistance au cisailment	BNQ2501-110		
-État intact (C _u)	84,9 Kpa		
-État remanié (C _r)	12,1 KPa		
-Sensibilité (S _t)	7		
Teneur en eau naturelle	BNQ2501-170	69,7%	

ESSAI PROCTOR (NQ2501-255)	
Méthode :	
Masse volumique maximale :	
Teneur en eau optimale :	

REMARQUES :

Préparé par : Y.O. Vérifié par : Nicolas Ouellet

Transmission de documents



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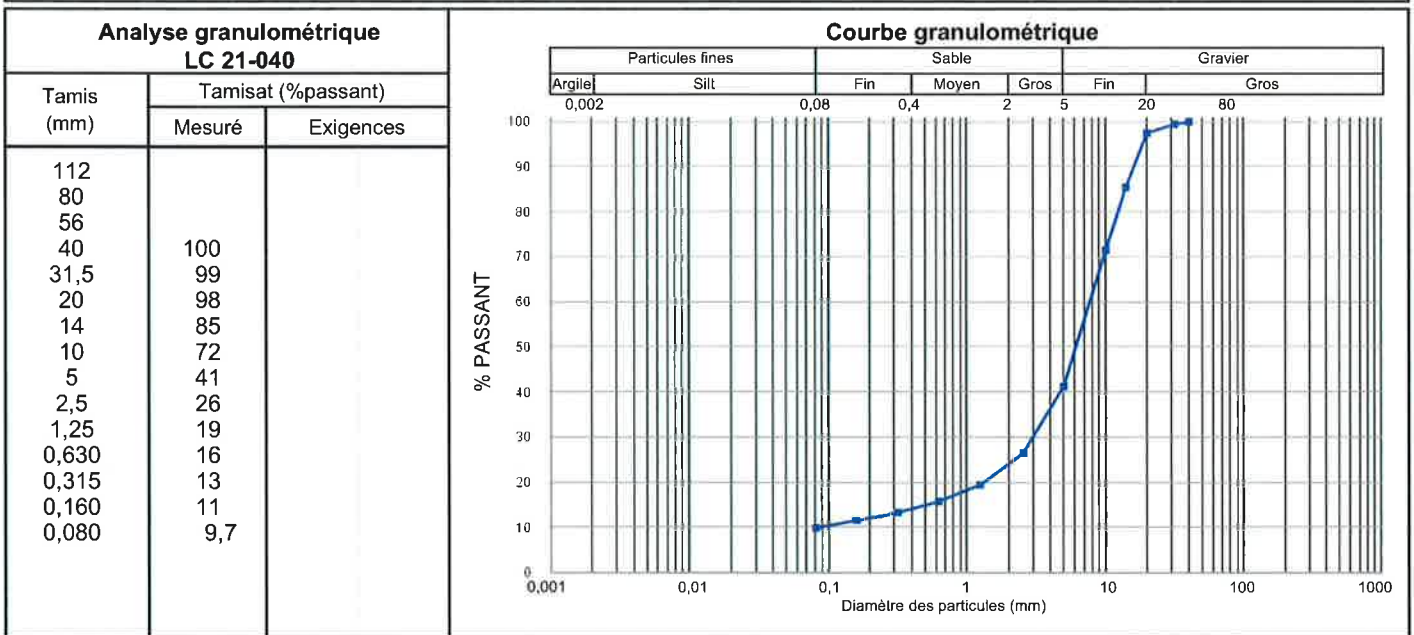


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**ESSAIS SUR SOLS, GRANULATS
 ET AUTRES MATÉRIAUX**

Certifié ISO 9001:2008

Client : WSP Canada inc.	Dossier n° : GEVS-229371-005400
Projet : Essais de laboratoire 2015	Échantillon n° : MO-8461
	Réf. client : 009194
Matériau : 0-31.5 mm , Pierre concassée	Prélevé le : N/D
Provenance : N/D	Endroit prélevé : Échantillon 03A
Utilisation : N/A	Reçu le : 2015-10-22



Essai Proctor	Autres essais	Résultats	Exigences
Méthode d'essai : Masse vol. max. : Humidité optimale :	IPPG NQ 2560-500	12	

Remarques :



Vérfié par : Eric Cardinal, chef de laboratoire Approuvé par : Alain Blanchette, Géol.M.Sc.A., Directeur principal - Bureau de Montréal Date : 2015-10-28



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SOLS ET GRANULATS

Détermination de l'indice pétrographique du potentiel de gonflement NQ 2560-500

Client : WSP Canada inc.	Date : 28 octobre 2015
	Dossier : GEVS-00229371-A0
Projet : Essais sur matériaux	Labo n° : MO-8461
	Réf. client : 009194

Échantillon : Pierre concassée 0-31.5 mm

Source : _____

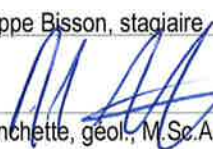
Prélevé par : Client

Localisation : Échantillon 03A

Masses utilisées								
Passant	20	mm	Retenue	14	mm	Masse	556,0	g
Passant	14	mm	Retenue	10	mm	Masse	276,0	g
Passant	10	mm	Retenue	5	mm	Masse	121,0	g
Passant	5	mm	Retenue	2,5	mm	Masse	29,0	g

Tableau synoptique									
Faciès pétrographiques	IP	retenue 14 mm	IPPG	retenue 10 mm	IPPG	retenue 5 mm	IPPG	retenue 2,5 mm	IPPG
Carbonates durs	0	62	0	47	0	53	0	66	0
Carbonates avec placages argileux minces	0,1	27	2,7	29	2,9	24	2,4	17	1,7
Carbonates argileux	0,5	11	5,5	24	12	28	14	17	8,5
IPPG par fraction :			8,2		14,9		13,9		10,2
IPPG du matériau :	12								

Remarques

Effectué par : Jean-Philippe Bisson, stagiaire	Date : 2015-10-27 AAAA-MM-JJ
Approuvé par :  Alain Blanchette, géol., M.Sc.A. Directeur principal	Date : 2015-10-28 AAAA-MM-JJ



ANNEXE A4

Étude hydraulique, rivière Richelieu au barrage de Saint-Ours – WSP, 2016

Hydraulic Study, Richelieu River, Saint-Ours Dam – WSP, 2016

REMPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE DE SAINT-OURS

ÉTUDE HYDRAULIQUE

JUIN 2016



REMPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE DE SAINT-OURS

ÉTUDE HYDRAULIQUE

Parcs Canada

Note technique – Version finale

Projet n° : 151-03113-03

Date : Juin 2016



WSP Canada Inc.

1175, boulevard Lebourgneuf, bureau 300
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Télécopieur : 418-780-4182

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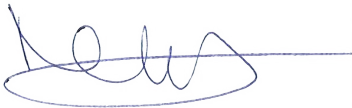


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PRÉPARÉ PAR

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N° OIQ : 116294

RÉVISÉ PAR



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N° OIQ : 132936

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RÉVISION N°	PRÉPARÉ POUR	DATE
Version préliminaire	Parcs Canada	8 janvier 2016
Version finale	Parcs Canada	30 juin 2016

TABLE DES MATIÈRES

1	INTRODUCTION.....	1
1.1	MISE EN CONTEXTE	1
1.2	OBJECTIFS.....	1
1.3	APPROCHE.....	1
2	DONNÉES	5
2.1	RELEVÉS	5
2.2	BATHYMÉTRIE COMPLÉMENTAIRE	7
2.3	CONFIGURATION DU BARRAGE	7
2.4	OPÉRATION DU BARRAGE	8
2.5	DONNÉES HYDROMÉTRIQUES.....	9
2.6	STATIONS HYDROMÉTRIQUES CONSULTÉES	11
2.6.1	DÉBIT DU RICHELIEU	11
2.6.2	NIVEAU DU SAINT-LAURENT.....	12
2.7	DONNÉES DU BARRAGE.....	12
3	MISE EN ŒUVRE D'UN MODÈLE HYDRAULIQUE 2D.....	15
3.1	LOGICIEL UTILISÉ	15
3.2	GÉOMÉTRIE DU MODÈLE.....	15
3.3	CONDITIONS FRONTIÈRES	17
3.4	ÉTALONNAGE.....	17
3.4.1	DÉMARCHE	17
3.4.2	NIVEAU D'EAU	17
3.4.3	VITESSE D'ÉCOULEMENT	17
3.4.4	LIMITATIONS DU MODÈLE	18
4	RÉSULTATS.....	19
4.1	SCÉNARIOS TYPES SIMULÉS.....	19

4.2	RÉSULTATS DES SIMULATIONS	19
4.3	ANALYSE DE SENSIBILITÉ SUR LE PATRON D'OUVERTURE DES VANNES	27
4.4	IMPACT DU NIVEAU D'EAU AVAL SUR LES VITESSES EN AMONT DU BARRAGE.....	28
4.5	AMPLITUDE DE LA VARIATION DES NIVEAUX D'EAU	28
5	CONCLUSIONS.....	31
6	RÉFÉRENCES BIBLIOGRAPHIQUES	33

TABLEAUX

TABLEAU 2-1	DÉBITS ET NIVEAUX D'EAU DU 23 SEPTEMBRE 2015.	9
TABLEAU 2-2	DÉBITS DU RICHELIEU AUX RAPIDES FRYER POUR DIFFÉRENTES PÉRIODES.	11
TABLEAU 2-3	DÉBITS DE CRUES ANNUELLES DU RICHELIEU AUX RAPIDES FRYER (ÉCHANTILLONS DE 1972 À 2011).	12
TABLEAU 2-4	NIVEAU DU SAINT-LAURENT À SOREL POUR DIFFÉRENTES PÉRIODES.	12
TABLEAU 4-1	DESCRIPTION DES SCÉNARIOS SIMULÉS.	20
TABLEAU 4-2	NIVEAUX D'EAU ET VITESSES SIMULÉS.	20

FIGURES

FIGURE 1-1	VUE EN PLAN DU BARRAGE DE SAINT-OURS.	3
FIGURE 2-1	RELEVÉS EFFECTUÉS PAR WSP LE 23 SEPTEMBRE 2015 AU BARRAGE DE SAINT-OURS.	6
FIGURE 2-2	COUPE TRANSVERSALE DU BARRAGE DE SAINT-OURS.	8
FIGURE 2-3	PROFIL DES VITESSES D'ÉCOULEMENT MESURÉES LE 23 SEPTEMBRE 2015 (DÉBIT DE 180 M ³ /S) À 80 M ET 280 M EN AMONT DU BARRAGE DE SAINT-OURS.	10
FIGURE 3-1	MAILLAGE DE CALCUL DANS LE SECTEUR DU BARRAGE DE SAINT-OURS.	16
FIGURE 4-1	VITESSES D'ÉCOULEMENT À DÉBIT TRÈS ÉLEVÉ (1 550 M ³ /S AUX RAPIDES FRYER).	21
FIGURE 4-2	VITESSES D'ÉCOULEMENT À DÉBIT ÉLEVÉ (1 070 M ³ /S AUX RAPIDES FRYER).	22
FIGURE 4-3	VITESSES D'ÉCOULEMENT À DÉBIT MOYEN (776 M ³ /S AUX RAPIDES FRYER).	23
FIGURE 4-4	VITESSES D'ÉCOULEMENT À DÉBIT PLUS FAIBLE (550 M ³ /S AUX RAPIDES FRYER).	24
FIGURE 4-5	VITESSES D'ÉCOULEMENT EN ÉTIAGE (175 M ³ /S AUX RAPIDES FRYER).	25
FIGURE 4-6	DIRECTION DE L'ÉCOULEMENT À DÉBIT MOYEN (776 M ³ /S AUX RAPIDES FRYER).	26
FIGURE 4-7	RÉPARTITION LATÉRALE DES VITESSES D'ÉCOULEMENT À 80 M ET 120 M EN AMONT DU BARRAGE DE SAINT-OURS (DÉBIT DE 776 M ³ /S AUX RAPIDES FRYER).	27

1 INTRODUCTION

1.1 MISE EN CONTEXTE

La rivière Richelieu est un cours d'eau navigable durant la saison estivale. L'Agence Parcs Canada (APC) est propriétaire et exploitant du canal et du barrage de Saint-Ours, localisé sur la rivière dans la ville de Saint-Ours au Québec.

Avant l'ouverture annuelle de la saison de navigation sur la rivière Richelieu, l'APC doit procéder à l'installation d'une estacade de sécurité en amont du barrage de Saint-Ours pour assurer la sécurité du public. L'estacade de sécurité existante est constituée d'une quinzaine de petites structures montées sur flotteurs et reliées ensemble par des câbles métalliques, lesquels sont accrochés à deux piliers de béton existants localisés dans la rivière près de chaque rive. La barrière, d'une longueur de 250 m, est installée parallèlement au barrage existant, à environ 30 m en amont de ce dernier.

