North Perimeter Wall Rehabilitation: Phase 3

Parliament Hill, Ottawa, ON,
Ottawa, ON

Final Design Development Report

Date: October 6th, 2014
Client: Public Works and Government Services Canada
PWGSC Project Number: R.011800.01
RMA Project No.: 13378

Robertson Martin Architects

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Executive summary

Robertson Martin Architects (the Consultant) was engaged by PWGSC to undertake a project to rehabilitate the North Perimeter Wall (NPW) on Parliament Hill, Ottawa, between Piers 33 to 45, and reconstruct the adjacent pathway around the Summer Pavilion from Piers 45 to 46, the third phase of wall rehabilitation. The work is to follow conservation principles and guidelines, predominantly an approach of minimum intervention, respecting the existing heritage character of the Parliament Hill Grounds.

The North Perimeter Wall consists of a low stone base with a wrought iron and cast iron/steel fence. It is part of the Parliament Hill Grounds which have been designated *Classified* by FHBRO, and also falls under the *National Historic Site* designation for Parliament Hill.

This report builds on the information, comments and decisions taken in the preceding 66% Design Development and Schematic Development Phase. The Schematic Design Report provided analysis of conditions, project requirements, and proposed options to rehabilitate the wall. The Consultant was directed to proceed with and develop "**Option 3B Hybrid Option - Partly Lower Path, Partly Raise Wall including raising the Lookout, combined with partial dismantle and rebuild of the masonry wall**." Overall, the option resolves the current conflict between the path and wall elevations in a more permanent way that will not require subsequent intervention during the Centre Block Major Rehabilitation Project as it had been initially thought necessary while minimizing impact on adjacent landscape elements and keeping within project budget and schedule. Key changes from the Schematic Design report, following advancement of the design include: removal of insulation below the footing where the walls are bearing on bedrock, retention of existing concrete support walls over tunnels only; and an adjustment to the footprint of the Lookout to permit the fencing to be restored to evenly spaced panels.

Comments made by stakeholders on the 66% Design Development report have been addressed in this report and the relevant drawings were revised. The most important change is the increase of the width of Library Drive to 7.5m on the north-east side of the Library, to allow for increased space for construction traffic. The impact of the Centre Block access road on the underground utilities is also discussed in the report and shown in the revised drawings. Clarifications to other stakeholder questions and comments is offered both in Appendix E and throughout the report.

Discussion on recommended pathway material was ongoing throughout the Design Development Stage. This was also discussed in the Schematic Design Report, and it is noted that stakeholders and the project team are in general agreement that limestone pavers should be installed along the length of the pathway in lieu of the standard asphalt that was installed for the informal part of the Perimeter Pathway in the Phase 1 project. However, this constitutes a change from the RFP requirements, which call for the implementation of a pathway paving material as accepted for Phase 1 (standard asphalt). In keeping with the TOR, and pending formal direction from PWGSC, standard asphalt will be the basis of design, except for around the Summer Pavilion, which will be stone paving. Consultant recommendations on pathway materials and lessons learned from the Phase 1 Pathway project regarding installation and design intent for limestone pavers are discussed briefly in this report.

Concurrent to this report, the program to pre-purchase of stone for rebuilding the wall has continued and is presently in tender. The tender is open to suppliers and stone cutting shops to provide stone from the St. Marc quarry in Quebec, as directed by PWGSC. In parallel to this a testing program is also underway to research into alternative stone supplies, should quality stone not be available from St. Marc.

A one-phased construction program is recommended for the overall rehabilitation project. A *Class B* estimate for the proposed option came in at **$5,038,300.00 *(Before taxes).***

1. Introduction

1.1 Report Mandate

The purpose of this report is to provide detailed description and analysis of design development for the North Perimeter Wall between Piers 33-45 and around the Summer Pavilion. The report builds on the Pre-Design Report and Schematic Design Report previously submitted, and on previous experience and lessons learned from the preceding two phases of rehabilitation of the North Perimeter Wall.

1.2 Project requirements

Robertson Martin Architects (the Consultant) was engaged by PWGSC to undertake a project to rehabilitate the North Perimeter Wall from Pier 33 to Pier 45 as well as reconstruct the adjacent pathway from Pier 33 to 46 (around the Summer Pavilion). This is the third phase of work for the North Perimeter Wall. Excerpted from the Consultant Terms of Reference for the project, the overall objectives of the project are as follows:

- Provide a design solution that resolves root causes of existing deficiencies and achieves a long lasting solution for this wall section, that is consistent with the approach taken from Phases 1 and 2, and follows the *Standards and Guidelines for the Conservation of Historic Places in Canada;*
- Respect the heritage character of this historically important structure;
- Address health and safety threats; and
- Ensure the long-term sustainability of the wall.

Specific objectives include:

- Maintaining as much access to the site as possible for the visiting public;
- Completing the work and vacating the site before the start of construction of other major projects, specifically the Centre Block Major Rehabilitation Project;
- Mitigating health and safety risks associated with the deteriorated condition of the North Perimeter Wall and adjacent path (specifically the lack of fall protection anchors and the height of the wall and railing relative to the pathway, which presents safety concerns especially along sections of the wall where the height is below 1070mm);
- Identifying the locations of the path that will need to be lowered as part of the future Centre Block project and provide additional courses of stone below grade to account for the future lowering;
- Evaluate the structural integrity of the foundation and assess if the foundation can properly support the masonry wall above;

- Review and analyze foundation support detail options, pros and cons with respect to project objectives, and make recommendation for the preferred option;
- Repair and/or reconstruct the masonry footing, foundation and above-grade structural elements as required;
- Restore the integrity of the masonry components including, but not limited to, repairing and replacing masonry face stones, capstones and pier stones;
- Procure high quality replacement masonry components including face stones, pier stones and capstones;
- Restore the integrity of the ironwork fence including repairing and replacing ironwork components, re-painting, and installation of new collars;
- Provide permanent fall arrest anchor system suitable for maintenance work to be performed on the escarpment, visually and physically compatible with the wall construction with least harm to heritage character. Evaluate anchor system options and recommend preferred option;
- Provide proper drainage along the wall and adjacent path;
- Replace the asphalt surface along the path with paving surface as approved for the Phase 1 Pathway, a including a limestone border; and replace the surface around the Summer Pavilion with limestone pavers.

The work will be completed under the Public Works and Government Services Canada (PWGSC) Long Term Vision & Plan (LTVP) for the Parliamentary Precinct Recapitalization Program to address urgent work necessary to preserve assets and deal with health and safety issues until such time as the buildings and grounds can undergo major renovations.

1.3 Update from 66% Design Development

The major discussion points that came out after the Design Development presentation are addressed below. The report and drawings were updated to reflect discussions during the Design Development presentation, stakeholder comments and coordination meetings. Design Development Minutes and project team's answers to stakeholder comments are appended to the report.

Coordination with the Centre Block Major Rehabilitation Project

During the Design Development presentation it was discussed that the Centre Block access road will located immediately next to the NPW path. Our team reviewed the Centre Block draft mobilization plan to determine if underground infrastructure can be buried deeper to accommodate the road. See sections 2.8, 9.3 and drawing C101-102.

Changes to Library Drive Width

Preliminary information received from Center Block project for the required width of Library Drive was that 6.5m would be adequate. During the Design Development Presentation concerns were raised by the Centre Block and West Block teams that the 6.5m width is no longer appropriate for the increased construction traffic on the Hill. Following additional study and coordination meetings it was agreed that the roadway will be increased to 7.5m. to provide sufficient room for construction and regular traffic. See revised mobilization plan - A100 and section 2.8.

Planting on the Escarpment

Some of the existing lilacs will need to be removed during construction. It is agreed that lilacs should not be planted as replacement. The objective of the new plants will be to provide a more sustainable biodiversity while maintaining the spectacular view to the river. Since the new plants will be located on a little plateau, the need for them to act as retaining structure is not as important as for the rest of the escarpment.

Planting material will be selected based on two criteria: that it is indigenous to the area and that it naturally grows low (less than 4 feet) in order to maintain the vista to the river. Also, replacement planting will not be composed of a single species, but will rather be made of a mix of low shrubs and ground covers to help increase biodiversity on the escarpment.

Coordination will be made with previous studies that have already addressed the issue of planting on the escarpment, such as the West Slope Staircase project and the Slope Vegetation Management Plan.

Pathway Material

Final choice of material for the main path is still to be confirmed, but it is noted that regular asphalt is not acceptable. It is the Consultant team's recommendation that limestone pavers be installed for the Perimeter Pathway - see section 8.1.1. Regular asphalt will be used for the secondary paths, since they will be used only for the short period between the end of this project and the beginning of Center Block mobilization.

1.4 Update from Schematic Design

On completion of the Schematic Design Stage the Consultant was directed to proceed with **Option 3B, partly lowering the path and partly raising the wall, including raising the wall at the Lookout** in order to limit impact on both the wall itself and adjoining monuments and landscape elements. The proposed option provides a more permanent way of responding to project requirements than initially expected. The hybrid option introduces limited changes to both wall height and pathway in a way that minimizes impact on adjacent landscape elements but provides needed wall height for health and safety and respects heritage value and the original aspect of the wall. This means that the grades at which the pathway is installed as part of this project can remain as final, with no further modifications during the Centre Block Major Rehabilitation Project. This, coupled with the uncertainty of the Cantilevered Walkway proposed for the back of the NPW in the Parliament Hill Landscape Plan, has led

stakeholders to reopen the discussion about options for pathway materials. Stakeholder preference is to install stone paving along the full length of the wall instead of standard asphalt as accepted for Phase 1, which is a change from the RFP. However, formal direction to proceed with installing limestone pavers has not been received to date. For the purpose of this report, lessons learned from the Phase 1 Pathway project are discussed, as well as the reasoning why limestone pavers are proposed as the pathway material. However, no advancement has been made on design of the pathway paving materials pending direction from the Project Manager.

1.5 Project Team and Stakeholders

The Project Team consists of:

- Robert Martin, OAA, CAHP, Conservation Architect, Robertson Martin Architects.
- James Maddigan, MScA, CAHP, Building Conservation Specialist, Robertson Martin Architects.
- Cristina Ureche-Trifu, M.Arch, M.A, Intern Architect, Robertson Martin Architects.
- John Cooke, Senior Conservation Structural Engineer, John G. Cooke and Associates Ltd.
- Lisa Nicol, Project Structural Engineer, John G. Cooke and Associates Ltd.
- Curtis Melanson, Civil Engineer, McIntosh Perry Consulting Engineers Ltd.
- Kristopher Parent, Landscape Architect, Groupe BC2 Consultants.
- Jeremy Glenn, Landscape Architect, Groupe BC2 Consultants.
- David Gilbert, Lead Geotechnical Consultant, Patterson Group.
- Craig Sims, Ironwork Conservator.
- Trevor Gillingwater, Masonry Conservator.
- Heather Tulloch, Project Archaeologist, Golder Associates Ltd.
- Simon Kasprzak, Surveyor, Adam Kasprzak Surveying Ltd.

Stakeholders include:

- National Capital Commission (NCC).
- Parliamentary Precinct Branch (PPB).
- Federal Heritage Buildings Review Office (FHBRO) / Parks Canada.
- Public Works & Government Services Canada.
- Users of Parliament Hill including:

- The House of Commons and Senate.
  - Members of Parliament, Ministers, Senators and their staff.
  - House of Commons and Senate administrative and support services, including building specific service units, administrative services and centralized support services.
- The Library of Parliament.
- Public Works and Government Services Canada.
- The public.

- Royal Canadian Mounted Police.
- Canadian Peace Officers' Memorial Association.

1.6 Project Approach and Methodology

Following site analysis, and based on previous studies of the North Perimeter Wall, the following premises were established regarding the design of the North Perimeter Wall.