La proximité du barrage et les vitesses d'écoulement importantes à l'emplacement de l'estacade actuelle rendent difficiles et dangereuses les opérations d'installation au début de la saison de navigation, alors que la rivière est en crue printanière. Par conséquent, l'APC doit attendre des débits moindres pour procéder à l'installation de l'estacade amont, ce qui peut reporter les opérations jusqu'à plus d'un mois après l'ouverture de la saison de navigation. Durant l'installation, l'APC doit également remonter les vannes du barrage, ce qui a pour effet de rehausser le niveau d'eau amont. Finalement, la configuration de l'estacade actuelle ne rencontre pas les recommandations de l'Association canadienne des barrages (ACB) concernant la sécurité du public.

1.2 OBJECTIFS

L'APC a mandaté WSP Canada Inc. (WSP) afin de concevoir une estacade de sécurité amont qui serait en mesure d'améliorer la sécurité du public de deux façons :

- son installation serait possible lors de la crue printanière, avant le début de la saison de navigation, sans fermer les vannes du barrage;
- sa configuration permettrait aux plaisanciers et nageurs en détresse de se rendre en lieu sûr vers les rives en s'aidant de l'orientation de l'estacade par rapport à la direction du courant.

1.3 APPROCHE

Afin d'établir les conditions d'écoulement en amont du barrage de Saint-Ours, un modèle hydraulique bidimensionnel (2D) de la rivière Richelieu dans le secteur du barrage a été mise en œuvre.

Ce modèle, couvrant la portion de la rivière débutant à 4 800 m en amont du barrage et se terminant à 400 m en aval de celui-ci, inclut les cinq pertuis du barrage, dans lesquels il est possible de modifier le niveau de la crête de chacune des vannes, selon le scénario à simuler. Ainsi, ce modèle permet de tenir compte de la submergence aval des pertuis se produisant lorsque le niveau d'eau du Richelieu en aval du barrage est élevé. Un débit constant correspondant au débit de la crue étudiée est injecté dans le modèle jusqu'à l'atteinte d'un état permanent.

Les débits et ouvertures des vannes du barrage sont sélectionnés de manière à reproduire différentes conditions :

- le débit du Richelieu attendu pour la période durant laquelle l'estacade projetée devra être installée;
- des débits plus élevés, représentatifs de conditions défavorables occasionnées par une crue tardive;
- des débits plus faibles, représentatifs des conditions prévalant durant la période d'installation actuelle de l'estacade.

Les résultats des simulations sont comparés et analysés selon les aspects suivants :

- le niveau d'eau atteint en amont du barrage;
- les vitesses d'écoulement sur des sections transversales localisées en amont du barrage, à 40 m d'intervalle;
- des figures montrant la répartition des vitesses d'écoulement dans l'ensemble du secteur prévu pour l'installation de l'estacade amont, mais aussi pour une éventuelle installation d'estacade en aval du barrage.



Figure 1-1 Vue en plan du barrage de Saint-Ours.

2 DONNÉES

2.1 RELEVÉS

Un relevé hydrométrique et bathymétrique a été réalisé par WSP sur le Richelieu dans le secteur du barrage de Saint-Ours afin de recueillir des données sur la configuration du site et de documenter un scénario d'étalonnage du modèle hydraulique. Ce relevé a été effectué le 23 septembre 2015. De manière plus précise, les éléments suivants ont été relevés :

- **géoréférencement du barrage** : relevé de l'élévation du dessus des piliers de béton du barrage et du dessus de la voie de circulation. Le but est de faire le lien entre le plan du barrage, sur laquelle l'élévation du seuil est indiquée;
- **vitesse d'écoulement à 80 m et 280 m en amont du barrage** : relevé des vitesses d'écoulement à l'ADCP sur ces deux sections transversales en amont du barrage;
- **jaugeage du débit** : mesure du débit de la rivière Richelieu dans le secteur du barrage par un minimum de quatre passages;
- **relevés bathymétriques** : relevé de la bathymétrie sur environ 300 m en amont du barrage, en effectuant un quadrillage, dont les lignes sont espacées de 20 à 25 m. Quatre sections transversales ont également été relevées en aval du barrage, le long de l'île Darvard. Les relevés ont été effectués à l'aide d'un échosondeur;
- **niveau d'eau et position de la rive** : relevé du niveau d'eau et de la position de la rive sur 400 m en amont du barrage et sur 400 m en aval du barrage, à intervalles de 50 m;
- **piliers de l'estacade existante et quais** : relevé de ces éléments à considérer lors de la conception de l'estacade;
- **photographies**.

Au moment des relevés, la vanne centrale (vanne 3) était en réparation, fermée en amont et en aval par des batardeaux. L'écluse, adjacente au barrage, n'a été opérée que pour laisser passer l'embarcation de WSP en début et en fin de journée.

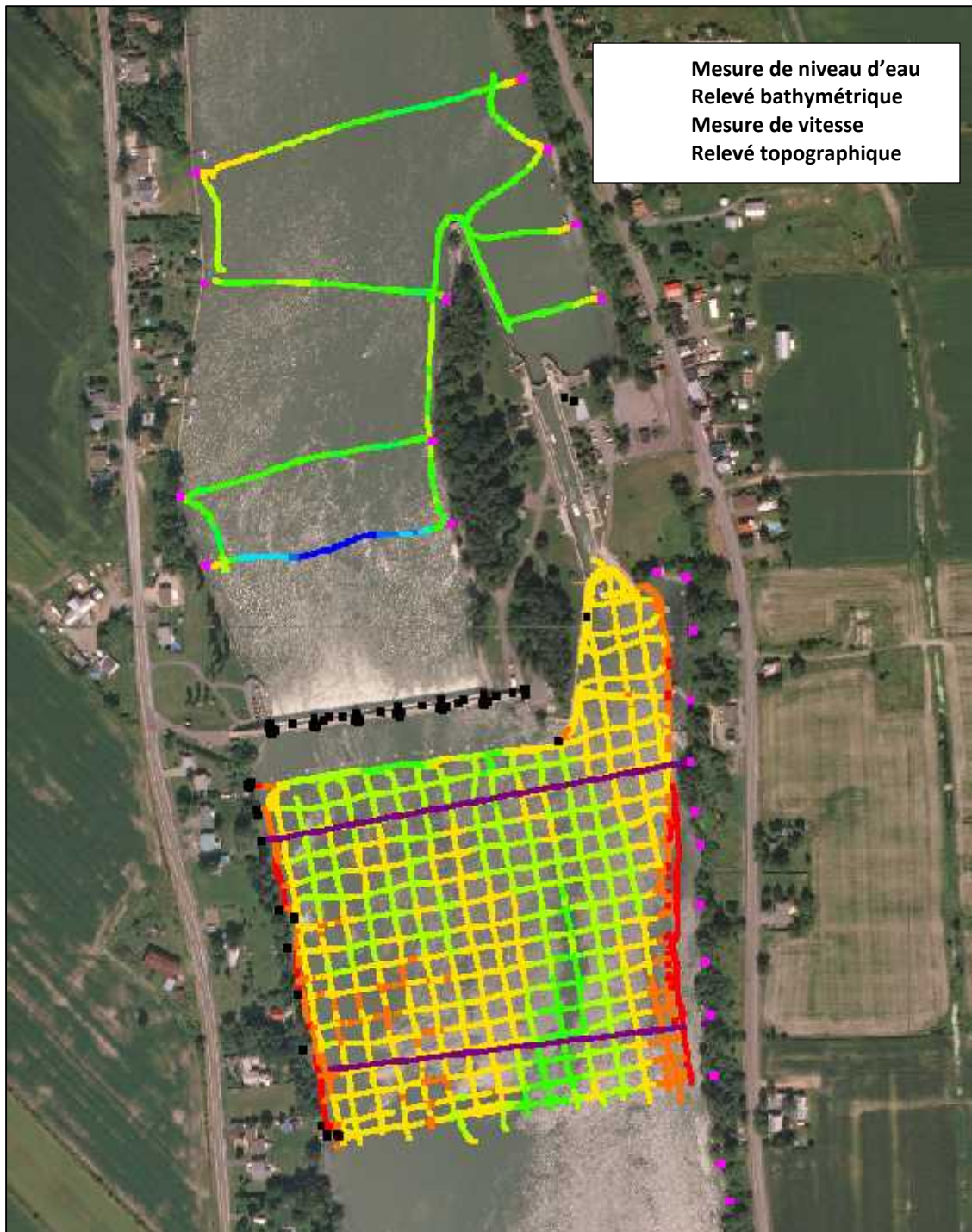


Figure 2-1 Relevés effectués par WSP le 23 septembre 2015 au barrage de Saint-Ours.

2.2 BATHYMÉTRIE COMPLÉMENTAIRE

Les données bathymétriques ont été complétées à l'aide des minutes hydrographiques du Service hydrographique du Canada (SHC) qui recueille des données afin de produire les cartes de navigation. Les ensembles de données utilisés pour constituer la géométrie du modèle hydraulique sont les suivants :

- 3005014 : données en date de 1981, couvrant le Richelieu sur environ 5 km en amont du barrage de Saint-Ours;
- 3103830 : données datant de 1997, couvrant le Richelieu en aval du barrage de Saint-Ours sur une distance de 420 m et l'amont du barrage sur 80 m.

2.3 CONFIGURATION DU BARRAGE

La configuration du barrage, en particulier des pertuis, est tirée des plans de construction du barrage, datant de 1968, et annotés avec la mention « AS BUILT ». Les numéros de fichier de ces plans sont les suivants :

- RU-11-108A.08.tif : Rivière Richelieu River – Barrage Saint-Ours Dam - VUE EN PLAN ET ÉLÉVATION – PLAN VIEW AND ELEVATIONS – Février 1967;
- RU-11-108A.03.tif : Rivière Richelieu River – Barrage Saint-Ours Dam – ARRANGEMENT GENERAL – GENERAL LAYOUT – 22 octobre 1965;
- RU-11-108A.49.tif : Rivière Richelieu River – Barrage Saint-Ours Dam – AGENCEMENT PILE TYPE – LAYOUT OF TYPICAL PIER – 25 novembre 1966.

La vue en plan du barrage a été superposée à l'orthophoto du barrage afin de reproduire le plus fidèlement possible la position et la configuration des piliers du barrage. Les principales informations fournies par ces dessins sont les suivantes :

- largeur des cinq pertuis : 100 pieds (30,48 m);
- largeur des piliers : 15 pieds (4,57 m);
- élévation du seuil des pertuis : 14 pieds (4,27 m);
- élévation du dessus des piliers : 36 pieds (10,97 m).

L'élévation du dessus des piliers a été relevée par WSP à la cote 11,03 m, soit 6 cm au-dessus du niveau indiqué par les plans. Le niveau du seuil a donc été placé à 6 cm au-dessus de la cote du plan, à l'élévation 4,33 m.

La figure 2-2 montre une coupe transversale du barrage (tirée du dessin RU-11-108A.03).

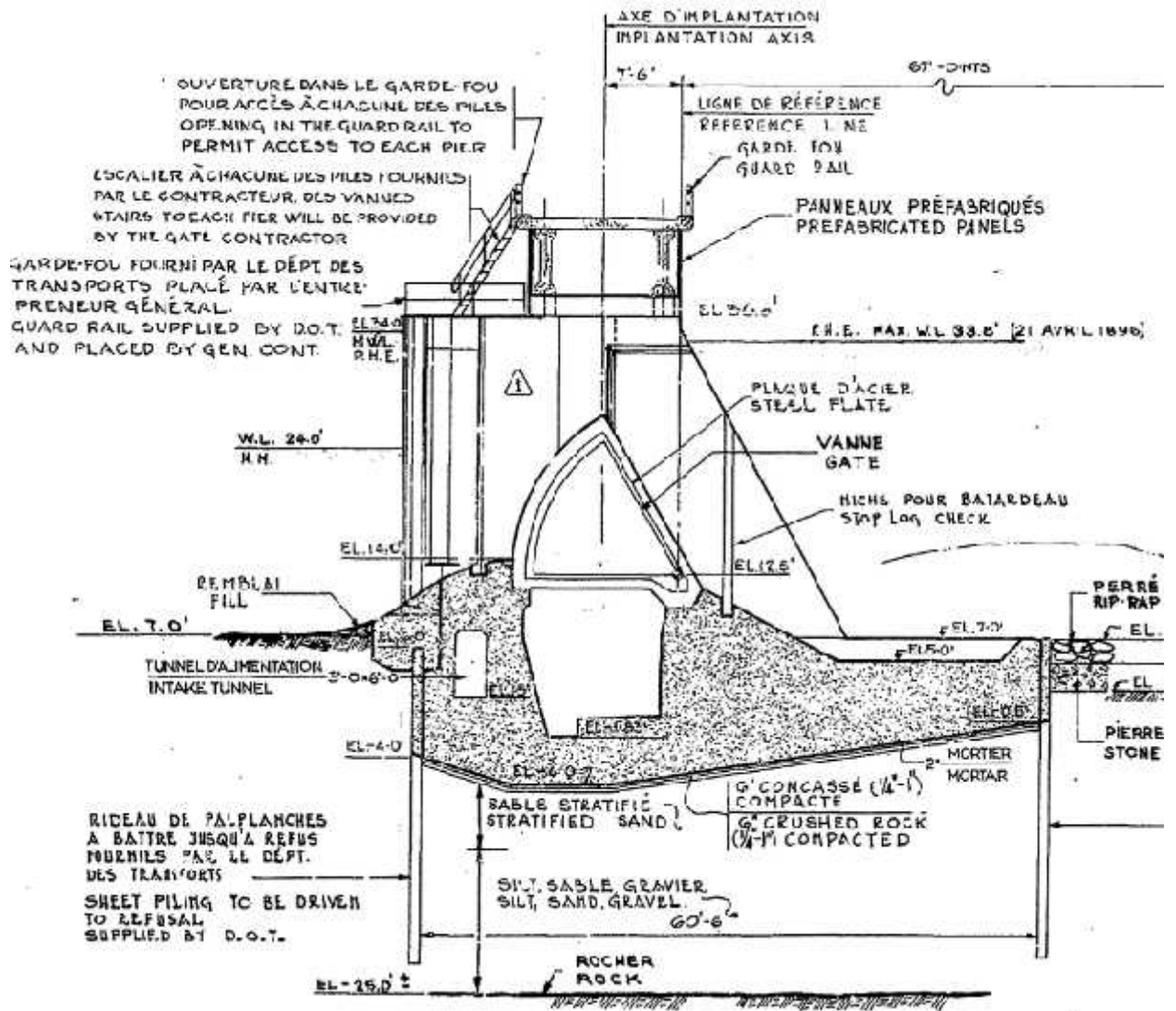


Figure 2-2 Coupe transversale du barrage de Saint-Ours.