Premises:

- Minor changes to the original geometry have occurred over the years, both for the wall and the path. We assume that the original intention was to create a wall that was horizontal, with changes in elevations at the piers only. We also assume that the slope of the original path was regular, without bumps and depressions. In accordance with these assumptions, the wall will be reinstalled horizontal and plumb and the path will have regular slopes.
- Exploratory excavations have shown that the stone face of the wall was gradually hidden by successive addition of asphalt on top of the original path, which appears to have been installed just above the joint between bottom of the wall face stone and top of the concrete foundation. This shows that the original intent was never to have the top of the path just below the copping stone as we can see at different areas of the North Perimeter Wall. In order to maintain an adequate amount of face stone visible, we will aim at having a minimum height of 200 mm of visible stonework, which gives a minimum height of 350mm for the wall to the top of capstone. This minimum height is representative of the height of stonework that can be observed in the exploratory excavations and along the remaining length of the wall, including Phases 1 and 2.
- The relationship between the piers and the wall should be coherent throughout the site. When close to the top of the pier, the top of the wall should align with the bottom of the pier's chamfer. When there is a change in elevation, those changes should be as regular as possible.

- The path should be of a standard width and be universally accessible (maximum of 5% slope), everywhere it is possible, as requested in the Parliament Hill Landscape Plan (PHLP) and the most recent version of the Parliament Hill Landscape Plan Implementation Strategy and Guidelines (PHLPISG).
- On the escarpment side, the wall should allow for the installation of fall arrest anchors for the safety of workers. This requires that the face of the concrete support wall on the escarpment side be at least 350 mm below the capstone and soil be removed at the back of the wall to this elevation.

Code Requirements:

Both the National Building Code and the Ontario Building Code provide height requirements for guards and barriers.

Article 3.3.1.18 of NBC Division B, Sentence (1) paragraph c): "a guard not less than 1 070 mm high shall be provided [....] at each raised floor, mezzanine, balcony, gallery, interior or exterior vehicular ramp, and at other locations where the difference in level is more than 600 mm."

As per article 3.3.1.17 paragraph c) of the Ontario Building Code (OBC) Division B: "a guard not less than 1 070 mm high shall be provided [....] at each raised floor, mezzanine, balcony, gallery, interior or exterior vehicular ramp, and at other locations where the difference in level is more than 600 mm."

Per article 4.4.3 of OBC Division B: "Every retaining wall that is designated in Sentence 1.3.1.1.(1) of Division A shall be protected by guards on all open sides where the public has access to open space at the top of the retaining wall."

Article 1.3.1.1. of OBC Division A, Sentence (1) paragraph a):

(1) "The following structures are designated for the purposes of clause (d) of the definition of building in subsection 1 (1) of the Act:

(a) a retaining wall exceeding 1 000 mm in exposed height adjacent to,

(i) public property,

(ii) access to a building, or

(iii) private property to which the public is admitted."

1.7 Conservation Approach

1.7.1 Heritage designation

The Parliament Hill Grounds have been designated as “Classified” by the Federal Heritage Buildings Review Office (FHBRO) because: it is one of the better Canadian examples of urban and institutional landscape design; it

was designed by the famous architect Calvert Vaux; it is the site for many nationally significant events and ceremonies; and it is a national landmark. The North Perimeter Wall is also located within the Parliament Buildings National Historic Site of Canada.

The Heritage Character Statement for the Parliament Hill Grounds identifies the following elements as having heritage value:

- the relationship between the grounds, the buildings, Wellington Street, and the Ottawa River;
- the scale, simplicity, and monumental appearance of the lawns;
- the formal composition of the southern grounds, their symmetry and linearity;
- the tension and contrast between the manicured centre and the rugged periphery;
- the topography of Parliament Hill and the careful shaping of the slopes and escarpments;
- the design and craftsmanship of the iron fence along Wellington Street;
- the natural and wild state of the cliff landscape; and
- the romantic, untouched, and picturesque appearance of the site as seen from the river.

1.7.2 Character Defining Elements

The key character defining elements of the NPW are seen as being:

- The transparent nature of the wall that encloses the plateau and adjacent Pleasure Grounds without obstructing the view of the wild escarpment and across the Ottawa River.
- The wrought iron fence, including typical heights and spacing of railings, baluster, collars and panels.
- The masonry wall made up of three main components - tapered, dressed pier stones; profiled, dressed capstones including typical heights and widths, and rock-faced face stone of various dimensions, located below the capstones. The general pattern of the face stones, the profile of the capstones and pier stones are all part of the character defining elements of the masonry wall. All stone is grey fossiliferous Ordovician limestone, originally believed to be Gloucester, a local stone no longer available.
- The general stepping of the wall at pier locations - the piers are used to mark changes in grade elevation and to allow the wall to step up and down gradually.
- The Lookout to the west of Pier 39, centered on the Library of Parliament - while this seems to be a more recent addition to the wall, the Lookout has become a character-defining element in its own right, and one of the most visited locations on the Hill.
- Pier locations - although it would seem that some sections of the wall have suffered some modifications throughout the years and it is likely that the current position of the piers is not the original one for the full

length of the wall, the location of the piers, general proportions of each bay and number of piers should be preserved.

- The wild character of the escarpment on the slope side of the wall.
- The various monuments present within the area of the project.

1.7.3 Compliance with Standards and Guidelines

The Consultant's conservation approach for the present report was guided by Parks Canada's *Standards and Guidelines for the Conservation of Historic Places in Canada, 2nd edition* (Standards and Guidelines), as well as Canadian and international material conservation standards and guidelines.

The conservation approach described below is primarily one based on the principle of minimum intervention and respect for the character-defining elements of the NPW and the Pleasure Grounds. The primary conservation treatment can be classified as *Rehabilitation,* as defined in the Standards and Guidelines, with the secondary treatment being one of *Conservation* (e.g. for the ironwork), and is based primarily on the idea of historical authenticity and minimal intervention by using the least aggressive means possible to achieve a balance between meeting project objectives and maintaining heritage character-defining elements. The conservation approach closely follows the recommendations of the Standards and Guidelines.

A brief commentary of some of the most relevant Standards follows below.

1. Conserve the heritage value of an historic place. Do not remove, replace or substantially alter its intact or repairable character defining elements. Do not move a part of an historic place if its current location is a character-defining element. Ironwork will be restored and replaced; as much as possible of the masonry will be restored and reinstalled in original positions (although experience from previous phases cautions that the percentage of reusable stone may be quite small). The location of the wall will be carefully surveyed so the wall can be reinstated in the same location.

4. Recognize each historic place as a physical record of its time, place and use. Do not create a false sense of historical development by adding elements from other historic places or other properties, or by combining features of the same property that never coexisted. Any new material used will be discretely, but visibly new. New piers that are being introduced at the Lookout will have a pentagonal shape which will help raise the Lookout and better define the space, and can be easily, yet discretely differentiated from the original piers.

5. Find a use for an historic place that requires minimal or no change to its character-defining elements. No change in the current use of the wall or pleasure grounds. The only changes proposed have to do with increased security for visitors and workers on slope side of the wall.

6. Protect and, if necessary, stabilize an historic place until any subsequent intervention is undertaken. Protect and preserve archaeological resources in place. Where there is potential for disturbing archaeological resources, take mitigation measures to limit damage and loss of information. Archaeological reports were reviewed prior to undertaking preliminary site investigations. Archaeological monitoring was provided throughout the investigatory openings. Based on archaeological report additional archaeological monitoring will be provided in the construction phase for areas of high archaeological potential. Should archaeological resources be discovered outside of these areas, proper measures to protect the findings will be taken.

7. Evaluate the existing condition of character-defining elements to determine the appropriate intervention needed. Use the gentlest means possible for any intervention. Respect heritage value when undertaking an intervention. This is being considered throughout the design process. Respect for heritage value is one of the key factors in judging the viability of the proposed design options.

8. Maintain character-defining elements on an ongoing basis. Repair character-defining elements by reinforcing their materials using recognized conservation methods. Replace in kind any extensively deteriorated or missing parts of character-defining elements, where there are surviving prototypes. Ironwork will be restored and replaced with limited modifications made at the Lookout. For the masonry wall and foundations the requirement to provide fall protection anchors and the poor condition of the current footings and most of the masonry require that new foundations be provided for most of the length of the wall, and replacement of the majority of the stonework. The masonry will be replaced in kind, with limestone of similar, compatible characteristics with the original stone, with historically accurate tooling. Because of structural requirements for the fall protection anchors - the foundations cannot be replaced in kind.

9. Make any intervention needed to preserve character-defining elements physically and visually compatible with the historic place and identifiable on close inspection. Document any intervention for future reference. Full documentation will be provided. New interventions will be clearly but discretely visible to the trained eye.

10. Repair rather than replace character-defining elements. Where character-defining elements are too severely deteriorated to repair, and where sufficient physical evidence exists, replace them with new elements that match the forms, materials and detailing of sound versions of the same elements. Where there is insufficient physical evidence, make the form, material and detailing of the new elements compatible with the character of the historic place. Same as for Standard 8. Design of new elements based on existing detailing and previously approved design approach from Phases 1 and 2.

11. Conserve the heritage value and character-defining elements when creating any new additions to an historic place or any related new construction. Make the new work physically and visually compatible with, subordinate to and distinguishable from the historic place. No new additions. New foundations and fall protection anchors to form integral part of the wall.

12. Create any new additions or related new construction so that the essential form and integrity of an historic place will not be impaired if the new work is removed in the future. New foundations to form integral part of the wall. Fall protection anchors could be removed in the future if desirable with limited impact on the wall. In most cases pathway material can also be replaced with limited impact.

1.7.4 Conservation Strategy

The treatments recommended are focused on the long-term conservation of heritage fabric. For the ironwork, the main intent is to clean, restore and repaint the ironwork using the approaches already validated during the previous two phases and replacing the collars with two-piece cast-iron collars.

During Schematic Design Phase option 3B - partly lowering the path and partly raising the wall was selected as the option that best reconciles project objectives while meeting health and safety requirements and protecting heritage value. For the largest part of the wall the path will be lowered, which maintains the height and configuration of the wall, brings the path closer to the original location and enhances the overall aspect of the wall. There are a few locations where the height of the wall and the stepping at the piers will be altered however the overall impact is not a significant one.

The most important change proposed is raising the Lookout by about 400mm in order to minimize impact with the underground tunnel. This helps limit the amount by which the wall needs to be raised between Piers 39 and 40 and also contributes to enhancing the Lookout location. As discussed below, it is also recommended that the layout of the Lookout be slightly modified to allow for a more proportional look of the ironwork.

It would appear that the section of the wall between Piers 39-40 has been modified at some time in the past and that the Lookout was not part of the original wall, but was added at some point in the past, most likely in connection with Library of Parliament renovations. Therefore, the current aspect of this section of the wall is not necessarily the original aspect of the wall. Raising of the masonry at the Lookout would not only limit the impact on the underground structures but would also constitute a more historically accurate decision in differentiating the Lookout from the surrounding masonry and introducing pier stones as seen along the rest of the wall.

It is also proposed to adjust the iron panels and layout of the Lookout in order to create a more consistent approach. For most of the wall the ironwork is in its original location and it will put it back in the same position. The exception is the Lookout - in recent decades it has been rebuilt and the iron panels on one side have been shortened and those on the other side lengthened. If we were to put it back that way we would only be reinstating

a distorted version of the original ironwork which does not constitute good practice. The original panel sizes range from around 785 to 812mm O.C. post to post. It is proposed is to rebuild the Lookout using multiples of a dimension as close as possible to these. The first posts that define the start and end of the Lookout would remain in their original locations. The intention is to restore the panel sizes to a more consistent sizing as it would have been constructed originally, not to an adjustment that was likely an afterthought during recent work.