2.4 OPÉRATION DU BARRAGE

Diverses informations ont été recueillies auprès de l'APC concernant le mode d'opération du barrage, les plus pertinentes pour l'étude hydraulique étant les suivantes :

- les vannes situées près des rives (vannes 1 et 5) sont opérées de façon manuelle;
- les trois vannes centrales sont opérées selon un mode automatique;
- les réparations et les entretiens de vannes sont effectués hors de la période de crue printanière;
- la gestion est effectuée à partir de niveaux cibles en amont du barrage;
- l'ouverture des vannes selon un patron en escalier est favorisée afin d'augmenter le débit s'écoulant à proximité de la passe migratoire, localisée en rive gauche.

De plus, certaines informations complémentaires ont été tirées d'un rapport de conception de la passe migratoire (Dumont et *al.*, 1997) :

- les vannes ont une hauteur de 3,43 m;
- le barrage doit maintenir les niveaux amont entre les cotes 6,7 m et 7,1 m (généralement entre 6,7 m et 6,85 m en crue);
- au moment de la crue, les vannes sont abaissées; par la suite, les cotes souhaitées sont obtenues par ajustement du niveau amont au moyen de deux vannes;
- le niveau aval dépend du débit de la rivière Richelieu et du niveau du fleuve Saint-Laurent;
- entre l'amont et l'aval du barrage, la dénivelée peut être de l'ordre de 25 cm lorsque toutes les vannes sont abaissées;
- le débit d'attraction de la passe migratoire est de 5 m³/s;
- le débit transitant dans la passe migratoire est de l'ordre de 1 m³/s.

2.5 DONNÉES HYDROMÉTRIQUES

Le tableau 2-1 présente le sommaire des relevés hydrométriques effectués par WSP le 23 septembre 2015. La figure 2-3 présente le profil de vitesses mesurées à l'ADCP, à des distances de 80 m et 280 m en amont du barrage de Saint-Ours. Sur ces profils, on remarque que les valeurs maximales sont de l'ordre de 0,5 m/s, étant un peu plus élevées sur la section à 80 m du barrage que sur la section plus en amont. De plus, les vitesses sont généralement réparties uniformément, étant plus faibles seulement en rive droite (en amont de l'écluse) et dans la portion plus profonde de la section à 280 m du barrage.

Tableau 2-1 Débits et niveaux d'eau du 23 septembre 2015.

MESURE EFFECTUÉE	DESCRIPTION	VALEUR
Débit - Jaugeage	Section transversale à 80 m en amont du barrage	181 m ³ /s
Débit - Jaugeage	Section transversale à 280 m en amont du barrage	177 m ³ /s
Niveau d'eau du Richelieu en amont du barrage	13 points de mesure en rive droite, sur 400 m en amont de l'écluse (moyenne)	6,86 m
Niveau d'eau du Richelieu en aval du barrage	4 points de mesure en rive droite, en aval de l'écluse (moyenne)	4,45 m
Profil de vitesses	Section transversale à 80 m en amont du barrage – moyenne sur la section	0,12 m/s
Profil de vitesses	Section transversale à 280 m en amont du barrage – moyenne sur la section	0,14 m/s

Source : Relevés effectués par WSP.

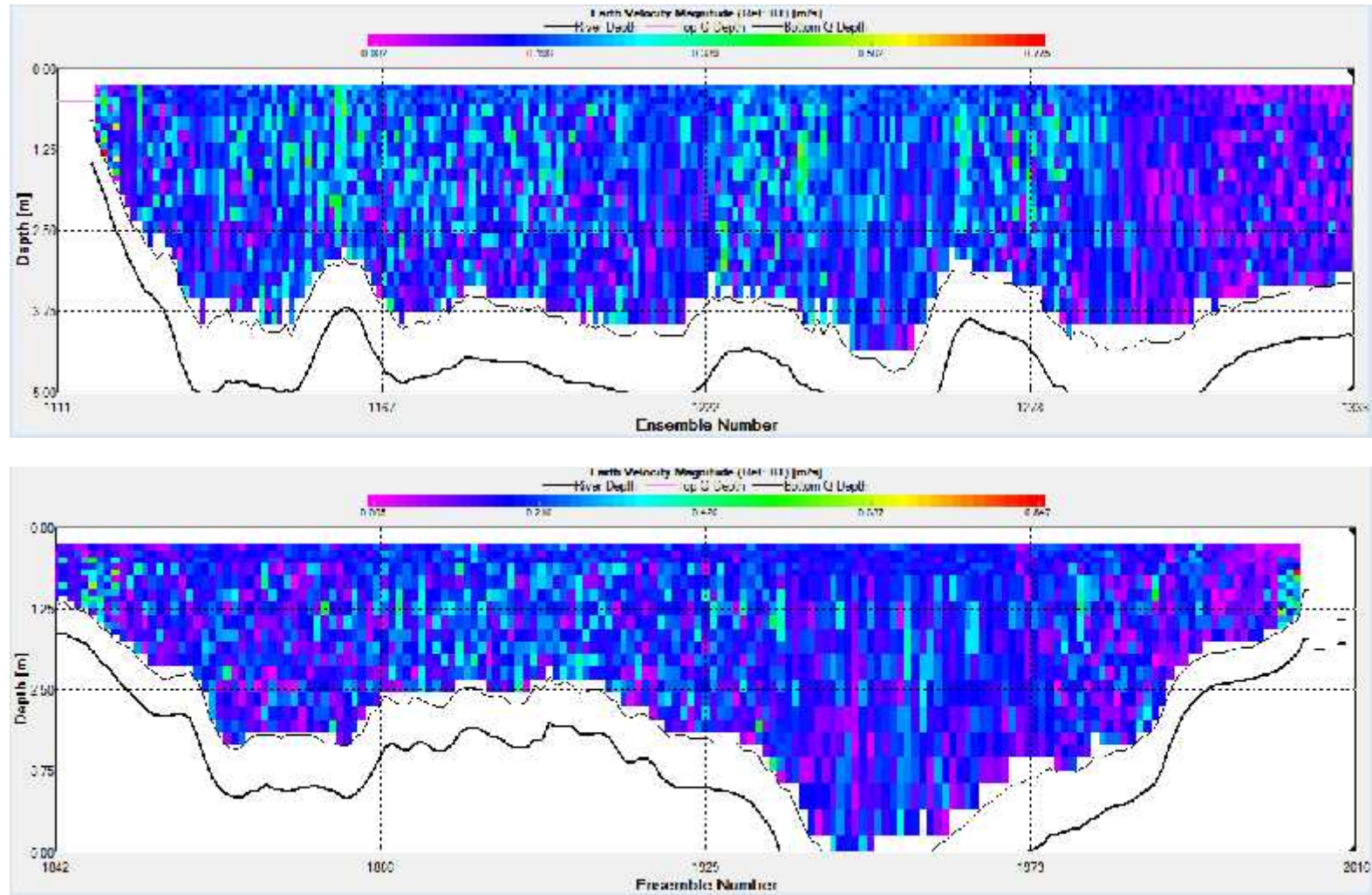


Figure 2-3 Profil des vitesses d'écoulement mesurées le 23 septembre 2015 (débit de 180 m³/s) à 80 m et 280 m en amont du barrage de Saint-Ours.

2.6 STATIONS HYDROMÉTRIQUES CONSULTÉES

2.6.1 DÉBIT DU RICHELIEU

La station hydrométrique 02OJ007, opérée par Environnement Canada depuis 1937, fournit les débits du Richelieu aux rapides Fryer, localisés à 56 km en amont du barrage de Saint-Ours. Des stations hydrométriques sont également en opération sur deux affluents du bassin versant intermédiaire (entre les rapides Fryer et le barrage de Saint-Ours), soit la station 030421 sur la rivière L'Acadie et la station 030415 sur la rivière des Hurons. La superficie jaugée par ces trois stations est de 22 675 km².

La superficie du bassin versant au barrage de Saint-Ours n'a pas été évaluée avec précision dans le cadre de ce mandat. Elle est cependant évaluée à 23 250 km², sur la base que le bassin versant total du Richelieu est de 23 720 km². Les débits des stations hydrométriques en opération, couvrant un bassin de 22 675 km², ont été majorés légèrement pour évaluer le débit du Richelieu à Saint-Ours en utilisant le rapport de la superficie des bassins versants. Ces débits majorés ont été utilisés pour les simulations hydrauliques.

La série de données journalières du débit aux rapides Fryer (1972 à 2011) a été utilisée afin d'établir les débits caractéristiques pour différentes périodes du printemps. Le tableau 2-2 présente ces valeurs. Pour la période d'installation visée pour l'estacade (le mois de mai), le débit pour différentes probabilités de dépassement est présenté.

Tableau 2-2 Débits du Richelieu aux rapides Fryer pour différentes périodes.

PÉRIODE	DÉBIT MOYEN DE LA PÉRIODE (m ³ /s)	DÉBIT POUR DIFFÉRENTES PROBABILITÉS DE DÉPASSEMENT (m ³ /s) ⁽¹⁾				
		10 %	25 %	50 %	75 %	90 %
1 ^{er} au 15 avril	694					
16 au 30 avril	788					
1 ^{er} au 15 mai	773	1 070	933	748	604	506
16 au 31 mai	672	974	776	640	518	429
1 ^{er} au 15 juin	550	787	677	521	405	321
16 au 30 juin	439					

(1) Les valeurs n'ont été présentées que pour les périodes jugées les plus pertinentes pour l'installation de l'estacade.

Source : Débits journaliers de 1972 à 2011, station hydrométrique 02OJ007.

La pointe de la crue printanière sur le Richelieu survient généralement à la fin du mois d'avril, mais les débits demeurent élevés lors de la décrue, en mai, alors que le débit diminue progressivement jusqu'à la fin juillet. Les débits de la crue annuelle, qui survient habituellement au printemps, sont présentés pour différentes périodes de récurrence au tableau 2-3. Ces débits avaient été évalués par GENIVAR (2013) dans le cadre des études hydrotechniques du canal de Chambly réalisées pour Parcs Canada en 2013. La crue d'une période de retour de 2 ans s'élève à 925 m³/s.

Tableau 2-3 Débits de crues annuelles du Richelieu aux Rapides Fryer (échantillons de 1972 à 2011).

PÉRIODE DE RETOUR (ans)	DÉBIT AUX RAPIDES FRYER (m ³ /s)
2	925
5	1 125
10	1 240
20	1 330
100	1 515

Source : GENIVAR (2013).

2.6.2 NIVEAU DU SAINT-LAURENT

Les niveaux d'eau du Saint-Laurent sont disponibles à la station 02OJ022, localisée à Sorel, soit près de l'embouchure du Richelieu, pour la période de 1912 à 2010. Le niveau du Saint-Laurent influence le niveau du Richelieu en aval du barrage de Saint-Ours, et même au-delà du barrage lorsque le niveau est très élevé en période de crue.

Le niveau du Saint-Laurent varie considérablement, entre 3,56 m et 7,6 m entre 1972 et 2010. Le niveau maximal de 7,6 m est largement supérieur au niveau du seuil des vannes, à 4,33 m, d'où l'effet de submergence aval au barrage.

Pour le mois de mai, séparé en deux périodes, les niveaux classés de 1972 à 2010 sont présentés au tableau 2-4.

Tableau 2-4 Niveau du Saint-Laurent à Sorel pour différentes périodes.

PÉRIODE	NIVEAU D'EAU POUR DIFFÉRENTES PROBABILITÉS DE DÉPASSEMENT (m)				
	10 %	25 %	50 %	75 %	90 %
1 ^{er} au 15 mai	6,58	6,17	5,66	5,17	4,65
16 au 31 mai	6,18	5,64	5,21	4,85	4,44

Source : Niveaux journaliers de 1972 à 2010, station hydrométrique 02OJ022.

Deux lignes d'eau mesurées le long du Richelieu en 1979 dans le cadre des études pour établir la cartographie des plaines d'inondation du Bas-Richelieu (Déziel et Boucher, 1985) fournissent un ordre de grandeur de l'écart de niveau d'eau entre le Saint-Laurent à Sorel et le pied du barrage de Saint-Ours. Ces valeurs sont les suivantes :

- 18-19 avril 1978 (débit de 991 m³/s aux rapides Fryer) : écart de 0,75 m;
- 29 mars 1979 (débit de 950 m³/s aux rapides Fryer) : écart de 0,53 m;
- 16 mai 1979 (débit de 679 m³/s aux rapides Fryer) : écart de 0,39 m.

2.7 DONNÉES DU BARRAGE

Le système d'opération du barrage de Saint-Ours permet de récupérer des données d'exploitation enregistrées sur une base horaire au cours des dernières années. Les données suivantes ont été récupérées et exploitées pour les besoins de la présente étude, pour la période de 2004 à 2015 :

- la position de chacune des cinq vannes (soit l'élévation de la crête de la vanne, en pieds);
- les niveaux d'eau en amont et en aval du barrage.

Par contre, certaines incohérences ont été observées sur les niveaux d'eau, dans certains cas le niveau aval étant supérieur au niveau amont, ou encore le niveau aval semblant être sous-estimé. Il est possible que la position de l'instrument de mesure du niveau d'eau induise une certaine erreur s'il est positionné directement sur le barrage, où les vitesses d'écoulement peuvent être très élevées, ou bien s'il y a formation de ressaut hydraulique. Par conséquent, les données de niveau d'eau aval ont été utilisées dans certains cas, mais dans d'autre, elles ont été remplacées par une estimation du niveau d'eau sur la base du niveau du Saint-Laurent disponible à Sorel.

3 MISE EN ŒUVRE D'UN MODÈLE HYDRAULIQUE 2D

3.1 LOGICIEL UTILISÉ

Un modèle hydraulique bidimensionnel (2D) a été mis en œuvre afin d'établir les conditions d'écoulement dans la rivière Richelieu dans le secteur du barrage de Saint-Ours, dans le cadre du remplacement de l'estacade de sécurité. Les niveaux d'eau et les vitesses sont évalués pour différents débits caractéristiques en considérant une ouverture appropriée des vannes du barrage. À cette fin, le logiciel TELEMAC-2D a été utilisé.

Le logiciel TELEMAC-2D, développé par le Laboratoire National d'Hydraulique et Environnement d'Électricité de France, résout les équations de Saint-Venant en deux dimensions, faisant appel à l'approche par éléments finis. L'application de TELEMAC requiert une discrétisation géométrique du domaine de calcul en un maillage irrégulier d'éléments triangulaires.

3.2 GÉOMÉTRIE DU MODÈLE

Le domaine modélisé couvre le tronçon de la rivière Richelieu de part et d'autre du barrage de Saint-Ours, débutant à 4 800 m en amont du barrage et se terminant à 400 m en aval de celui-ci. Il inclut les cinq pertuis du barrage, alors que les piliers sont représentés comme des îlots non maillés.

Ce domaine est découpé en éléments triangulaires de dimensions variables. Il en résulte un maillage de densité variable selon la configuration de la bathymétrie locale, la complexité des écoulements, la présence de structures et les zones d'intérêt. Le maillage est illustré à la figure 3-1.

Le maillage est composé d'environ 24 600 nœuds et la taille des mailles passant de 0,5 m autour des piliers de barrage, à 1 m dans le secteur immédiat du barrage, à 5 dans l'ensemble de la zone d'étude pour l'implantation des estacades amont et aval, à 20 m dans la portion amont de la rivière. Le maillage prévoit un alignement des triangles le long de la crête des vannes segments, de manière à obtenir une élévation uniforme de cette crête à l'intérieur de chaque pertuis.

Un modèle numérique de terrain est créé à partir des données bathymétriques et topographiques disponibles et décrites précédemment. Certaines corrections locales (configuration des îles et hauts fonds) ont pu être réalisées à partir de l'orthophoto disponible, notamment pour préciser la position des berges. Ces élévations sont interpolées sur chacun des nœuds du maillage de calcul.

La position des vannes segments est ajustée à même la géométrie du modèle, en modifiant l'élévation des nœuds alignés sur la crête, dans le fichier de géométrie. Ainsi, il a été nécessaire de produire différentes versions de la géométrie pour simuler chaque cas particulier.

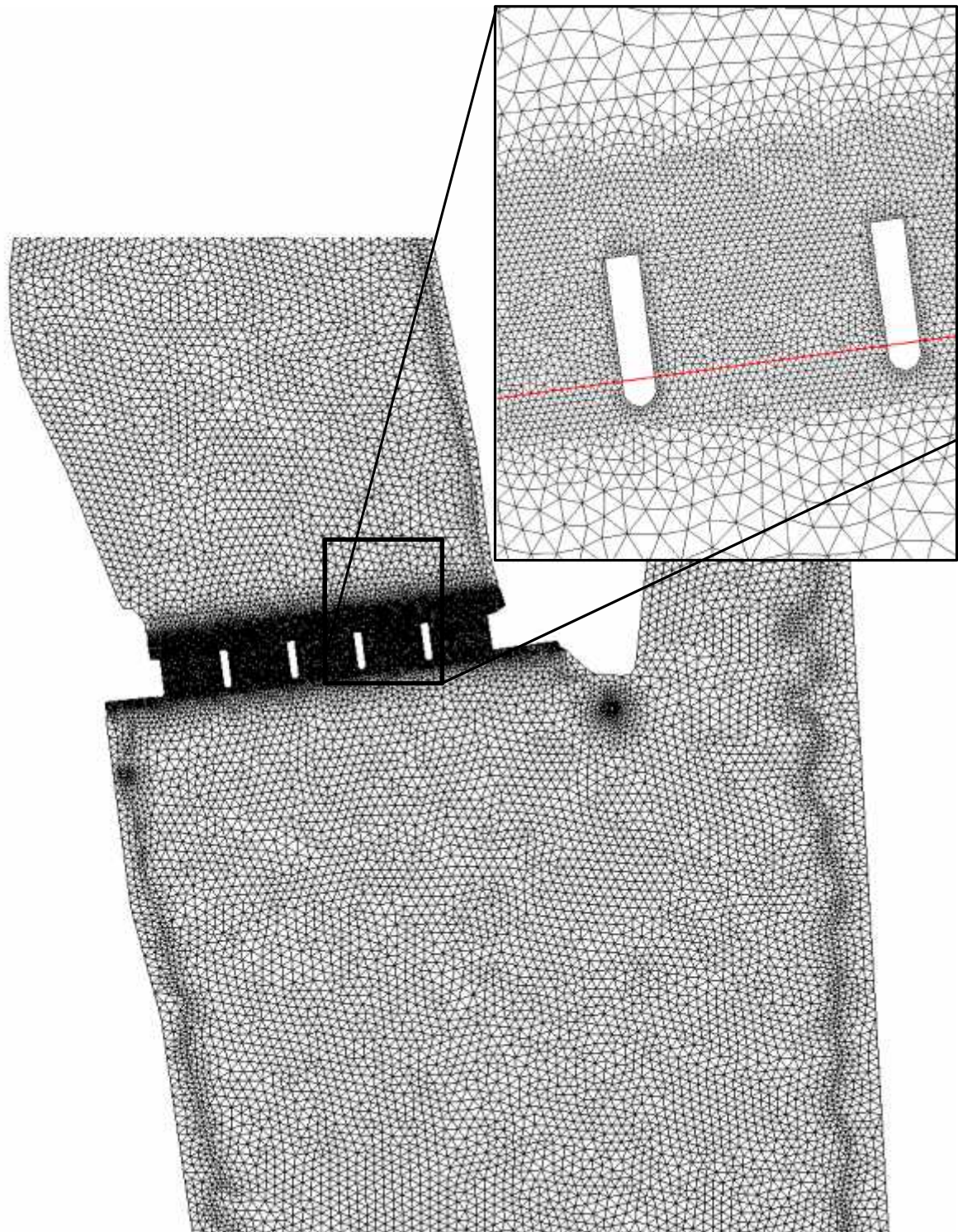


Figure 3-1 Maillage de calcul dans le secteur du barrage de Saint-Ours.

3.3 CONDITIONS FRONTIÈRES

Les conditions imposées aux frontières du modèle numérique sont les suivantes :

- le débit de la rivière Richelieu entrant en amont;
- le débit de la passe migratoire et le débit d'attrait, estimés à 6 m³/s, sortent du modèle sur la face amont du barrage, juste à gauche de la vanne 1;
- un niveau est imposé à la limite aval du modèle.

3.4 ÉTALONNAGE

3.4.1 DÉMARCHE

L'étalonnage du modèle hydraulique a été réalisé sur la base des conditions observées lors du relevé effectué par WSP le 23 septembre 2015. Selon les données obtenues, la crête des vannes 1, 2, 4 et 5 se situait à l'élévation 6,29 m, alors que la vanne 3 était complètement relevée et fermée par un batardeau.

Le coefficient de frottement dans la zone du barrage a été ajusté de manière à approcher le niveau amont mesuré, tout en conservant des valeurs typiques pour le frottement. Les coefficients (n de Manning) imposés sont les suivants :

- dans le secteur immédiat du barrage : 0,045;
- dans le reste du domaine modélisé : 0,025.

Deux paramètres ont pu être vérifiés :

- le niveau d'eau obtenu en amont du barrage en écoulement permanent;
- les deux profils de vitesses mesurées, à 80 m et 280 m en amont du barrage.

3.4.2 NIVEAU D'EAU

Le niveau d'eau mesuré le 23 septembre 2015 en amont du barrage, en rive droite où les écoulements sont lents, était en moyenne de 6,86 m. La simulation hydraulique des conditions hydrologiques indique un niveau amont de 6,82 m. L'écart entre le niveau d'eau mesuré et le niveau d'eau simulé étant de seulement 4 cm, l'étalonnage sur les niveaux d'eau est jugé adéquat.

3.4.3 VITESSE D'ÉCOULEMENT

Les vitesses mesurées le 23 septembre 2015 sur deux sections transversales en amont du barrage ont été converties en vitesses moyennes sur la colonne d'eau, à des points espacés de 1 à 2 m le long de cette ligne. La comparaison des vitesses mesurées et simulées pour les conditions du 23 septembre 2015 indique une bonne correspondance, l'écart moyen entre les vitesses mesurées et simulées étant de 0,07 m/s pour la section à 80 m du barrage, et de 0,05 m/s à 280 m du barrage. Les vitesses d'écoulement simulées sont présentées à la figure 4-5 de la section suivante.

3.4.4 LIMITATIONS DU MODÈLE

La précision du modèle dans certaines conditions est limitée par les facteurs suivants :

- l'étalonnage du modèle a été effectué pour des conditions d'étiage (conditions du 23 septembre 2015) : les simulations pour des débits printaniers, plus élevés, demeurent une extrapolation;
- le passage des eaux dans les pertuis du barrage est simulé en deux dimensions, alors qu'il s'agit d'un type d'écoulement variant fortement dans les trois dimensions : ainsi, l'effet de perte de charge et de submergence aval ne peut être fidèlement reproduit;
- il existe une multitude de configurations d'ouverture de vannes possibles, seules les conditions semblant les plus probables ont été simulées;
- en période de crue, le niveau d'eau du Saint-Laurent a une influence sur les conditions d'écoulement en amont du barrage. Pour chaque période étudiée (début mai, fin mai, début juin), le niveau du Saint-Laurent a été imposé à la valeur médiane de chaque période. Des niveaux d'eau plus bas pourraient avoir pour effet d'augmenter les vitesses d'écoulement en amont du barrage en raison de la diminution du phénomène de submergence et de la réduction de la section d'écoulement.

Nonobstant ces incertitudes, l'utilisation d'un modèle d'écoulement 2D pour simuler des conditions printanières est considérée pour une approche relativement fiable et adaptée aux besoins du projet.

4 RÉSULTATS

4.1 SCÉNARIOS TYPES SIMULÉS

Pour les besoins de conception de l'estacade et pour évaluer les conditions d'écoulement lors de son installation, quatre scénarios types ont été modélisés. Ces scénarios couvrent les cas suivants :

- une valeur moyenne : le débit correspondant à une probabilité de dépassement de 25 % pour la période du 16 au 31 mai, soit 776 m³/s aux rapides Fryer;
- une valeur élevée : le débit correspondant à une probabilité de dépassement de 10 % pour la période du 1^{er} au 15 mai, soit 1 070 m³/s aux rapides Fryer;
- une valeur très élevée : le débit de la pointe de la crue du printemps 2011, soit 1 550 m³/s;
- une valeur plus faible, pouvant se rapprocher des conditions de la période durant laquelle l'estacade est habituellement installée : le débit moyen de la période du 1^{er} au 15 juin, soit 550 m³/s aux rapides Fryer.