In respect to the masonry the intent is to salvage as much as possible of the face stone and reinstate them in the same location. Based on experience on Phase 2, a 30% salvage rate is anticipated. The wall will be documented prior to dismantling, after the pathway material is removed so the full extent of masonry is visible. New face stones will be installed so as to match the existing pattern. All the pier stones and the majority of capstones will be replaced. As was done in the previous phase the tooling on the new dressed stones will be attuned to the historical finish. If some of the newer capstones between Piers 40-45 can be salvaged these will be cleaned as needed and reinstated. Given that the iron posts are set with epoxy in the area between Piers 40-45, for salvageable capstones it is proposed to restore the ironwork without removing the spears from the capstones so as not to damage the stone.

Overall, every effort will be made so as not to negatively impact the heritage character of the Perimeter Wall but rather serve to enhancing it. The changes proposed are in line with the cultural landscape of the Pleasure Grounds of Parliament Hill - which has seen a number of alterations throughout its history, to adapt to the changing needs of the site and site users. The alterations proposed in this option are quite limited in scope and remain in keeping with the overall history of the wall and a values-based approach to conservation.

1.8 Study Limitations and Assumptions

This report was developed based on previous studies, existing information and site surveys. Some information regarding future projects was not available at this point and could not be integrated in our analysis, such as:

- Future elevations for the Pleasure Ground as a result of the future Centre Block Major Rehabilitation project. The options developed are based on the Consultant's best interpretation of the historic grades of the Pleasure Grounds and reasonable future modifications to the grades that could take place;
- Exact position and elevation of relocated monuments. Two drawings were received for the concrete bases of the Cartier and Mackenzie monuments. The drawings received do not include any information on grading or elevations at which the monuments will be installed, nor exact position of the monuments on site, in relation to the pathway. No as-builts, CAD drawings, or topographic info were received for the relocated monuments. It should also be noted that the monuments, as well as the east parking, were completed after the topographic survey by the NPW3 surveyor was finalized. It is not estimated that the proposed work for the NPW3 project will have a significant impact on these monuments, but the final mitigation strategies will be detailed in construction drawings.

- Exact intent and position for the Centre Block Major Rehabilitation Project mobilization area and fence line. A draft mobilization plan dated April 2014 was made available to the Consultant team in late September 2014, however it is understood that the exact layout may still change. The Consultant team has reviewed the plan and determined potential impact on underground utilities being installed as part of the NPW3 project, however final responsibility for protecting underground utilities and ensuring proper drainage is being maintained for the NPW will fall with the Centre Block team.
- The width of the space available for pedestrian traffic between the North Perimeter Wall and the Centre Block fence cannot be determined as part of this project. It is recognized that the location of the fence may create some pinch points along the pathway, however the relation between the perimeter pathway and the fence will ultimately depend on the final design for the Centre Block mobilization area which is still being developed.
- Construction traffic requirements - it is our understanding that a traffic consultant will be engaged to review and manage the construction traffic on the Hill. Following Design Development Presentation and subsequent coordination meetings it was agreed that the NPW3 project will allow a 7.5m wide road within project limits, where existing conditions allow. It is understood that following review of traffic by traffic consultant the minimum road requirements may change, however the Consultants caution that a road wider than 7.5m on the north-east side of the Library will be posing increased challenges for the NPW3 project and is not recommended. No changes are being made as part of the NPW3 project where the existing road width is narrower, this lies outside of the scope of the NPW3 project.
- The project team was only recently (Sep 2014) given a copy of the Lighting Plan and incorporation of this plan into the NPW3 design was never part of the original scope of work. Further, the extent and scope of work for Centre Block major rehabilitation is unknown at this time. As a result, there is a real risk that some of the work done for NPW3 will be demolished, removed and/or dismantled. The NPW3 project will therefore maintain the existing light fixtures.

2. Masonry Conservation

Given the conditions of the wall assembly and the masonry components and the project requirements, the masonry cannot be effectively restored, but will require dismantling and rebuilding. Many of the capstones and pier stones are fractured, or have the potential to fracture on removal and when the ironwork is removed from the capstones and pier stones, and will need to be replaced. While it is desirable to retain as many of these stones as is possible, in reality there are very few which are of sufficiently sound condition to warrant repairing. Some of this stone may be salvageable by cutting down into smaller stones for the wall face, but experience from Phase 2 showed that this was not feasible as apparently sound stones would break up when being cut down to smaller sizes.

It is recommended that all the pier stones and the majority of capstones will be replaced. If some of the newer capstones between Piers 40-45 can be salvaged these will be cleaned as needed and reinstated. Given that the iron posts are set with epoxy in the area between Piers 40-45, for salvageable capstones it is proposed to restore the ironwork without removing the spears from the capstones so as not to damage the stone.

Wall face stones, most of which are not visible due to the asphalt buildup, are anticipated to be in poor to good condition throughout and based on previous Phase 1 and Phase 2 experience it is anticipated that less than 20-30% will be reusable though this can only be confirmed once dismantling is completed. Each stone should be recorded and reset to their original positions.

To address variations in the existing masonry work, attributed to poor practices, some adjustments will be made to the existing layout/design:

- The length of the capstones will be adjusted so that the joints between the capstones are not close to the fence spear posts, with a minimum of 150 mm between the joints and the posts and the majority of the capstones about 1200mm long. This will minimize early cracking of the stone, when the fence post is installed too close the edge of the capstone;
- Mortar mix and sand will be based on Phase 2, a 1:2:9 cement: lime: aggregate mix with the colour being given by the sand;
- Tooling of the surface will match that used on the Phase 1 and Phase 2 Wall projects;
- The ends of the capstones will be cut to work with the radius of the wall and be consistent in width;
- Double stones used as mid pier stones will be replaced with single stones to minimize shifting;
- Custom, pentagonal pier stones will be introduced at the corners of the Lookout to help offset the change in elevation.
- Stones will be installed so that a minimum of 150mm of stone will be below grade, to prevent the concrete from being exposed, in keeping with existing and Phase 1 and Phase 2 detailing and to allow for some slight changes in final grades. It should be noted that in the approved Option 3B the grades are being

installed at final levels and there is no intent or perceived need for the Centre Block to perform any additional changes to grades in the future. As a result, there is no need to install additional courses of stone for a future lowering of the pathway.

- The wall will be documented prior to dismantling and face stones will be reinstalled according to their current location and the current pattern for all stones visible above grade. However, for the bottom row of face stones some changes will be needed in order to ensure that there are no continuous vertical joints and that face stone is always a minimum of 80mm high. This is based on experiences from the Phase 2 project where narrow bands of stone were installed at the bottom and is proposed in order to ensure the long term durability of the wall.
- A waterproof membrane will be used to coat the concrete and separate the concrete from the masonry, along with a drainage plane matt, mortar drop matrix and weepers. This membrane will be introduced because the stone must not be in contact with the concrete to prevent soluble salts from transferring into the stone. This will not interfere with the mortar adhesion as we are not relying on a bond between the mortar and concrete to assist in the stone wall construction, but rather the on the mechanical fasteners between the stones and concrete;
- Movement joints filled with sealant on backer rod, will be introduced between the pier stones and each adjacent wall section to account for differential thermal movement between the concrete and the stone. Other control joints will also be introduced in the concrete structure and the masonry as needed to address movement. It is suggested to use sanded sealant joints to mask the appearance of the sealant;
- Through wall drainage will be introduced at the spear post setting locations, in both the capstones and the top pier stones, to help drain any water that may infiltrate between the lead and the spear posts; and
- Spear post setting holes will be squared using hand tools and flared at the bottom to provide rough sides and a better key for the setting lead.
- The Lookout will be rebuilt as a full masonry wall, with face stones on both sides. Along the rest of the wall the escarpment side of the wall will be finished as in Phase 2 - with a light sandblast on the concrete.

Stone procurement for the masonry wall is being undertaken in parallel with this project. The procurement package is currently being tendered for the pre-purchase of St. Marc's stone, as directed by PWGSC. St. Marc's limestone has been used for previous repairs of the wall and in the previous two phases. However, there have been recent concerns that this quarry may no longer be able to produce top quality stone in the required dimensions and quantities. Top quality stone is particularly important to source, to ensure the durability and longevity on this section of the wall which is more exposed. In order to ensure proper quality, sizes and quantity of stone is available for this project a separate stone testing project is underway to determine the best alternative to the St. Marc's stone should the quarry fail to provide the required quantity and quality of stone. At this time stone is being sourced for sampling from St. Constant quarry, Quebec and Carrières du Hainaut, Belgium. Potential supply from Ireland was not sourced due to budgetary reasons.

3. Ironwork Conservation

The approach to the ironwork restoration has been fairly validated on the Phase 1 and Phase 2 projects and continues to apply to this project with some modifications.

- Each railing spear and panel will be inspected and conditions noted. It is very important that the need for all metal work repairs be identified at this stage, not only in the interest of preparing a thorough tender package, but because when the iron components return to the site in their restored state, any on site modifications to the metal work would compromise the integrity of the paint film.
- Each component should be labeled prior to disassembly with two tags per component.
- The panels should be carefully removed first. This will entail cutting the deteriorated collars.
- The railing spears and their lead setting can be removed by tipping the spear and coping on their side, heating the lead, and allowing it to pour out. Any lead residue on the stone can be cleaned by micro-abrasive cleaning.
- Where iron spears are set in epoxy (piers 40-45) this should be carefully removed with chemical and mechanical tools, taking care not to damage the stone or the spear.
- The existing paint films and all corrosion products will be removed using electrolytic reduction. This is the most thorough and gentle method.
- Based on the site survey all metal repairs can then be undertaken - areas that are ‘wasted’ will be built up by welding and ‘puddling’ in with wrought iron and grinding smooth. If rails are too short, they can be extended using wrought iron bars of a matching cross sectional size and welded in using wrought iron filler rod.
- As with the previous phase, it is planned to replace all collars with two-piece collars fabricated from ductile cast iron and marked with the year of construction.
- A 5-coat paint system consisting of zinc rich primer, epoxy base coats and polyurethane top coats will be applied.
- The accurate placement of the sockets in the coping stones will be critical to the success of the project and as most of the coping stones are to be replaced there is some flexibility. Accurate surveys before dismantling and laying out of the sockets in the capstones using a licensed surveyor, under the direction of the metal restoration company and the general contractor, will ensure accurate re-installation.
- To avoid damaging the paint film, the iron should be adequately protected throughout the process with something like bubble-wrap™. The general rule is that the railing spear should be 25mm deep in the socket for every 300mm of railing height.

- Prior to pouring the lead around the railing spears it is very important that they are positioned exactly, and stabilized in place. The railing sections will be used as guides to position and shim the spears, confirming all spacing and alignments, the railings will then be removed to allow for the lead to be poured. The lead is to be poured in three pours, hammering and packing between pours to compact the lead, with the third pour being poured proud of the capstone, creating a collar, that is tooled so that water runs off and does not collect.
- The conservation of the metal work should only be undertaken by firms specializing in metal conservation.
- The panels at the Lookout should be resized for a more proportional fit, see Section 5 below.

4. Lookout Layout

The Lookout will be raised by about 400mm to avoid conflict with the C3 tunnel (fig. 1).