Le tableau 4-1 présente le détail de l'ouverture des vannes et des niveaux d'eau amont et aval du barrage et du débit au barrage. Pour élaborer ces scénarios, les hypothèses suivantes ont été posées :

- le débit de la passe migratoire totalise 6 m³/s;
- l'écluse n'est pas opérée;
- le niveau d'eau en aval du barrage correspond au niveau du Saint-Laurent à Sorel (débit médian de la période étudiée), plus la perte de charge dans la rivière estimée à partir des lignes d'eau de 1978 et 1979;
- l'ouverture des vannes est toujours plus grande à la vanne 2, puis remonte en escalier vers les berges. La position des vannes a été établie en observant des scénarios similaires s'étant produits entre 2005 et 2015, puis à partir de la débitance des vannes calculée sur la base de l'équation de déversoir à parois mince.

4.2 RÉSULTATS DES SIMULATIONS

Le tableau 4-2 et les figures 4-1 à 4-5 présentent les vitesses d'écoulement (moyenne sur la profondeur) simulées pour les quatre cas types établis précédemment et pour un scénario d'étiage correspondant aux conditions du 23 septembre 2015 (le scénario d'étalonnage). Les vitesses maximales (tableau 4-2) sont données sur chacune des sections transversales tracées à intervalle de 40 m en amont du barrage et illustrées sur les figures. La figure 4-6 présente l'orientation des écoulements pour le scénario de débit moyen (776 m³/s aux rapides Fryer).

Tableau 4-1 Description des scénarios simulés.

SCÉNARIO	DESCRIPTION	DÉBIT À FRYER (m³/s)	NIVEAU D'EAU EN AVAL DU BARRAGE (m)	POSITION DES VANNES (ÉLÉVATION DE LA CRÊTE, m)				
				Vanne 1	Vanne 2	Vanne 3	Vanne 4	Vanne 5
Débit très élevé	Crue historique – 6 mai 2011	1 550	8,15	4,33 ⁽¹⁾	4,33	4,33	4,33	4,33
Débit élevé	Prob. dép. ⁽²⁾ de 10 % du 1 ^{er} au 15 mai	1 070	6,51	4,33	4,33	4,33	4,33	4,33
Débit moyen	Prob. dép. ⁽²⁾ de 25 % du 16 au 31 mai	776	5,66	5,75	4,33	4,33	5,00	5,75
Débit plus faible	Débit moyen du 1 ^{er} au 15 juin	550	5,26	5,95	4,33	5,18	5,95	5,95
23 septembre 2015	Scénario d'étalonnage	180	4,45	6,29	6,29	7,63 ⁽³⁾	6,28	6,28

(1) L'élévation 4,33 m correspond à la position complètement ouverte de la vanne.

(2) Probabilité de dépassement de la valeur pour la période donnée.

(3) Cette vanne était en réparation, fermée par des batardeaux.

Tableau 4-2 Niveaux d'eau et vitesses simulés.

SCÉNARIO	DÉBIT À FRYER (m³/s)	NIVEAU D'EAU EN AVAL DU BARRAGE (m)	NIVEAU D'EAU EN AMONT DU BARRAGE (m)	VITESSE D'ÉCOULEMENT MAXIMALE EN AMONT DU BARRAGE (m/s)				
				à 40 m	à 80 m	à 120 m	à 160 m	à 200 m
Débit très élevé	1 550	8,15	8,42	1,57	1,37	1,27	1,17	1,28
Débit élevé	1 070	6,51	6,97	1,69	1,25	1,16	1,08	1,23
Débit moyen	776	5,66	6,82	1,19	0,96	0,87	0,81	0,92
Débit plus faible	550	5,26	6,78	0,77	0,69	0,63	0,58	0,66
23 septembre 2015	180	4,45	6,86	0,30	0,20	0,19	0,18	0,20

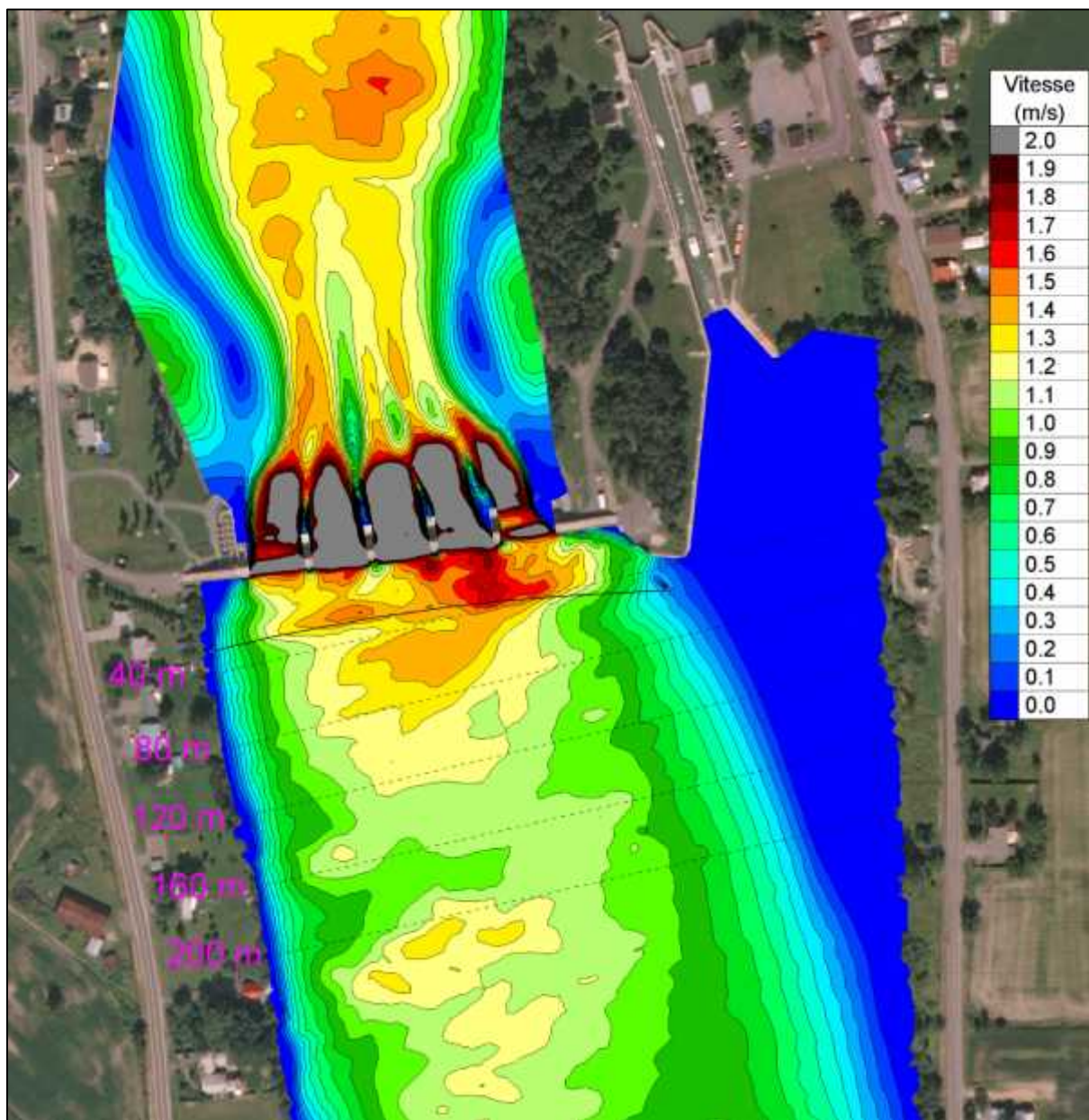


Figure 4-1 Vitesses d'écoulement à débit très élevé (1 550 m³/s aux rapides Fryer).

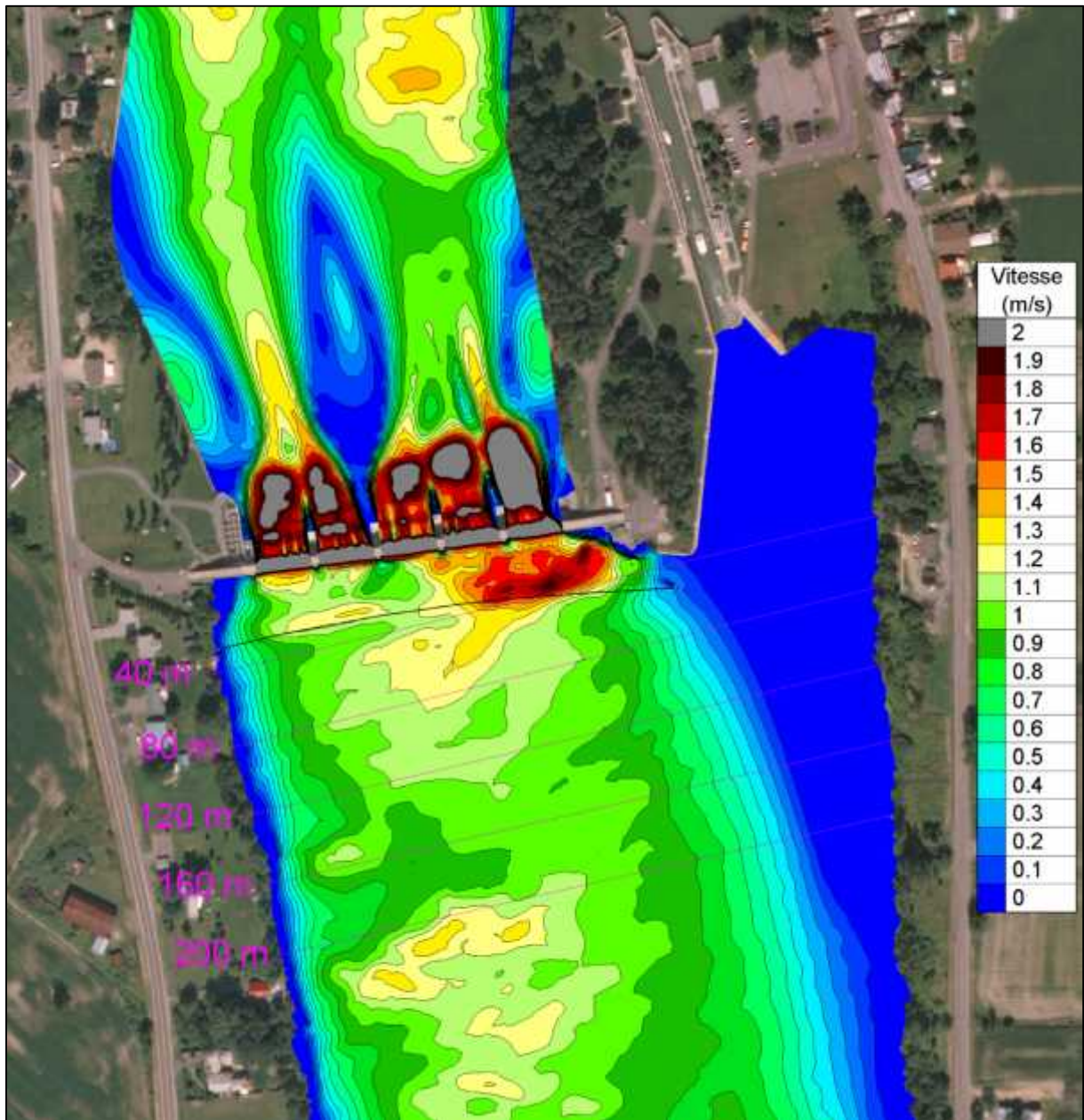


Figure 4-2 Vitesses d'écoulement à débit élevé (1 070 m³/s aux rapides Fryer).

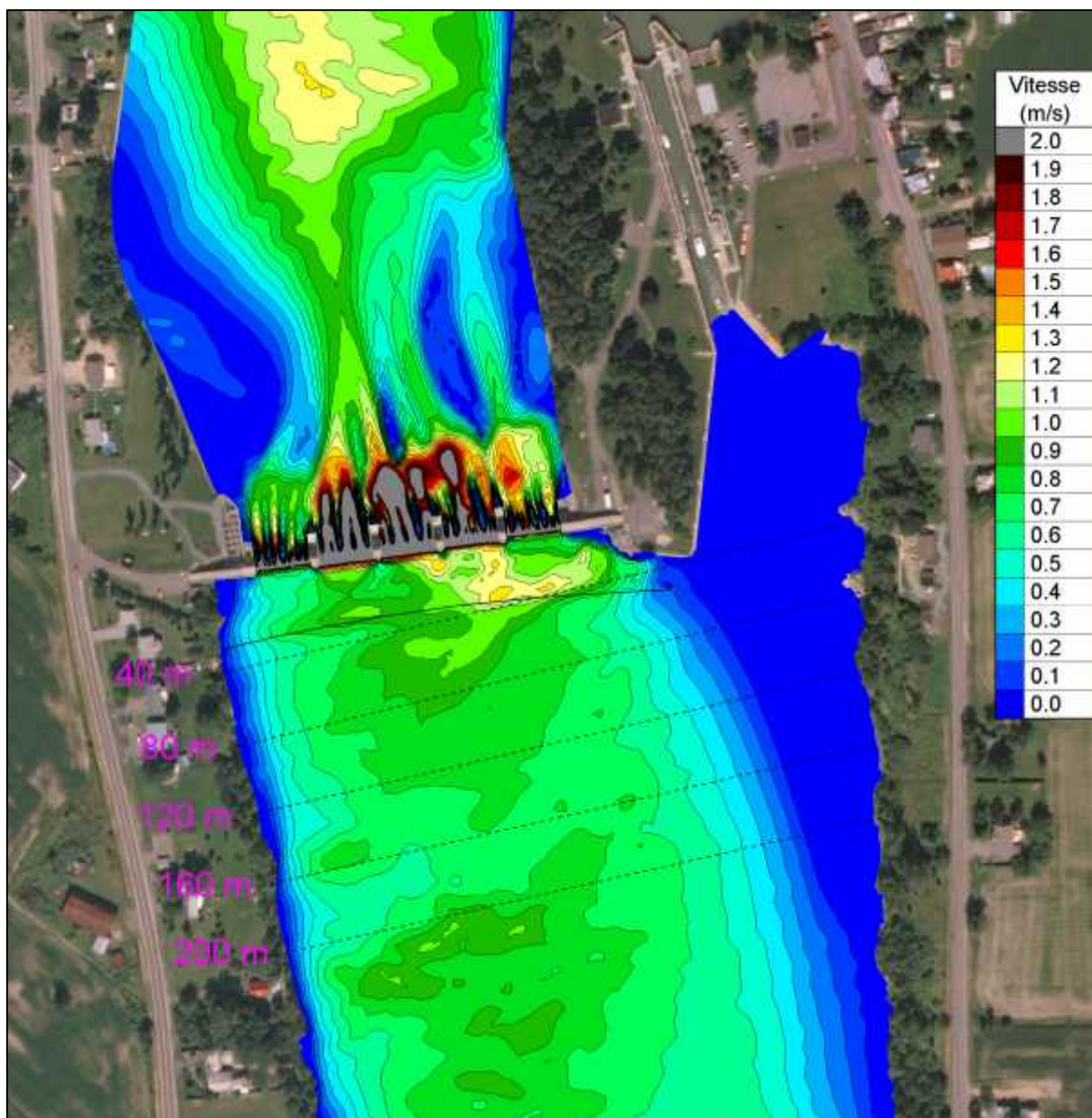


Figure 4-3 Vitesses d'écoulement à débit moyen (776 m³/s aux rapides Fryer).

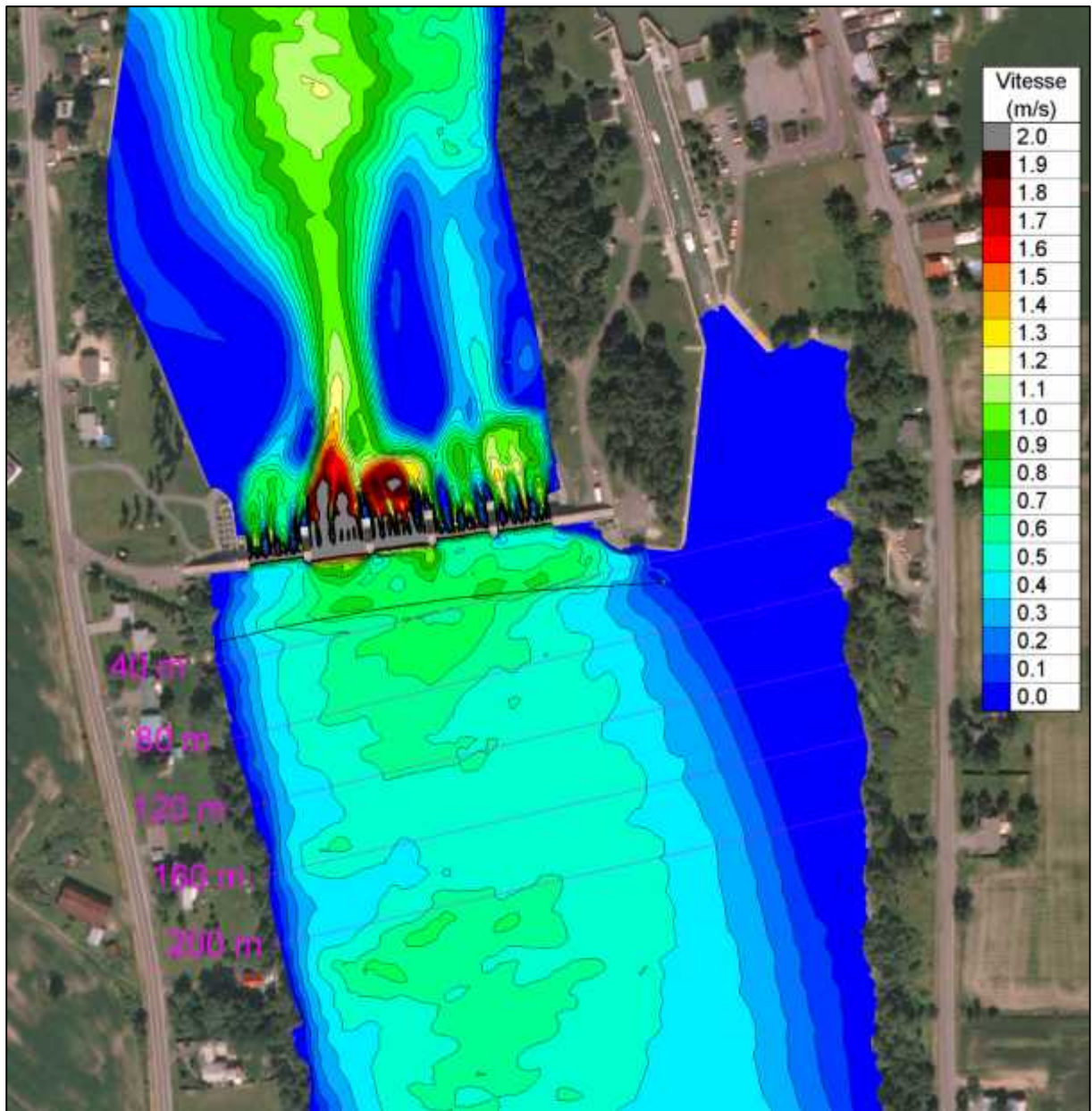


Figure 4-4 Vitesses d'écoulement à débit plus faible ($550 \text{ m}^3/\text{s}$ aux rapides Fryer).

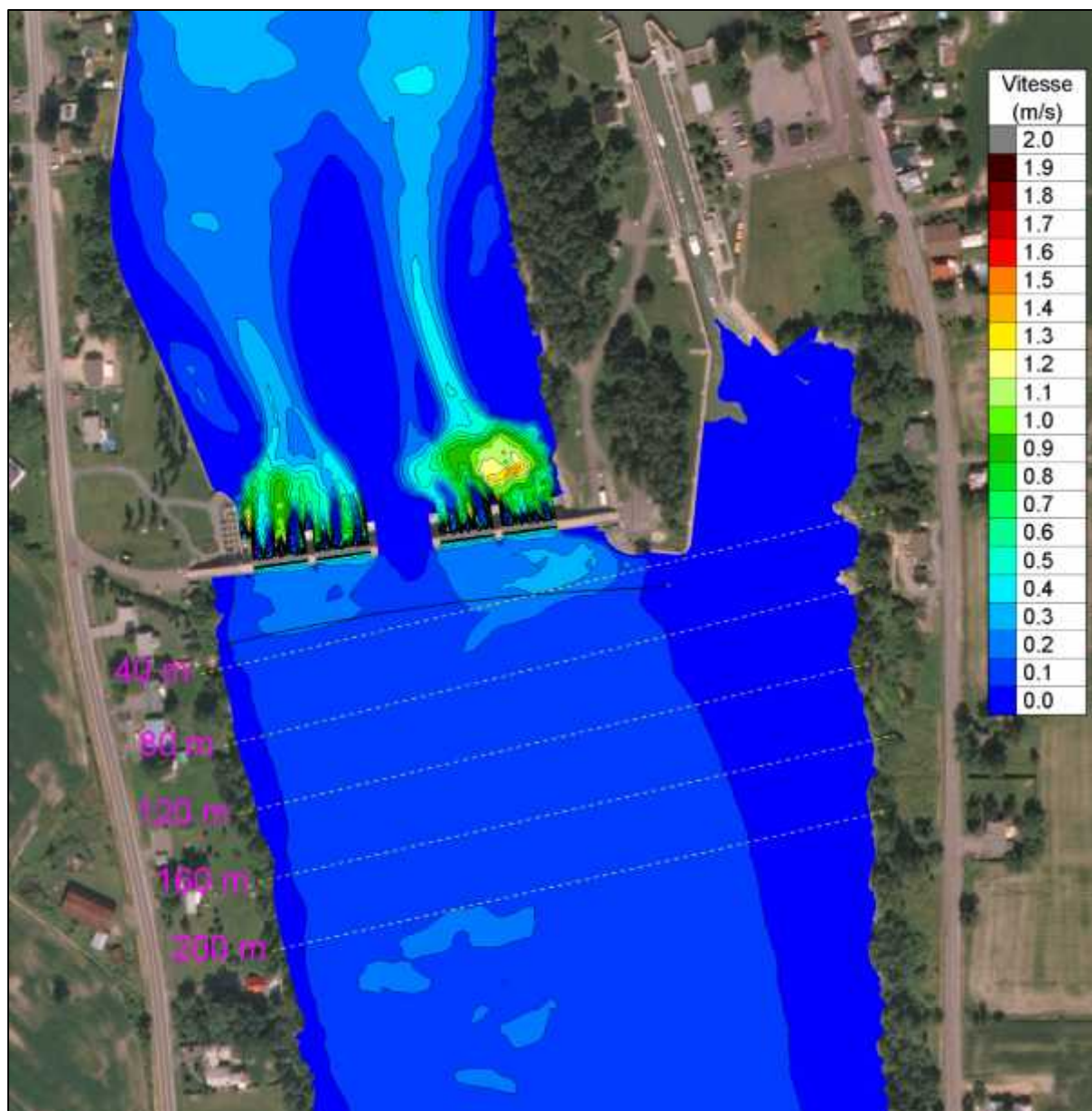


Figure 4-5 Vitesses d'écoulement en étiage (175 m³/s aux rapides Fryer).

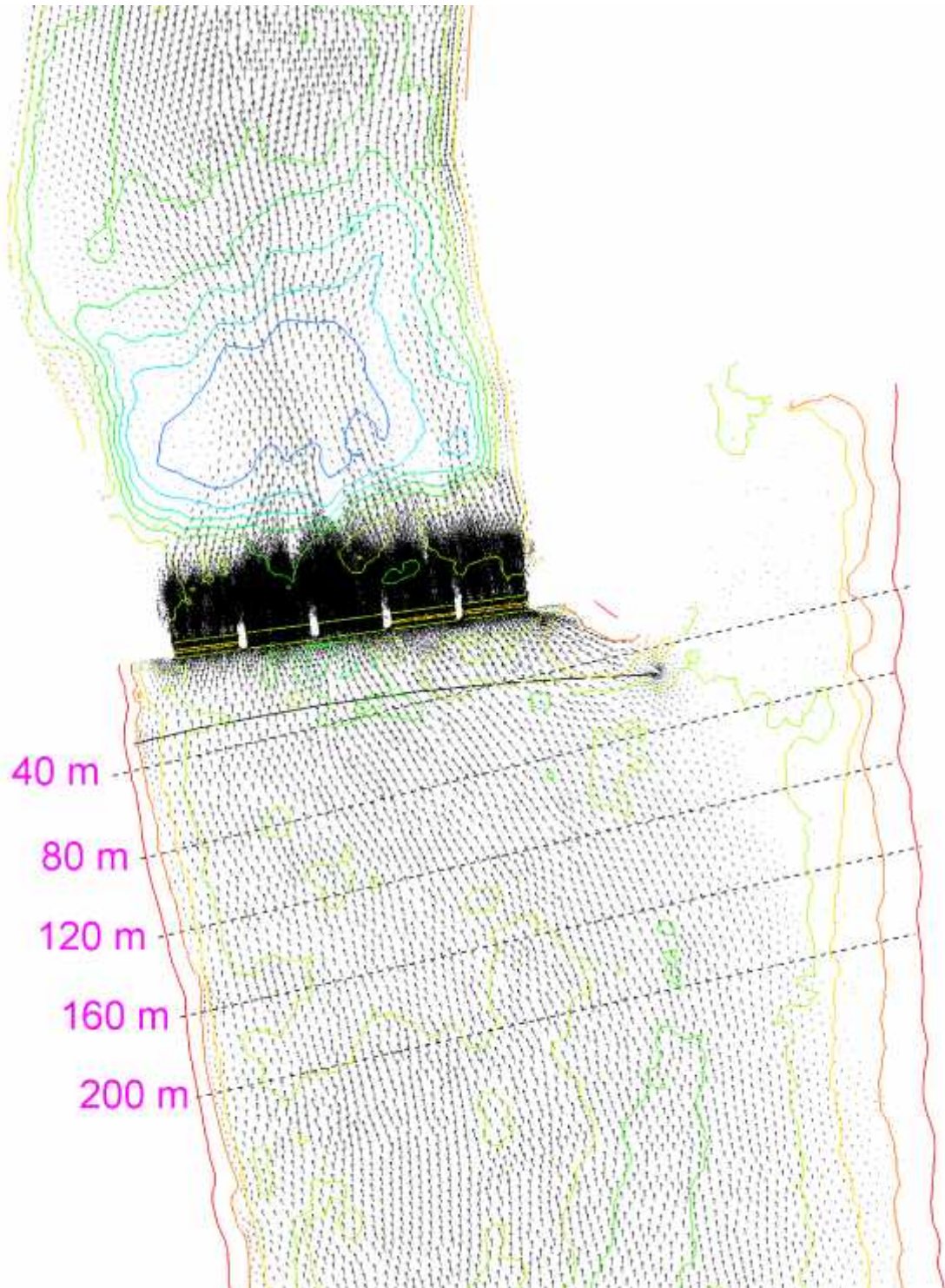


Figure 4-6 Direction de l'écoulement à débit moyen (776 m³/s aux rapides Fryer).