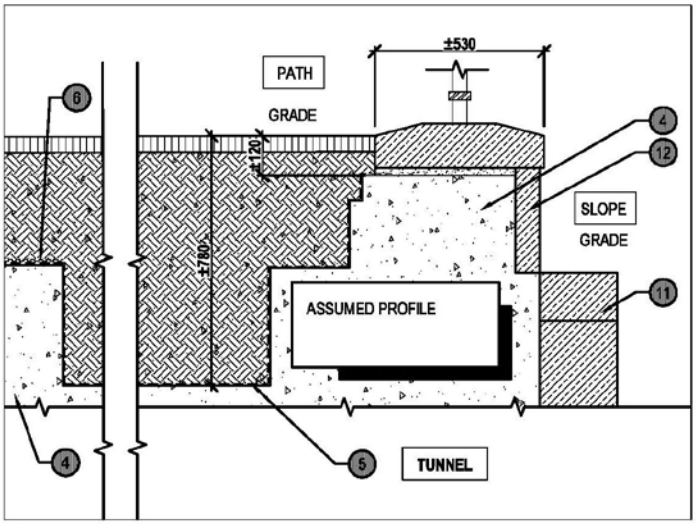

Figure 1: Section at Lookout over Tunnel C3 - existing condition.

A new pier is introduced at the western corner of the Lookout that allows the wall to be raised around the Lookout and eliminates the need to do excavation at the edge of the Lookout. This also helps define the Lookout as a space instead of a simple enlargement of the path. Pier 39 is relocated at the eastern corner of the lookout for symmetry. Additional piers are added at the inside corners of the Lookout to help better define the space. The new piers will all be pentagonal in shape, to match the orientation of the Lookout, while the capstones between them will all be at the same level, with changes in elevation stopping to either side of the Lookout (fig. 2).

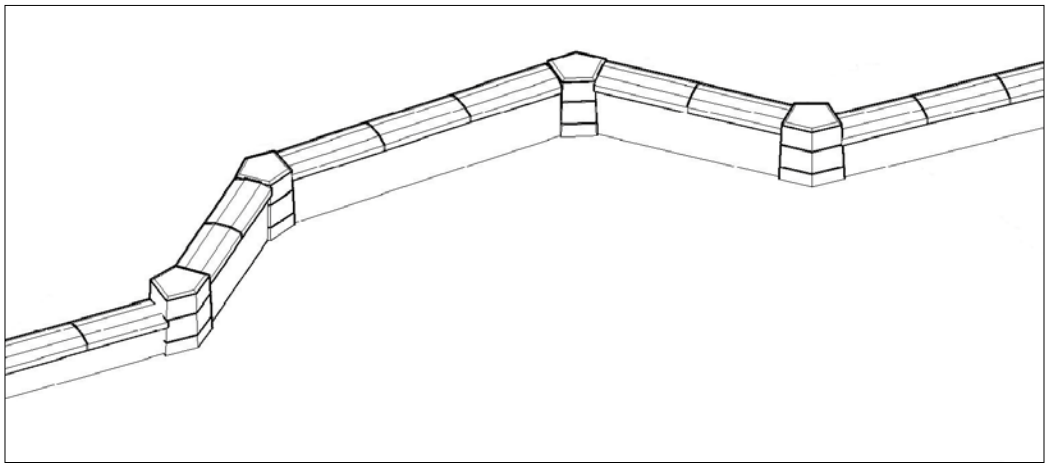

Figure 2 - Schematic axonometry of reworked Lookout - introducing pentagonal piers at the corners (fencing not shown).

It is also proposed to adjust the iron panels and layout of the Lookout in order to create a more consistent approach and to address the previous poor quality modifications. The original wall consists of repetitive panels, with the panel sizes ranging from around 785 to 812mm O.C. post to post. It is proposed is to rebuild the Lookout using multiples of a dimension as close as possible to these. While the angle of the two sides of the Lookout will change slightly to allow for a more equal spacing of the iron panels, the overall skewed shape of the Lookout will not change. We believe the best solution would be to have the side walls equal, at about 3050mm long (4x762mm panels) and the long wall 5070mm long (6x845mm panels). This would mean the first posts that define the start and end of the Lookout would remain in their original locations and the longer stretch of the wall would be shifted slightly to the east, also resulting in a slight change in the angles of the inner corners. It should be noted that the Lookout currently has an irregular shape, of a skewed trapezoid, determined by the fact that the long side needs to remain parallel with the top of the tunnel portal, which is not parallel to the wall which is where the sides of Lookout spring from.

Figure 3 - Showing existing condition at the Lookout with capstones at grade level and uneven ironwork panels.

5. Foundation Rehabilitation

5.1 Foundation Design Considerations

The approach to the foundation design has advanced based on additional design information provided by the geotechnical engineer. For most of the length of the wall, the design will follow that used on Phase 2, where a deep 500m footing is used to provide weight for the wall to resist forces from the use of fall arrest anchors. A change from Phase 2 is that the footing is expected to bear mostly on sound bedrock which removes the need for insulation. Further detailing is required to detail installations at tunnels and where the new wall joins existing walls at Pier 33 and 48. See accompanying drawings and the structural letter at Appendix D.

Discussion with the geotechnical engineer confirmed we could place the new foundations on bedrock, if weathered bedrock is removed, and a 600mm minimum depth of soli coverage is maintained. Other locations that may bear on soil may require insulation. It is proposed to include a detail for foundations bearing on fill in the final construction package, and price it as a unit rate. To be advanced further in the next stage. Design of the footing over Tunnel C2 will require further consideration.

5.2 Fall Arrest Anchors

The structural plans submitted with this report show the location of fall arrest anchors. It was agreed that the anchors will follow a 5m spacing for most of the wall length, with no anchors being provided above the tunnels, for structural reasons.

6. Wall Reconstruction

In the Schematic Design Report, it had been proposed to partially salvage a few sections of the existing wall, specifically above two of the three original ventilation tunnels (the east tunnel and the tunnel under the Lookout), above the CBUS exhaust tunnel and potentially between Piers 40-45 where the wall had been recently rebuilt, during the CBUS work and creation of the ventilation tunnel for CBUS. As part of the Design Development, this approach was considered further, with further discussions taking place between architecture, structure, landscape and geotechnical. Based on these discussions and the advancement of the design, it has been decided that it is most practical to only retain existing concrete sub-structure at three of the tunnels (C3, C4 and CBUS exhaust tunnel). The remainder of the wall concrete substructure that had been considered between Piers 40 and 45 will be replaced with the new concrete foundation design. This decision was made as the best balance between meeting design requirements for fall arrest, simplifying construction, and avoiding costs associated with modifying the existing concrete foundation structure to take the loads from the fall arrest anchors. Retention and modification (as needed) of existing concrete over the tunnels is considered feasible as no fall arrest anchors will be installed at the tunnel locations, and leaving the concrete avoids disturbing the tunnels. The connection of the existing concrete to the new concrete will be designed in the next stage of the project, along with any required modifications to suit the grade height and installation of new masonry. See the accompanying structural drawings for proposed typical foundation design and the structural letter at Appendix D.

The following points are brought forward and updated from last report:

- Face stones between Piers 40-45 have their faces saw-cut rather than tooled, and are only about 76mm thick. These will be replaced. Capstones will be retained where sound but tooled to match the rest of the capstones to be installed as part of this project.
- At the Lookout there are no face stones below the capstones on the path side, but a stone veneer does exist on the slope side, which are believed to be thin in section. At this time, it is planned to cut down the concrete wall, and build on top of it with a full masonry wall, with exposed faces on the path and slope sides. Face stones on the path side would need to be provided as part of this project with a lowering of the path grade.
- The capstones at the Lookout are currently at the level of the grade. The wall will be raised to provide proper clearances to the grade, and the wall locations adjusted to allow for correcting iron work layout.
- Control joints will need to be installed between the new foundations and the existing ones, and additional movement joints located along the wall to allow for movement and thermal expansion and contraction.
- Frost protection will need to be carefully detailed around the locations where original walls and foundations are kept. As most of the wall will bear on bedrock, insulation under the footing will not be required, unlike the design for Phase 2, where most of the wall bore on fill, and the insulation was

deemed necessary, and carried under the footing that bore in bedrock to maintain consistency of the wall construction.

It is still expected that keeping the concrete walls over the existing tunnels (C1, C3, and C4) will mean there will be less disturbance to these tunnels and therefore a decreased risk of impacting them and schedule delays.

The existing concrete wall and footings will be fully removed, bedrock excavated to remove weathered bedrock, and a new concrete retaining wall installed. The footings will need to span over the tunnel C2.

7. Landscape Design

7.1 Pathway Material

As discussed in Section 2.4 above, during the Schematic Design phase the discussion about options for pathway materials was reopened with the stakeholders. It would appear that there is general consensus that the stone paving should be installed along the full length of the wall instead of asphalt as accepted for Phase 1, however formal direction to proceed with installing limestone pavers has not been received to date. For the purpose of this report, no advancement has been made on pathway paving materials pending direction from the Project Manager. Below follows a brief summary of relevant documentation and guidelines to help inform this decision.

7.1.1 Recommended Pathway Material

The project Request for Proposals (RFP), dated September 11, 2014, references the May 2013 version of the Parliament Hill Landscape Plan Implementation Strategies and Guidelines (PHMLPISG) and instructs the Consultants to redo the paving along the NPW between Piers 33 and 45, using the same material that was installed on the informal pathway in the Phase 1 project (Piers 27-33), which is HL3 standard asphalt.

There are two pathway materials defined in the Parliament Hill Landscape Plan (PHLP) of 2000, Pedestrian Paving Type 1, which is made of crushed stone, and Pedestrian Paving Type 2, that is made of large limestone pavers. In that plan, the path along the NPW is removed and replaced with a Cantileved Walkway located on the escarpment side, starting east of Pier 36 and going all the way to Pier 46. A new path, made of crushed stone, is proposed in the Pleasure Grounds, further from the wall. No material is specified on the details of the cantilevered walkway in that document. However, the question of the Cantilevered Walkway is still being studied and its future appears uncertain at this time, while urgent repairs need to be done to the NPW. In this situation, the existing path next to the wall is to remain. That possibility was planned for in the May 2013, version of the PHMLPIGS of May 2013 where Guideline 103 states: "If the Cantilevered Walkway is not constructed, install a 2m-wide stone dust pathway along the perimeter wall".

In parallel with changes to the PHMLPISG, a Perimeter Pathway Material Study was developed by PWGSC, Robertson Martin Architects and Groupe BC2 in October 2013. This study was generated by the fact that the stabilized crushed stone used during NPW Phase 1 was observed to present numerous maintenance challenges. In the Perimeter Pathway Material Study, recommendations were made for materials to be used for permanent and temporary pathways. It was agreed by stakeholders that the selected materials will be used in all subsequent restoration phases, as prescribed in the PHMLPISG. The repartition of the permanent and temporary pathways was illustrated taking into account recommendations from the PHMLPISG, with the perimeter pathway between Pier 27 and the Lookout (where the Cantilevered Walkway would be installed) being listed as temporary. The recommended material for the informal pathway was exposed-aggregate asphalt. The recommended material for the formal pathways was limestone pavers. The use of limestone pavers for the formal pathway and the proposed

pattern were guided in part by direction given in the 2000 PHLP and the precedent of installing St. Marc's limestone pavers at the East Gate. Tender documents for the Phase 1 project were prepared in the fall of 2013 to install limestone pavers between Piers 3 and 27 and stone-mastic asphalt from Piers 27 to 33. During construction of the Phase 1 pathway, due to difficulties in obtaining the desired aspect of the stone-mastic asphalt, the material was ultimately changed to standard HL3 asphalt, as used elsewhere on the Hill.

Based on the above, for the NPW3 consultants to install pathway materials as accepted for Phase 1, per the RFP, it would mean installing standard HL3 asphalt for the length of the pathway between Piers 33 and 45. As discussed during the Schematic Design and Design Development presentations, the stakeholders do not find this material acceptable as it does not give the path a suitably dignified aspect, does not take visitors' and users' experience into consideration and creates a dangerous precedent of accepting the installation of a lower quality material. It was also noted in the Design Development presentation that in all likelihood the earliest the Cantilevered Pathway would be installed is after the end of the Centre Block Major Rehabilitation Project. This would amount to roughly two decades during which the only area accessible to the public on the north side of the Hill will be perimeter pathway.

In the final version of the PHMLPISG dated September 30th, 2013, after the TOR for this current project were issued, Guideline 103 was amended to: "If the Cantilevered Walkway is not constructed, install a 2m-wide limestone pathway along the perimeter wall". The following fundamental principle is also given in the final version of Guideline 103: "The pathway that follows the perimeter of the Plateau is a formal more distinguished type of pathway linking." This fundamental principle would allow one to determine that all paths following the wall should be made of limestone, including the portions located before and after the Cantilevered Walkway, between the Lookout and Pier 45, and between piers 33 and 36.

Considering the above and the fact that no structural provision was made in the rehabilitation of the NPW for the future construction of the Cantilevered Walkway, it is to be assumed that it will not be built in a foreseeable future and the instruction of Guideline 103 of the September 2013 version of the PHMLPISG should be applied which is to build a two meter wide limestone path next to the NPW.

7.1.2 Lessons Learned from Phase 1 Pathway Project

Should it be decided that limestone pavers should be installed for the full length of the pathway, the design of the pathway and the laying out of the pavers should be based largely on previous experience and lessons learned during the Phase 1 Pathway project. During construction of NPW Rehabilitation Phase 1, decision was made to create a smaller version of the limestone pavers for the path (pedestrian pavers Type 2a), and use the large version only for nodes (pedestrian pavers Type 2), which are marking special places. The area around the Summer Pavilion was marked as such a node, and upon further study, we believe that the area of the Lookout should be marked as a node also, which correlates with input from stakeholders.

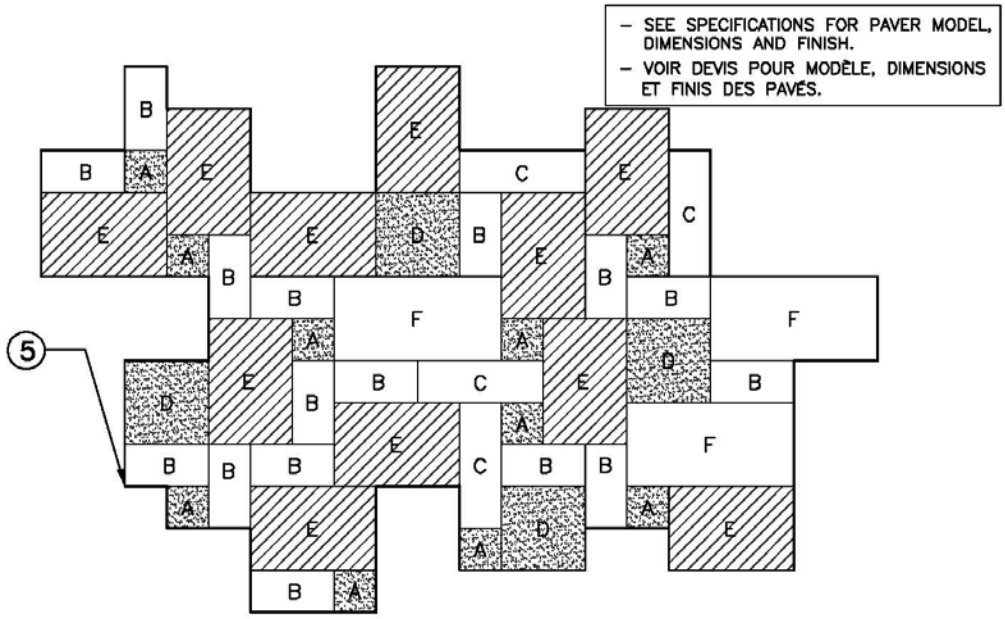

Figure 4 - Limestone pavers pattern layout

The pattern for both the path and the nodes was the same, but paver sizes are twice as large in the nodes, except for thickness. A special soldier course was introduced in front of each pier to help with pattern alignment. For this section of the wall, it might be necessary to include soldier courses between piers also, since there are major changes in pathway orientation between some piers, like between Piers 35 and 36.

The pathway is delimited on the grass side by a limestone border, level with the pavers.

Secondary Pathway Material

In Phase 1 of the project, secondary paths were made out of limestone pavers, up to a natural transition point (stairs, curbs). When such a transition area is not available within a few meters of the path, and given the temporary nature of most of these pathways (they will be used only for the short period between the end of this project and the beginning of Center Block mobilization), regular asphalt should be used.

Cobblestones

The new path location create more space to manage changes in grades, which eliminates the need for cobblestone surfaces on steep slopes. This material will be removed wherever possible, since this material is not part of the proposed surfaces in the 2000/2013 Landscape Plan.

7.2 Landscape Design Intent

7.2.1 Summer Pavilion

Access to the area of the Summer Pavilion is made from the east and south by limestone steps that are in fair condition. From the north, an asphalt ramp gives access to the path next to the perimeter wall. Access to the pavilion itself is made from the east by wood stairs and from the south by a concrete universal accessible ramp. Benches are located on a concrete slab on the south and north sides of the Summer Pavilion, along the path. These elevations need to be respected.

The paving around the Summer Pavilion is asphalt, bordered with low iron cresting at grade and at the slope side with a cast iron fence on stone curb. The existing asphalt on the terrace surrounding the Summer Pavilion will be replaced with large limestone pavers, typical of nodes. The pattern to be used would be as illustrated in fig. 4. The pavers need to meet the existing grades around the Pavilion as well as the existing stairs. No changes will be done at the shape of the terrace, except where it meets with the NPW pathway. That area will be sloped in order to meet the ramp leading toward the path.

The existing wrought-iron fence and planting will be maintained. A new limestone curb will delimitate the edge of the paved area where no wall is present.

7.2.2 Width of pathway

The width of the existing path between Piers 45 and 33 varies greatly, from 1.93m in front of the Baldwin Lafontaine Monument, up to 3m in front of the Victoria Bell Monument, with an average width of about 2.7m. The 2m width recommended in the PHLPISG (Sept 2013) will be applied to the new path. This helps in reducing the impact of the path grade changes toward surrounding small landscape elements such as lamp posts and monuments, but it will significantly reduce the overall space available on the path.

7.3 Small Landscape Elements

The proposed changes in grades of the pathway have an impact on some of the existing landscape elements. These impacts are described below.

7.3.1 Monuments

Victoria Bell Monument: The proposed path in front of the Victoria Bell Monument is lowered by less than 50mm. This can be easily corrected within the existing paved area between the monument and the path. This correction is made even easier by the reduction of the path width that allows for a longer transition. It also requires that new granite pavers be installed between the monument and the path to fill the gap with the new path location.

Baldwin Lafontaine Monument: The path is lowered by 160mm at the back of the monument. Considering the very narrow space available in that area, the change in grade will be managed using the limestone border that will gradually change from a ground level border to a 150mm curb for a short distance, and then go back to ground level. No direct universal access is required to the back of the monument that remains close enough from the path to be accessible. The cobble stone paving between the path and the monument will be eliminated and replaced with the approved pathway material.

Sun Dial Monument: The path next to the sun dial is lowered by an average of 200 mm. Considering that this monument requires to be close in order to be able to read the dial, universal access needs to be maintained. So the paving surrounding the monument will be lowered to meet the new path elevation, as will be the monument itself. The monument being pretty small, lowering it is a simple task that presents little risks. The paving surrounding the sun dial should be the same as for the path.

New Monuments: The impact of the grade changes will to be assessed further once as-built information is provided by PWGSC. Note that existing information on the bases for the Cartier and Mackenzie monuments shows a fairly shallow temporary concrete footing, part of which is above the existing grade. Lowering of the path is proposed close to these monuments, which means that more of these concrete foundations will be exposed. However, given the fact that most of the monuments will only be in these positions temporarily, we belive extensive measures should not be required as part of the NPW3 project to accommodate them.

7.3.2 Lamp Posts and Fire Hydrant

From Pier 40 to Pier 39 (0+024 to 0+095), the proposed changes in path grades are limited to an average of 75mm. Such a small change can easily be adjusted in grass areas surrounding the lamp posts so that no changes are needed to the lamp posts next to the path in that area.

From pier 39 to the Baldwin Lafontaine monument to the west of Pier 37 (0+095 to 0+150), the change in grade is greater, the path being lower from 135 mm up to 273 mm. There are 3 lamp posts and one fire hydrant next to that portion of the path. Since the path will be further from the lamp posts than it is now, it is possible to leave the lamp posts in place, but it will create small mounds around each base that will be noticeable in the landscape.

From 0+150 to 0+177 the path is lowered by less than 100 mm. There are two lamp posts adjacent to the path and they can be left in place as they are since such a small change in grade can be done in the grassed area without being too noticeable.

Between 0+177 and the Baldwin Lafontaine monument (0+206), the path is lowered from 100mm to 160 mm. There is only one lamp post in that area and the path is lowered by 114 mm next to that lamp post. The lamp post should be left in place.

The lamp post located directly next to the sun dial monument should be lowered by about 300 mm to meet the new grades around the sundial.

Overall we recommend lowering 1 lamp post.

7.3.3 Library Drive

The proposed modifications to Library Drive are done in order to maximize green space and provide a larger buffer area between the path and monuments and the parked cars. During construction, this new configuration will allow for a slightly larger mobilization area that would be an asset considering the tight space presently available. The proposed changes allow at all times, including during construction, for a minimal road space 7.5m wide, and pedestrian circulations. See mobilization plan - drawing A100. The number of parking spaces remains the same.

The existing concrete curb is modified from the existing handicapped parking (0+072) to past the Baldwin Lafontaine monument (0+230). One existing catch basin (0+154) will need to be moved in order to remain in the parking area and provide the required drainage. The secondary paths leading to the Lookout and the one leading to the path at 0+180 need to be extended. Small signs will need to be moved to be relocated next to the curb.

7.4 Escarpment Grading

Restoration of the NPW will require complete removal of the existing wall, excavation of new foundations, formwork and masonry. An area of at least one meter will need to be cleared behind the wall, on the escarpment side, for construction purposes. In that area, all existing lilacs will need to be completely removed, to allow for construction. It appears that the grade on the slope side of the wall has increased over the years, as at some points it is higher than the capstones.

Once the construction is completed, a minimum height of concrete wall face of 350mm will need to be left apparent to allow for fall arrest anchors to be installed, and give the required clearance to connect to the anchors. This will create a small flat area at the back of the wall, on top of the escarpment. The slope will no longer come up to the top of the wall, which will help maintain an open view toward the river by lowering the plants, and return the slope side to what it may have looked like originally.

7.5 Planting Material

New planting will be done only on the escarpment side, to provide plant cover on the areas where vegetation will be eliminated by construction work. The existing lilacs will be removed and replaced by low indigenous shrubs, typical of the area. A mix of various shrubs will be used to create more biodiversity in the escarpment and promote the propagation of indigenous plants from natural seeding.

Apart from the construction area directly next to the wall, we recommend keeping the existing lilacs in the escarpment slope since they contribute to the stability of the slope. They should continue to be trimmed to keep them from obstructing the view. Although the lilacs are not indigenous to the escarpment, the risks involved in removing them and replacing them with an indigenous species are too important during the transition period where the lilacs are gone and the new species is not yet strong enough to play their role in the stabilization of the escarpment.

The flat open area created by the restoration work will be planted with low indigenous shrubs to help introduce new species in the foreground, that might help reduce the horticultural aspect of the lilacs in the wild escarpment. Shrubs listed below could be used:

- Red-osier dogwood (Cornus stolonifera), 2m high;
- Bush honeysuckle (Diervilla lonicera), 1.2m high;
- Beaked hazelnut (Corylus cornuta), 2.5m high;
- Ninebark (Physocarpus opulifolius), 2.5m high;
- Sandbar willow (Salix interior), 2m high;
- Large-leaved meadowsweet (Spirea latifolia), 1.5 m high;
- Aronia melanocarpa, 1m high.