4.3 ANALYSE DE SENSIBILITÉ SUR LE PATRON D'OUVERTURE DES VANNES

Afin de compléter le portrait des conditions d'écoulement attendues durant la période visée pour l'installation des estacades, une analyse de sensibilité a été réalisée sur la configuration d'ouverture des vannes. Pour le scénario de débit moyen ($776 \text{ m}^3/\text{s}$ aux rapides Fryer), qui prévoit une ouverture en escalier depuis les vannes 2 et 3, qui sont complètement ouvertes, la configuration d'ouverture a été modifiée. Dans un premier cas, ce sont les vannes 1 et 2 qui sont complètement ouvertes (ouverture à gauche). Dans un second cas, ce sont les vannes 4 et 5 qui sont complètement ouvertes (ouverture à droite). La répartition transversale des vitesses pour les trois configurations d'ouverture est comparée graphiquement à la figure 4-7, à des distances de 80 et 120 m en amont du barrage. Cette analyse démontre que la configuration de l'ouverture dans ces conditions de débit n'a pas une influence significative, la différence sur la vitesse maximale obtenue étant de moins de $0,1 \text{ m/s}$.

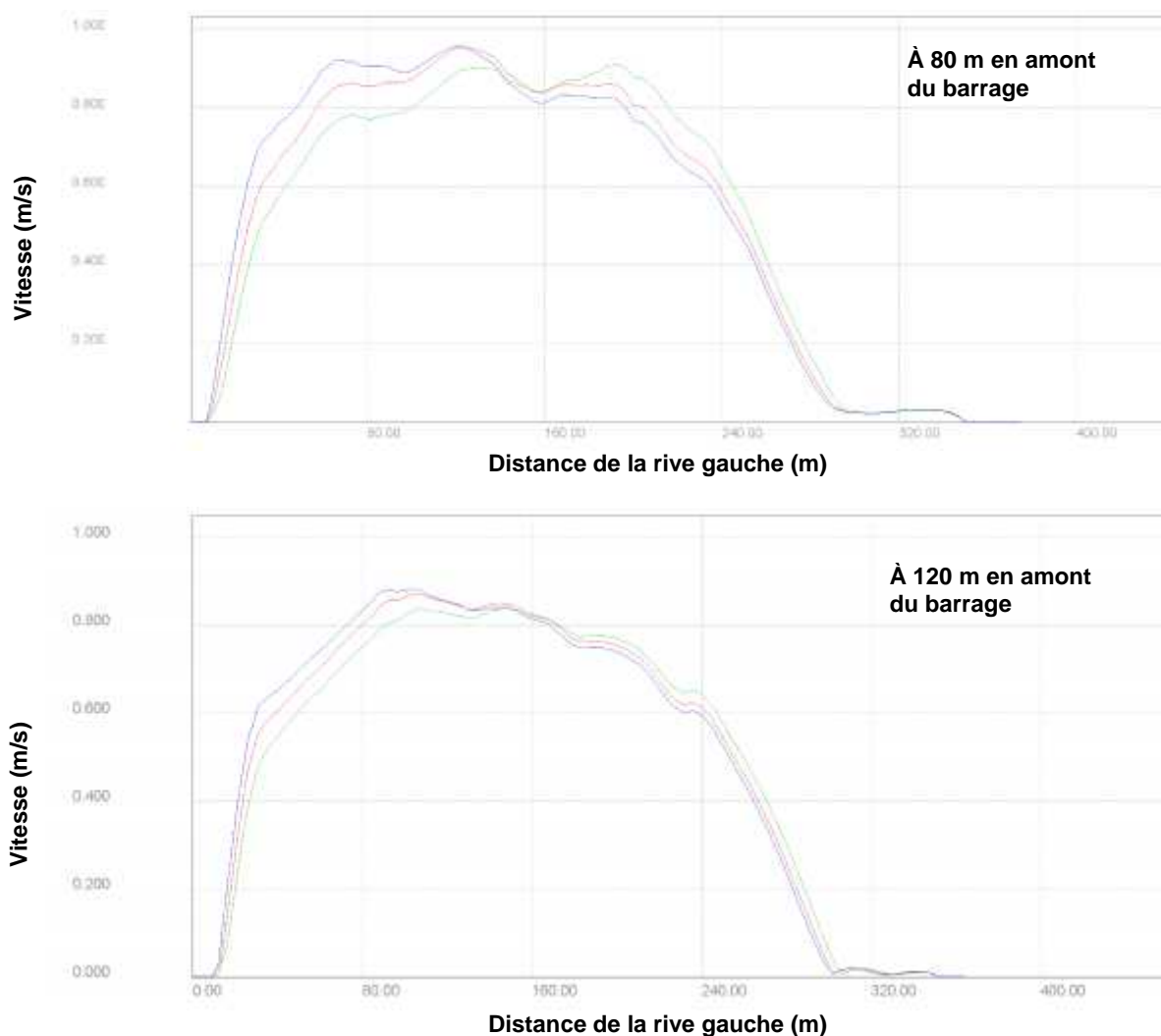


Figure 4-7 Répartition latérale des vitesses d'écoulement à 80 m et 120 m en amont du barrage de Saint-Ours (débit de $776 \text{ m}^3/\text{s}$ aux rapides Fryer).

4.4 IMPACT DU NIVEAU D'EAU AVAL SUR LES VITESSES EN AMONT DU BARRAGE

Un niveau d'eau du Saint-Laurent particulièrement élevé peut avoir pour effet de rehausser les niveaux d'eau en amont du barrage de Saint-Ours lorsque le niveau du seuil des vannes est dépassé. Cette situation est susceptible de se produire au moment de l'installation des estacades, qui a lieu durant la période de crues printanières. Les vitesses d'écoulement en amont du barrage se trouveraient réduites par cette augmentation du niveau d'eau amont, en raison de l'augmentation de la section d'écoulement pour un débit demeurant le même dans le Richelieu.

D'autre part, dans le cas inverse où le niveau d'eau du Saint-Laurent serait particulièrement bas durant la période d'installation de l'estacade amont, le niveau d'eau en amont du barrage serait quand même maintenu au niveau cible (généralement entre 6,7 m et 6,85 m en crue). Ce niveau est maintenu en modifiant l'ouverture des vannes du barrage en fonction du débit à laisser passer. Par conséquent, les vitesses d'écoulement en amont du barrage ne seraient pas augmentées par un niveau du Saint-Laurent particulièrement bas.

4.5 AMPLITUDE DE LA VARIATION DES NIVEAUX D'EAU

L'amplitude de variation des niveaux d'eau entre le 15 mai et la fin octobre aux estacades du barrage de Saint-Ours a été évaluée pour une probabilité de dépassement de 10 %. Il ne s'agit donc pas des niveaux d'eau extrêmes, mais plutôt de la gamme des niveaux d'eau qui seront rencontrés la plupart du temps, durant certaines périodes.

NIVEAU ÉLEVÉ :

Les analyses effectuées sur les données disponibles et résultats de simulations hydrauliques permettent de tirer les conclusions suivantes :

- débit de crue : la crue d'une probabilité de dépassement de 10 % est de 974 m³/s (aux rapides Fryer) pour la période du 15 au 31 mai, soit la période d'installation visée. Elle est légèrement supérieure à la crue annuelle d'une récurrence de 2 ans (914 m³/s);
- niveau aval : le niveau du Saint-Laurent à Sorel, pour cette même période du 15 au 31 mai, également d'une probabilité de dépassement de 10 %, est de 6,18 m. Il se traduit en un niveau d'eau en aval du barrage estimé à 70 cm plus haut en présence d'une crue de 974 m³/s, soit 6,88 m;
- niveau amont : en amont du barrage, pour un débit de 974 m³/s et un niveau en aval du barrage de 6,88 m et toutes les vannes ouvertes, on obtient un niveau d'eau de 7,11 m en amont du barrage.

NIVEAU BAS :

Les analyses effectuées sur les données disponibles permettent de tirer les conclusions suivantes :

- niveau amont : le niveau en amont du barrage est maintenu, en fermant les vannes, à une cote minimale de 6,70 m, selon les informations obtenues sur le mode d'exploitation du barrage;
- niveau aval : le niveau d'eau en aval du barrage correspond au niveau du Saint-Laurent à Sorel, dépassé 90 % du temps entre le 1^{er} mai et le 31 octobre. Pour la période de 1972 à 2010, ce niveau est évalué à 4,13 m. À ce niveau, on ajoute une perte de charge de 12 cm due à l'écoulement du Richelieu pour une même probabilité de dépassement (un débit de 137 m³/s à Fryer). Le niveau aval bas du barrage de Saint-Ours est donc 4,25 m.

Donc, en résumé :

- Amont du barrage :
 - niveau haut : 7,11 m;
 - niveau bas : 6,70 m.
- Aval du barrage :
 - niveau haut : 6,88 m;
 - niveau bas : 4,25 m.

5 CONCLUSIONS

Les simulations hydrauliques 2D effectuées ont permis de mettre en évidence que les vitesses d'écoulement dans la zone un peu en amont de l'estacade actuelle sont significativement plus faibles qu'à son emplacement actuel. La vitesse maximale passe de 1,2 m/s à l'emplacement actuel (soit 40 m en amont du barrage), à 0,9 m/s à 120 m en amont du barrage, pour un débit dont la probabilité de dépassement est de 25 % du 16 au 31 mai (le débit « moyen »).

L'avantage de déplacer l'estacade vers l'amont devient encore plus évident en cas de crue printanière tardive ou si l'estacade doit être installée durant la première moitié du mois de mai. Pour un débit dont la probabilité de dépassement est de 10 % du 1^{er} au 15 mai (le débit « élevé »), la vitesse d'écoulement passe de 1,7 m/s à 1,2 m/s entre 40 m et 120 m en amont du barrage.

6

RÉFÉRENCES BIBLIOGRAPHIQUES

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- DUMONT, P., J, LECLERC, J,-D, ALLARD ET S, PARADIS. 1997. *Libre passage des poissons au barrage de Saint-Ours, rivière Richelieu, Québec*. Ministère de l'Environnement et de la Faune, Direction régionale de la Montérégie, Service de l'Aménagement et de l'exploitation de la faune et Direction des ressources matérielles et immobilisations, Québec, et ministère du Patrimoine canadien (Parcs Canada), xiii + 88 p.
- GENIVAR. 2013. *Canal de Chambly – Études hydrotechniques*. Rapport de GENIVAR inc. à Parcs Canada. 119 p. et annexes.

ANNEXE A5

Dossier de photos

Photos

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 1

Flotteur typique de l'estacade amont existante.
Typical buoy (existing upstream safety boom).



Photo 2

Pilier d'ancrage amont côté droit, et vue sur le point de fixation localisé sur le mur de soutènement de l'île Darvard.
Upstream right bank anchor pile. View of the anchoring point located on Darvard Island retaining wall.

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 3

Pilier d'ancrage amont côté droit.
Upstream right bank anchor pile.



Photo 4

Pilier d'ancrage amont côté droit et vue sur l'estacade existante (de la rive droite).
Upstream right bank anchor pile. View of the existing safety boom (from the right bank).

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 5

Pilier d'ancrage amont en rive gauche.
Upstream left bank anchor pile.



Photo 6

Pilier d'ancrage amont en rive gauche.
Upstream left bank anchor pile.

REMPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 7

Vue – de l'aval - sur l'enrochement de l'île Darvard (rive gauche de l'île).
View (from downstream) of Darvard Island riprap (left bank of the island).



Photo 8

Vue – de l'aval - sur l'enrochement de l'île Darvard (rive gauche de l'île).
View (from downstream) of Darvard Island riprap (left bank of the island).

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 9

Enrochement de l'île Darvard (rive gauche de l'île).
Darvard Island riprap (left bank of the island).



Photo 10

Enrochement de l'île Darvard (rive gauche de l'île).
Darvard Island riprap (left bank of the island).

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 11

Enrochement de l'île Darvard (rive gauche de l'île).
Darvard Island riprap (left bank of the island).



Photo 12

Mur de soutènement en aval du barrage, en rive gauche, à la limite de la propriété de l'APC.
Retaining wall downstream of dam (left bank) at PCA's property limit.

REMPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 13

Mur de soutènement en aval du barrage, en rive gauche, à l'extérieur de la limite de propriété de l'APC.
Retaining wall downstream of dam (left bank) outside PCA's property limit.



Photo 14

Mur de soutènement en aval du barrage, en rive gauche, à l'extérieur de la limite de propriété de l'APC.
Retaining wall downstream of dam (left bank) outside PCA's property limit.

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 15

Mur de soutènement en aval du barrage, en rive gauche, vue vers le barrage.
Retaining wall downstream of dam (left bank). View towards dam.



Photo 16

Mur de soutènement en aval du barrage, en rive gauche, vue vers l'aval.
Retaining wall downstream of dam (left bank). View towards downstream.

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 17

Île Darvard – Chemins d'accès à proximité du barrage (vue en direction du barrage).
Darvard Island – Access roads near dam (view towards dam).



Photo 18

Île Darvard – Chemins d'accès à proximité du barrage (vue en direction de l'aval).
Darvard Island – Access roads near dam (view towards downstream).

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 19

Île Darvard - Chemin d'accès (à proximité du point d'installation de l'ancrage aval côté droit) et vue sur le mur de soutènement en rive gauche.
Darvard Island – Access road (near the downstream right bank anchor installation point). View of the left bank retaining wall.



Photo 20

Île Darvard - Enrochement (à proximité du point d'installation de l'ancrage aval côté droit).
Darvard Island – Riprap (near the downstream right bank anchor installation point).

REPLACEMENT DE L'ESTACADE DE SÉCURITÉ DU BARRAGE
LHNC DU CANAL-DE-SAINT-OURS



Photo 21

Île Darvard – Vue sur le barrage, à proximité du point d'installation de l'ancrage aval côté droit.
Darvard Island – View of the dam, near the downstream right bank anchor installation point.



Photo 22

Île Darvard - Chemin d'accès, vue vers l'amont.
Darvard Island – Access road, view towards upstream.

ANNEXE A6

Fiche signalétique des repères géodésiques

Survey Markers Data Sheet

Données descriptives

■ Identification

Matricule : 722308 (N° R-39)

Type de point : Point plan. intégré rés. niv.

Date d'inspection : 1997-04-22

État : En bon état

■ Repère

Description : Médaillon convexe ancré(e) sur une dalle/base de béton

Inscription : AGENCE MARITIME SOREL R-39

Illustration : Croquis

Grille d'obstacle : Aucune

Classe : Repère artificiel permanent

Regard : Absence de regard

Site : Voir accès et situation topo.

Magnétisme : Repère non détectable

■ Localisation

Accès et situation

Le point est situé sur l'écluse à l'ouest de l'écluse St-Ours, le médaillon est sur le sommet de l'écluse, environ 75 mètres à l'est de la porte ouest, 95 cm au sud du parapet. Nord barrière ouverte le jour de 8:00 à 17:00 du lundi au vendredi.

Municipalité : 53040 Saint-Roch-de-Richelieu (M)

Mode de transport : Automobile

Adresse du propriétaire

PARC CANADA "ROBERT MORIN"

Données altimétriques - CGVD28

Altitude orthométrique (m) : 13,687

Ordre : 1X

Méthode : Nivellement géométrique

Classe : 1 - Excellent

Statut : Organisme de calcul

Modèle : HT-2

Projet : A04L78 (1)

Date de publication : 1978-01-01

Ondulation du géoïde (m) : -31,099

Produit en vertu d'une licence de sa majesté la reine du chef du Canada, représentée par le ministre des ressources naturelles

Données planimétriques - NAD83

Feuille : 31H14-200-0102

Ordre : 3B

Méthode : Polygonation

Classe : 3 - Acceptable

Statut : Validée(s)

Projet : S26T83 (8)

Date de publication : 1991-02-11

■ Coordonnées

Système	Fuseau	Latitude/y (m)	Longitude/x (m)	Facteur d'échelle	Convergence
Géo.		45° 51' 46,68475"	73° 08' 57,00294"		
UTM	18	5 080 488,094	643 666,901	0,999 853 7	+ 1° 19' 42,69"
SCOPQ	8	5 080 406,590	332 040,925	0,999 909 1	+ 0° 15' 06,43"

■ Points visés

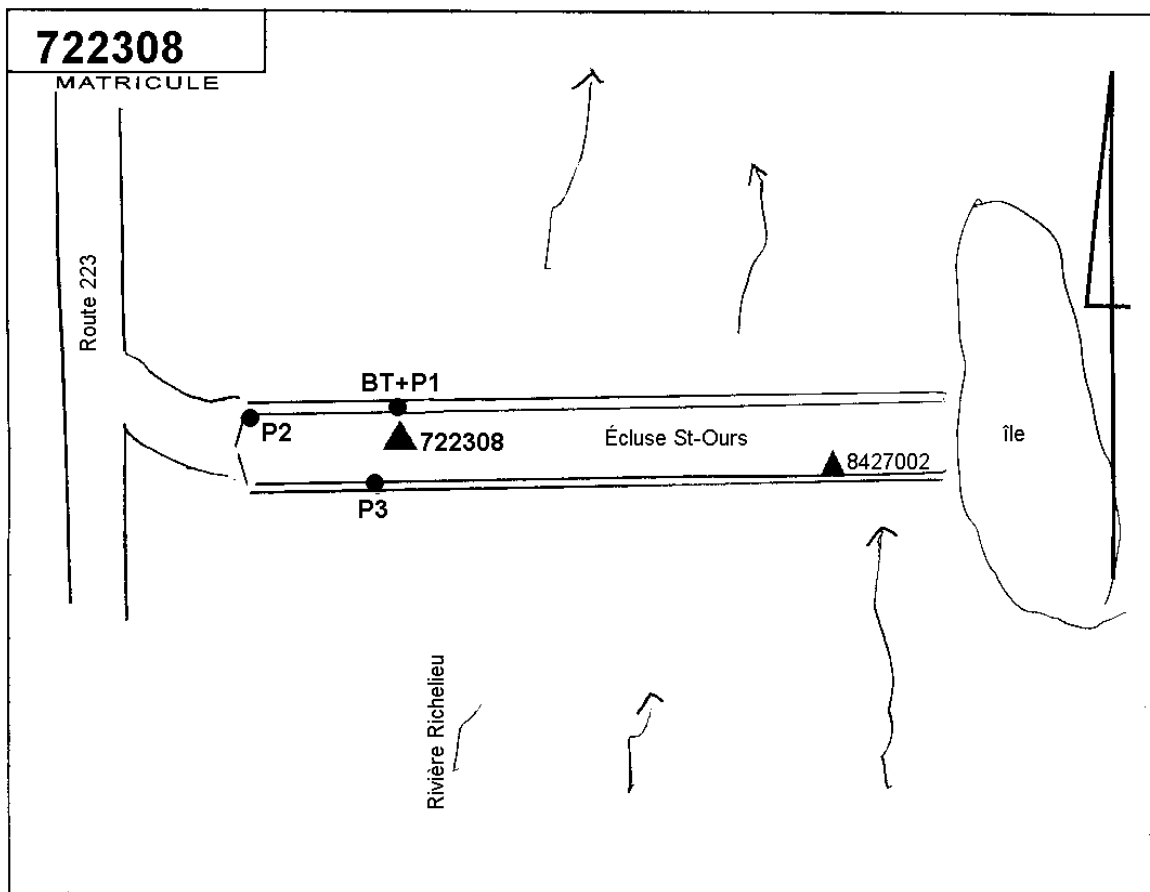
Matricule	Origine	État	O	C	Azimut géo.	Distance géo. (m)	Gisement (SCOPQ)	t-T
67KP073	2907	Bon état	IB	1	357° 24' 36,74"	2 887,215	357° 09' 30,12"	-0,20
7223014	R-38	Détruit	3B	3	351° 43' 56,43"	2 942,177	351° 28' 49,80"	-0,20
722309	R-40	Détruit	3B	3	176° 45' 46,91"	2 197,329	176° 30' 40,64"	0,15
8129111	8129111	Détruit	3B	3	167° 16' 56,63"	1 402,218	167° 01' 50,29"	0,09
8129112	8129112	Détruit	3B	2	352° 09' 34,35"	1 448,753	351° 54' 27,82"	-0,10
8129186	8129186	Bon état	IB	2	350° 13' 11,30"	3 268,271	349° 58' 04,65"	-0,22

Matricule : 722308 (N° R-39)

Repérage

Code	Identification des points	Code	Orientation	Code	Distance (m)	Dénivelée (m)
BT	Balise sur parapet	B	358°	H	0,93	
P1	Bordure de béton clôture	B	358°	H	0,71	
P2	Poteau clôture entrée ouest	B	270°	H	68,70	
P3	Poteau de lumière a-7	B	200°	H	4,13	

■ **Croquis**



Données descriptives

■ Identification

Matricule : 8427002 (N° 8427002)

Type de point : Point planimétrique

Date d'inspection : 2014-05-01

État : En bon état

■ Repère

Description : Médaillon convexe ancré(e) sur une dalle/base de béton

Inscription : CANADA LANDS SURVEYS 1984 NO 8427002

Illustration : Photographie

Grille d'obstacle : Aucune

Classe : Repère artificiel permanent

Regard : Absence de regard

Site : Voir accès et situation topo.

Magnétisme : Repère non détectable

■ Localisation

Accès et situation

Au village de Saint-Roch, prendre la rue Saint-Jean-Baptiste (route 223) en direction de Beloeil jusqu'au barrage. Le repère est sur le barrage plus sur le côté de l'île Darvard. Ouverture de la barrière de 8:00 à 17:00 du lundi au vendredi.

Municipalité : 53032 Saint-Ours (V)

Mode de transport : Automobile

Données altimétriques - CGVD28

Altitude orthométrique (m) : 13,67

Ordre : 3B

Méthode : Nivellement géométrique

Classe : 1 - Excellent

Statut : Validée(s)

Projet : I18X14 (2)

Date de publication : 2015-03-23

Ondulation du géoïde (m) : -31,098

Modèle : HT-2

Données planimétriques - NAD83

Feuille : 31H14-200-0102

Ordre : 4B

Méthode : Polygonation

Classe : 1 - Excellent

Statut : Validée(s)

Projet : J06X84 (3)

Date de publication : 1991-01-30

■ Coordonnées

Système	Fuseau	Latitude/y (m)	Longitude/x (m)	Facteur d'échelle	Convergence
Géo.		45° 51' 47,05167"	73° 08' 52,07988"		
UTM	18	5 080 501,881	643 772,787	0,999 854 1	+ 1° 19' 46,23"
SCOPQ	8	5 080 418,385	332 147,058	0,999 909 2	+ 0° 15' 09,96"

■ Points visés

Matricule	Origine	État	O	C	Azimut géo.	Distance géo. (m)	Gisement (SCOPQ)	t-T
67KP073	2907	Bon état	IB	1	355° 17' 31,17"	2 882,667	355° 02' 21,01"	-0,20
8129186	8129186	Bon état	IB	2	348° 21' 25,26"	3 276,879	348° 06' 15,08"	-0,22
8427001	8427001	Bon état	4B	1	264° 57' 59,05"	241,068	264° 42' 49,09"	0,00
8427003	8427003	Détruit	4B	1	26° 04' 00,20"	218,392	25° 48' 50,22"	-0,01
9024004	9024004	Bon état	IB	1	351° 49' 40,67"	1 192,579	351° 34' 30,63"	-0,08
9024005Y	LF-2202	Détruit	IB	1	326° 47' 48,38"	769,333	326° 32' 38,38"	-0,04
93KSV34	93KSV34	Bon état	4B	1	138° 15' 23,04"	353,432	138° 00' 13,10"	0,02

Matricule : 8427002 (N° 8427002)

Repérage

Code	Identification des points	Code	Orientation	Code	Distance (m)	Dénivelée (m)
BT	Balise poteau sur parapet	B	218°	H	1,03	
P1	Face nord muret sud	B	168°	H	0,59	
P2	Barrière est de l'écluse	B	90°	H	34,76	
P3	Lampadaire no a-17	B	136°	H	1,25	
P4	Lampadaire no a-16	B	254°	H	9,80	

■ **Croquis**