Coordination will be made with previous studies that have already addressed the issue of planting on the escarpment, such as the West Slope Staircase project and the Slope Vegetation Management Plan.

8. Surface Drainage

8.1 Existing Conditions

Parliament Hill natural drainage mostly goes from the building toward the escarpment and from west to east. The presence of the NPW prevents natural runoff in the escarpment even as natural drainage tends to send water in that direction.

The development area currently consists of a storm network which has interconnected catch basins, manholes and storm pipe ranging from 150 mm in diameter to 300 mm. This existing storm network is located throughout the vicinity of the development area including below the walkway and adjacent grass areas. Grading within the contract boundaries directs runoff via overland sheet flow during major and minor storm events to the south-east along the edge of the pathway. In some areas flows were being directed towards the retaining wall before draining into the CB due to the grading. The runoff is ultimately carried to discharged in the Ottawa River.

The walkway is set directly against the masonry wall. Improper drainage is one of the contributing causes of the deterioration of the North Perimeter Wall. Improper drainage at the juncture of the wall and the pathway has led to water and moisture to accumulate and in turn, to promote masonry deterioration. The new drainage and grading plan will ensure positive drainage away from the wall is maintained and flows are directed to the existing infrastructure.

8.2 Proposed Scope

The proposed scope for the grading and drainage systems will include re-grading adjacent areas of the pathway to a newly constructed grass swale. A transversal slope of 1% to 1.5%, leading away from the wall, is proposed on the path next to the wall. That slope extends into the grassed areas where a grass swale directs the water toward catch basins. The grass swale will be constructed with new catch basins and sub drain as required to ensure sufficient outlets for the storm runoff. In the long flat area between Pier 40 and the lookout, the catch basins create a low point between each lamp posts, in order to avoid the creation of a deep ditch next to the path. This strategy is maintained between the lookout and the Baldwin Lafontaine Monument. Directing runoff water in grass swales allows for water infiltration in the ground, which corresponds to one of the guidelines regarding sustainable development in Parliament Hill. The drainage pattern is interrupted in front of the Baldwin Monument by the introduction of a raised curb next to the monument for a short distance (5m). After the curb goes back to ground level, and the standard drainage goes back toward the grassed areas.

Drainage strategy around the Summer Pavilion is different since we have to work with the existing elevations all around the Pavilion and at the existing stairs. Linear drains are proposed at various locations that will carry storm runoff towards the existing catch basins and manholes within the vicinity of the area via underground piping.

8.3 Impact of Proposed Centre Block Access Road on Underground Utilities

The following observations and attached plans are based on the location of the Centre Block access road as shown in the April 2014 draft Centre Block Access and Loading Dock Feasibility Report (Option 2), received September 25, 2014. The Consultants have assumed that roadway elevations would be maintained to ±0.15m of the current elevations.

Based on the above-mentioned document, the following items will within the access pathway:

- 5 existing storm structures and sewers
    - 1 pipe run will require additional cover
- 3 proposed storm structures and sewers
    - 1 existing pipe will be replaced to achieve proper burial depth.

The proposed drainage design between Piers 33-46 will take all appropriate measures to mitigate any future changes during the installation of the Center Block service road. Our proposed design will ensure that all the proposed structures and pipes will have sufficient ground cover to withstand the service road loading. Additionally, steps will be taken to upgrade and protect the existing storm infrastructure that falls within the service roads footprint (shown as a solid gray hatch).

Drawings C101-C102 show the existing infrastructure (shown in green), proposed infrastructure (shown in blue) that will be protected in anticipation of the Centre Block service road, along with existing structures (shown in purple) that will be relocated. All reasonable efforts will be made by the Consultant team to avoid conflict between the new infrastructure and the Centre Block service road, based on the known information. However, as the service road design is in a preliminary stage, and the North Perimeter Wall Phase 3 is moving into Construction Documents Phase, it will be the responsibility of the Centre Block design team to ensure their final design will not impact any other infrastructure than what is noted in the attached plans. Any existing infrastructure within the service road foot print that is outside our contract limits will be have to be assessed and protected by the Centre Block design team.

9. Procurement

The restoration of the ironwork and masonry should only be undertaken by specialized firms. This can be undertaken in two ways: A two-envelope bid can be used, the first envelope being for pre-qualification requirements, the second for the bid price. However, a two-bid tender may be slightly more time consuming and the project needs to be completed in a tight schedule. Alternatively, if this is acceptable to RPCD, experience requirements can be incorporated in the specs and a one-envelope bid can be used instead.

10. Closure

We trust the above report meets this stage of the project mandate and Client needs. For any questions relating to this please do not hesitate to contact the undersigned.

Robert Martin OAA, MRAIC, CAHP, LEED AP
for Robertson Martin Architects

Appendix A:

Geotechnical Report

patersongroup

Consulting Engineers
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September 11, 2014
File: PG3172-LET.01 Rev. 1

Robertson Martin Architects
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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Services

www.patersongroup.ca

Attention: **Mr. James Maddigan**

Subject: **Geotechnical Investigation**
Proposed North Perimeter Wall Rehabilitation - Phase 3
Parliament Hill - Ottawa

Dear Sir,

Paterson Group (Paterson) has prepared the following letter report to present our findings from the geotechnical investigation at the aforementioned site. The following letter report presents the findings and recommendations.

The objectives of the current investigation were to:

- ❑ to determine the subsurface soil, bedrock and groundwater conditions by means of test pits and boreholes.
- ❑ provide geotechnical recommendations for the design of the proposed north perimeter wall rehabilitation (phase 3), including construction considerations which may affect the design.

1.0 Method of Investigation

Field Program

The fieldwork for the geotechnical investigation was conducted on April 16 and 24, 2014. The geotechnical investigation consisted eighteen (18) test pit and thirteen (13) borehole locations. The test pits were excavated with a rubber tire backhoe operated by Public Works Government Services Canada (PWGSC). The test pits were completed as part of an archaeological study and Paterson reviewed the subsurface conditions at the open test pit locations.

The boreholes were completed with a track mounted drill rig supplied by a local contractor. The drilling procedure consisted of hollow stem augering to the required depths at select locations, sampling and testing the overburden. Bedrock was cored using a diamond drill bit at selected borehole locations.

Sampling and In Situ Testing

Soil samples were recovered from a 50 mm diameter split-spoon, the auger flights or grab samples. The split-spoon, auger and grab samples were classified on site and placed in sealed plastic bags. All samples were transported to the laboratory. The depths at which the split-spoon, auger and grab samples were recovered from the boreholes are presented as SS, AU and G, respectively, on the Soil Profile and Test Data sheets.

Standard Penetration Tests (SPT) were conducted and recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split-spoon sample 300 mm into the soil after the initial penetration of 150 mm using a 63.5 kg hammer falling from a height of 760 mm.

Diamond drilling was completed at five locations during the current investigation (BH 2, BH 5, BH 7, BH 10 and BH 13) to confirm the bedrock quality. A recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are presented as RC on the Soil Profile and Test Data sheets in Appendix 1. The recovery value is the ratio of the bedrock sample length recovered over the drilled section length, in percentage. The RQD value is the total length ratio of intact rock core length more than 100 mm in one drilled section over the length of the drilled section, in percentage. These values are indicative of the quality of the bedrock.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division.

Field Survey

The location and ground surface elevations at the borehole locations were surveyed by Paterson field personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying. The location of the test pits and boreholes and the ground surface elevations of the test hole locations are presented on Drawing PG3172-1 - Test Hole Location Plan.

2.0 Field Observations

The subsurface profile encountered at the test hole locations consisted of 25 to 50 mm thick layer of asphaltic concrete over a crushed stone granular fill layer. A silty sand fill mixed with gravel and cobbles was encountered below the abovenoted layers. Practical refusal to augering/excavation or grey limestone bedrock was encountered at all test hole locations at depths varying between 0.4 to 1.4 m. Refer to the Soil Profile and Test Data sheets attached for specific details of the soil profile encountered at the test pit and test hole locations.

Selected photographs taken during our field inspections of the subsoil conditions encountered at the test pit locations are presented in the attached photographs.

A grey limestone bedrock was cored at BH 2, BH 5, BH 7, BH 10 and BH 13. Based on the RQD values of the recovered core samples, the upper 1 m of the bedrock varies between a poor to very poor quality. The remainder of the bedrock was noted to be of fair to excellent quality. Photographs of the recovered bedrock core are attached to the present letter report.

All boreholes and test pits were observed to be dry upon completion of the sampling program. Groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

Also, based on available geological mapping, bedrock consists of limestone of the Lindsay Formation and is expected to range between 0 and 5 m depth in the area of the subject site.

3.0 Geotechnical Assessment

Based on our findings, it is anticipated that the proposed perimeter wall can be supported by conventional shallow footings founded directly over bedrock or a granular pad placed over an approved soil bearing surface. It is understood that the majority of the perimeter wall foundation will extend at least 300 mm below the existing bedrock surface based on current underside of footing level. It should be noted that surface-sounded bedrock, free of significant mud seams and fissures, and approved by the geotechnical consultant at the time of excavation will be considered non-frost susceptible. Therefore, the perimeter wall foundation will not require additional frost protection to compensate for the reduced soil cover where founded directly over an approved surface-sounded bedrock bearing surface.

To ensure that adequate frost protection is provided for areas where soil is encountered at subgrade level, it is recommended that the proposed footings be provided with a minimum 600 mm thick soil cover layer and a minimum 100 mm thick layer of rigid insulation placed below footing level. The rigid insulation should extend at least 1.2 m beyond the footing face. It is further recommended that the proposed footing be placed over a minimum 300 mm thick granular pad, consisting of Granular A crushed stone, compacted to 98% of its SPMDD. For areas where bedrock is encountered at or above subgrade level, the recommended granular fill pad is not required.

The abovenoted design recommendations and other construction precautions are discussed in the following sections.

Site Grading, Preparation and Bedrock Removal

Asphalt, topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any settlement sensitive structures, such as the proposed wall structure.

Backfill placed for grading beneath the proposed wall structure, unless otherwise specified, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The backfill should be tested and approved prior to delivery to the site. The backfill should be placed in maximum 300 mm thick lifts and compacted to 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at a minimum compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be placed to increase the subgrade level for areas to be paved, the backfill material should be compacted in maximum 300 mm thick to a minimum density of 95% of the SPMDD.

Based on the bedrock encountered in the area, it is expected that hoe-ramming may be required to remove the bedrock.

As a general guideline, peak particle velocity (measured at the structures) should not exceed 25 mm/s during the bedrock removal to reduce the risks of damage to the existing structures.

Foundation Design

Footings placed over a minimum 300 mm thick engineered pad over a silty sand fill bearing surface approved by the geotechnical consultant can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **175 kPa**, incorporating a geotechnical resistance factor of 0.5.

It is recommended that the engineered fill pad, consist of a Granular A crushed stone, compacted to 98% of its SPMDD and placed in maximum 300 mm loose lifts. It is further recommended that the existing silty sand subgrade be proof-rolled using adequately sized vibratory rolling equipment making several passes under dry conditions and in above freezing temperatures. Any poor performing areas should be removed and replaced with an engineered fill, such as Granular A or Granular B Type II, compacted to 98% of its SPMDD.

An acceptable soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Footings designed using the bearing resistance value at SLS for the abovenoted soils will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a soil bearing medium when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V, passes only through in situ soil or engineered fill of the same or higher capacity than the in situ soil.

Footings placed on a clean, surface sounded limestone bedrock surface can be designed using a bearing resistance value at SLS of **500 kPa** and a factored bearing resistance value at ULS of **1,000 kPa**, incorporating a geotechnical resistance factor of 0.5.

A clean, surface sounded bedrock bearing surface should be free of loose materials, and should not contain surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings designed using the abovenoted bearing resistance value at SLS placed over a bedrock surface will be subjected to negligible settlements.

Design for Earthquakes

Foundations for the proposed wall can be designed using a seismic site response **Class C** as defined in the Ontario Building Code 2012 (OBC 2006; Table 4.1.8.4.A). The soils underlying the site are not susceptible to liquefaction.

Protection of Footings Against Frost Action

It should be noted that surface-sounded bedrock, free of significant mud seams and fissures, and approved by the geotechnical consultant at the time of excavation will be considered non-frost susceptible. Therefore, the perimeter wall foundation will not require additional frost protection to compensate for the reduced soil cover where founded directly over an approved surface-sounded bedrock bearing surface.

Exterior unheated footings, such as those for the proposed wall structure, founded over a soil bearing surface are prone to deleterious movement associated with frost action. To ensure adequate frost protection is provided, the following recommendations should be adhered to:

- ❏ A minimum 600 mm thick soil cover should be present between the finished grade and underside of footing level.
- ❏ A minimum 100 mm thick layer of HI-40 rigid insulation or equivalent should be placed immediately below the underside of footing.
- ❏ A minimum 100 mm thick layer of SM rigid insulation or equivalent should extend horizontally at least 1.2 m beyond the footing face. Where space is limited and does not allow for the 1.2 m horizontal extension, it is recommended to place at least a 100 mm thick layer of SM rigid insulation vertically extending downward positioned at the end of the reduced horizontal rigid insulation layer. The vertical section should extend at least 300 mm below the horizontal layer.

Lateral Earth Pressures

It is expected that the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 40 degrees and a drained unit weight of 20 kN/m^3. An interface friction angle of 30 degrees between the wall and the backfill material is applicable for the abovenoted parameters. Two (2) distinct conditions, static and seismic, must be reviewed for design calculations. The parameters for design calculations for the two (2) conditions are presented on the following pages.

Static Earth Pressures

Under static conditions, the walls may be designed using a triangular earth pressure distribution with a maximum stress value at the base of the wall equal to $K_o \gamma H$ where:

K_o - At-rest earth pressure coefficient = 0.35
γ - unit weight of the fill = 20 kN/m^3
H - height of the retained fill against the wall, m

It is understood that a maximum height differential of 300 mm is anticipated along the perimeter wall. However, due to the sloping ground surface along the slope side of the wall, it is recommended to design for a minimum 600 mm height differential to compensate for the reduced earth pressure provided by the sloping ground surface.

An additional pressure having a magnitude equal to $K_o q$ and acting on the entire height of the wall must be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall.

Actual earth pressures could be higher than the "at-rest" case if care is not exercised during the compaction of the backfill materials to stay at least 0.3 m away from the walls with the compaction equipment.

Seismic Earth Pressures

Seismic loading conditions influence the earth pressures that will act on earth retaining structures during seismic events. In Ottawa, the peak ground acceleration (PGA) is 0.32 for the OBC 2012.

The magnitude of seismic earth pressures acting on a structure is dependent upon the relative flexibility of the structure. Isolated free-standing retaining walls are generally flexible enough to be considered as "yielding" earth retaining structures.

The total active earth force acting on a wall under seismic conditions can be estimated using a pseudo-static approach based on the Mononobe-Okabe (M-O) Method. The seismic intensity is represented by the horizontal seismic coefficient, k_h. For yielding structures, the value of k_h can be taken to be one half of PGA. Note that the vertical seismic coefficient is taken to be zero.

The M-O Method is used to calculate the total active earth pressure (P_{AE}). The resulting force is then split into the static (active) (P_A) and seismic component (ΔP_{AE}).

The total active earth pressure (P_{AE}) can be calculated using $0.5K_{AE}\ \gamma H^2$ where:

- K_{AE} - Dynamic active earth pressure coefficient. For the conditions previously stated, K_{AE} is 0.3.
- γ - unit weight of the fill of the applicable retained soil (kN/m^3)
- H - height of the wall (m)

The static component (P_A) can be calculated using $0.5K_A\ \gamma\ H^2$ where:

- K_A = dynamic active earth pressure coefficient, 0.2
- γ = unit weight of the fill of the applicable retained soil (kN/m^3)
- H = height of the wall (m)

The dynamic seismic component (ΔP_{AE}) can be calculated by $\Delta P_{AE} = P_{AE} - P_A$.

The static component (P_A) is a conventional triangular shaped pressure distribution with the resultant located H/3 up from the wall base. The seismic component (ΔP_{AE}) is acting approximately 0.6H up from the wall base.

On this basis, the total active pressure (P_{AE}) will act from a height:

$$h = \left\{P_A(H/3)+\Delta P_{AE}(0.6H)\right\} \Big/ P_{AE}$$

The earth pressures calculated are unfactored. For the ULS case, the earth pressure loads must be factored as live loads, as per OBC 2012.

Sliding Resistance

Sliding horizontal shear resistance of the footings founded over a bedrock surface or on a rigid insulation layer over a granular fill can be computed using a horizontal shear resistance (friction) factor of 0.6 and 0.4, respectively.

Pavement Structure

The existing asphaltic concrete finished pathway is anticpated to be reinstated upon completion of the wall rehabilitation work. The proposed pavement structure presented in Table 1 is recommended for the pathway.

Table 1 - Recommended Pavement Structure - Pedestrian Pathway	
Thickness (mm)	**Material Description**
50	**WEAR COURSE -** HL-3 or Superpave 12.5 Asphaltic Concrete
300	**BASE** - OPSS Granular A Crushed Stone
SUBGRADE - Either in situ soil, fill or OPSS Granular B Type II material placed over in situ soil or fill.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the SPMDD using suitable compaction equipment.

Excavation Side Slopes

The side slopes of excavations in the overburden materials should either excavated to acceptable slopes from the beginning of the excavation until the structure is backfilled. Sufficient room is assumed to be available for the greater part of the excavation to be constructed as open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. A shallower slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should maintain safe working distance from the excavation limits.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

Groundwater Control

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

The groundwater infiltration rate into the excavation through the overburden should be low for expected founding level. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

If more than 50,000 L/day are to be pumped during the construction phase, a temporary MOE permit to take water (PTTW) will be required.

Winter Construction

Precautions should be considered if winter construction is to be completed.

Where excavations are completed in proximity of existing structures which may be adversely affected due to the freezing conditions. Provisions should be made in the contract document to protect the walls of the excavations from freezing, if applicable.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

4.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials.
- ❑ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❑ Observation of all subgrades prior to backfilling.
- ❑ Field density tests to determine the level of compaction achieved.

Upon request, a report confirming work has been conducted in general accordance with the recommendations could be issued following the completion of a materials testing and observation program by the geotechnical consultant.

5.0 Statement of Limitations

The recommendations in this report are in accordance with Paterson's present understanding of the project. The recommendations should be reviewed when the project drawings and specifications are complete.

This geotechnical investigation is a limited sampling of the site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein, or by person(s) other than Robertson Martin Architects or their agents is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Best Regards,

Paterson Group Inc.

Joe Forsyth, P.Eng

David J. Gilbert, P.Eng.

Attachments

- ❏ Soil Profile and Test Data sheets
- ❏ Symbols and Terms
- ❏ Test Pit and Rock Core Photographs
- ❏ Figure 1 - Key Plan
- ❏ Drawing PG3172-1 - Test Hole Location Plan

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	86.75		
Asphaltic concrete 0.05									
FILL: Dark brown silty sand with stone dust		SS	1	53	50+				
0.60									
End of Borehole									
Practical refusal to augering at 0.60m depth									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
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REMARKS

FILE NO. PG3172

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** April 25, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.05		
25mm Asphaltic concrete over crushed stone									
0.23									
FILL: Brown silty sand with gravel, trace clay		AU	1						
0.63									
		RC	1	83	39	1	86.05		
BEDROCK: Grey limestone with shale partings throughout									
- upper 0.9m noted to be weathered						2	85.05		
		RC	2	100	97				
2.92									
End of Borehole									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

FILE NO. PG3172

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.11	20 40 60 80	
Asphaltic concrete 0.05									
FILL: Brown silty sand with gravel 0.23		AU	1						
FILL: Compact, brown silty sand with gravel and cobbles		SS	2	50	23				
		SS	3	67	50+	1	86.11		
1.17									
End of Borehole Practical refusal to augering at 1.17m depth (BH dry upon completion)								20 40 60 80 100 **Shear Strength (kPa)** ▲ Undisturbed △ Remoulded	

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

FILE NO. PG3172

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
25mm Asphaltic concrete over crushed stone mixed with silty sand		AU	1			0	87.18		
0.20									
FILL: Loose to compact, brown silty sand with gravel, trace cobbles		SS	2	42	8				
		SS	3	35	50+	1	86.18		
1.42									
End of Borehole Practical refusal to augering at 1.42m depth (BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** April 25, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.32		
Asphaltic concrete 0.05									
FILL: Crushed stone 0.23									
FILL: Brown silty sand with gravel, trace clay and cobbles		AU	1						
0.76						1	86.32		
		RC	1	97	15				
BEDROCK: Grey limestone with shale partings and occasional calcite in-filled fractures						2	85.32		
		RC	2	100	100				
3.12						3	84.32		
End of Borehole									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
Asphaltic concrete 0.05						0	87.54		
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Compact, brown silty sand with gravel, trace cobbles		SS	2	46	13				
1.09						1	86.54		
End of Borehole Practical refusal to augering at 1.09m depth (BH dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH 7

BORINGS BY CME 55 Power Auger **DATE** April 25, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.75		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Brown silty sand with gravel		AU	2						
0.91						1	86.75		
		RC	1	100	0				
BEDROCK: Grey limestone with shale partings throughout and occasional mud seams noted - upper 0.9m weathered						2	85.75		
		RC	2	100	73				
3.08						3	84.75		
End of Borehole (BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH 8

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.90		
Asphaltic concrete 0.08		AU	1						
FILL: Crushed stone with silty sand 0.18									
		SS	2	46	10				
FILL: Compact, brown silty sand with gravel, trace cobbles		SS	3	43	50+				
0.99									
End of Borehole									
Practical refusal to augering at 0.99m depth									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH 9

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.78		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Dense, brown silty sand with gravel and cobbles		SS	2	42	35				
		SS	3	75	50+				
0.91									
End of Borehole									
Practical refusal to augering at 0.91m depth									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH10

BORINGS BY CME 55 Power Auger **DATE** April 25, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.69		
25mm Asphaltic concrete over crushed stone		AU	1						
0.23									
FILL: Brown silty sand with gravel, trace cobbles		AU	2						
0.59						1	86.69		
		RC	1	92	22				
BEDROCK: Grey limestone with shale partings throughout - upper 1m noted to be weathered with occasional mud seams						2	85.69		
		RC	2	100	72				
3.02						3	84.69		
End of Borehole (BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH11

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.63		
25mm Asphaltic concrete over crushed stone with silty sand		AU	1						
0.20									
FILL: Brown silty sand with gravel, trace clay		AU	2						
		SS	3	50	50+				
0.48									
End of Borehole									
Practical refusal to augering at 0.48m depth									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH12

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.61		
25mm Asphaltic concrete over crushed stone with silty sand 0.13		AU	1						
FILL: Brown silty sand with gravel, some clay, trace cobbles		AU	2						
0.63									
End of Borehole									
Practical refusal to augering at 0.63m depth									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. BH13

BORINGS BY CME 55 Power Auger **DATE** April 24, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.27		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20		AU	1						
FILL: Brown silty sand with gravel, trace clay and cobbles		AU	2			1	87.27		
1.12									
		RC	1	92	42				
BEDROCK: Grey limestone with shale partings, occasional mud seams noted throughout - vertical fracture from 2.2 to 3.0m depth						2	86.27		
		RC	2	98	50	3	85.27		
3.22									
End of Borehole (BH dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP 1A

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	86.56		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20									
FILL: Brown silty sand with gravel and cobbles, some organics 0.81									
Weathered **BEDROCK**						1	85.56		
1.32 End of Test Pit									
(TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP 2A

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	86.86		
FILL: Crushed stone with silty sand									
0.20									
FILL: Brown silty sand with gravel and cobbles, some organics									
0.65									
End of Test Pit TP terminated on bedrock surface at 0.65m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

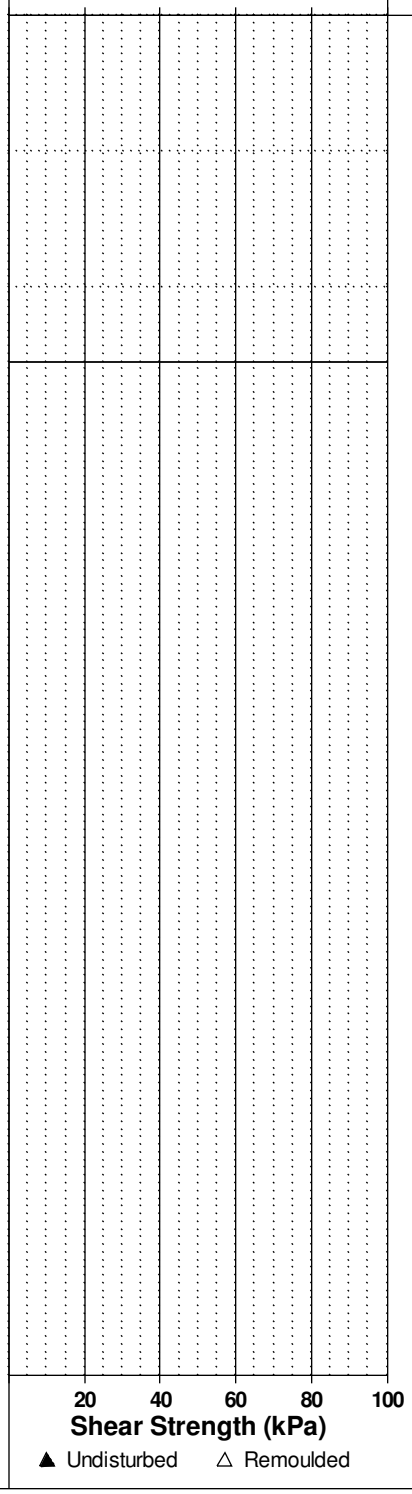
REMARKS

FILE NO. PG3172

HOLE NO. TP 3B

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	86.99		
Asphaltic concrete 0.05									
FILL: Crushed stone 0.13									
FILL: Brown silty sand with gravel, trace cobbles									
0.51									
End of Test Pit									
TP terminated on bedrock surface at 0.51m depth									
Stone block pavers were encountered at ground surface along east side of test pit									
(TP dry upon completion)									



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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP 4A

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.13		
25mm Asphaltic concrete over crushed stone									
0.13									
FILL: Brown silty sand with gravel and cobbles									
0.94									
End of Test Pit Practical refusal to excavation at 0.94m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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REMARKS

FILE NO. PG3172

HOLE NO. TP 5B

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.32		
25mm Asphaltic concrete over crushed stone									
0.18									
FILL: Brown silty sand with gravel and cobbles						1	86.32		
1.12									
End of Test Pit TP terminated on bedrock surface at 1.12m depth along south side of the test pit. Bedrock was not encountered at north side of test pit. (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP 6A

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.36		
25mm Asphaltic concrete over crushed stone									
0.20									
FILL: Brown silty sand with gravel and cobbles									
0.76									
End of Test Pit TP terminated on bedrock surface at 0.76m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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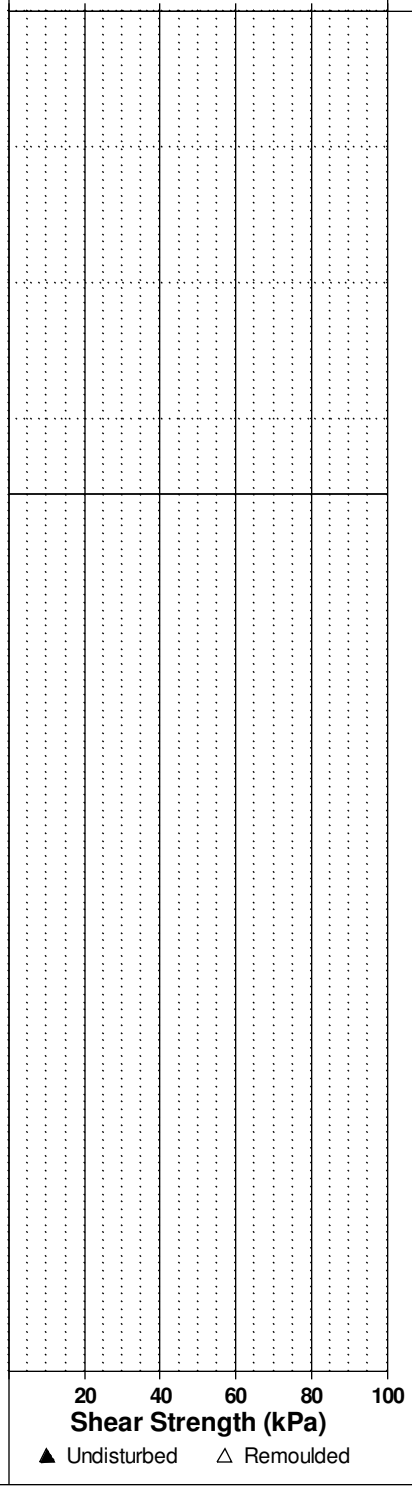
REMARKS

FILE NO. PG3172

HOLE NO. TP 7B

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.67		
25mm Asphaltic concrete over crushed stone									
0.13									
FILL: Brown silty sand with gravel, trace cobbles									
0.71									
End of Test Pit TP terminated on weathered bedrock surface at 0.71m depth (TP dry upon completion)									



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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

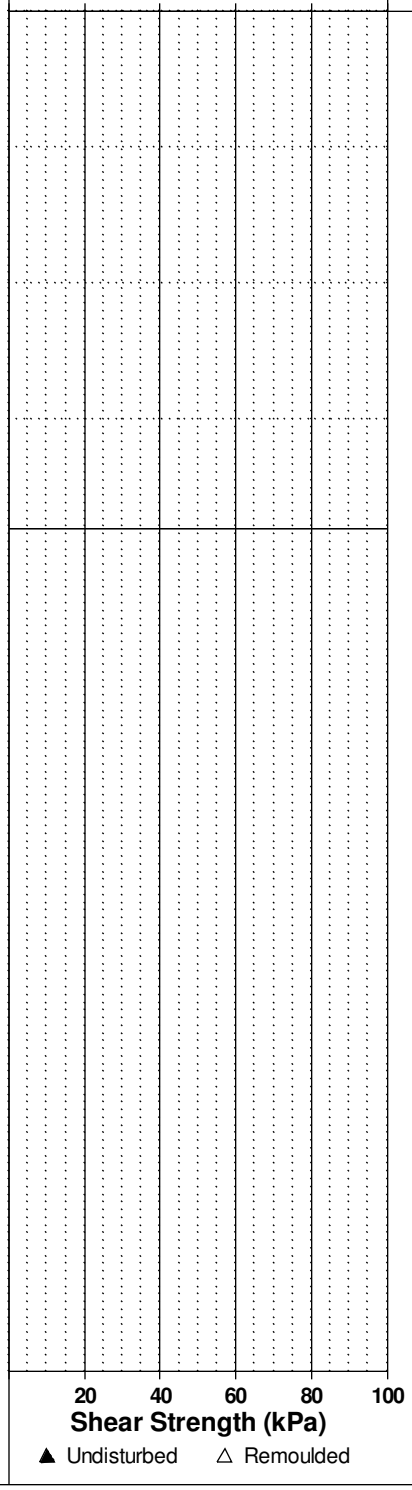
REMARKS

FILE NO. PG3172

HOLE NO. TP 8A

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.78		
25mm Asphaltic concrete over crushed stone - rootlets noted throughout									
0.25									
FILL: Brown silty sand with gravel, cobbles, trace clay									
0.76									
End of Test Pit TP terminated on bedrock surface at 0.76m depth (TP dry upon completion)									



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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP 9C

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.76		
Asphaltic concrete 0.05									
FILL: Crushed stone						1	86.76		
(TP dry upon completion) 1.60									
End of Test Pit									
TP terminated on top of concrete tunnel surface at 1.60m depth. Exposed face of concrete foundation below existing perimeter wall Perforated, corrugated PVC drainage pipe encountered at base of foundation wall.									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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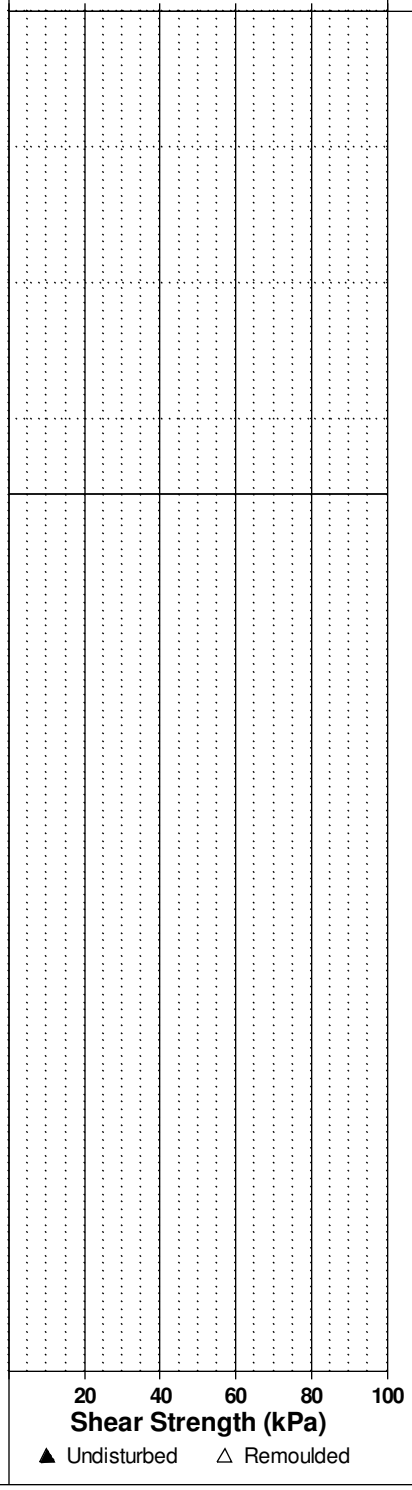
REMARKS

FILE NO. PG3172

HOLE NO. TP10B

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
Asphaltic concrete 0.05						0	87.83		
FILL: Crushed stone with silty sand 0.18									
FILL: Brown silty sand with gravel 0.71									
End of Test Pit Test pit terminated on bedrock surface at 0.71m depth (TP dry upon completion)									



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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP11A

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.87		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.18									
FILL: Brown silty sand with gravel, trace cobbles						1	86.87		
1.25									
End of Test Pit TP terminated on bedrock surface at 1.25m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP12D

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.84		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.53									
FILL: Brown silty sand with gravel, cobbles, trace clay 1.12						1	86.84		
End of Test Pit TP terminated on bedrock surface at 1.12m depth A portion of the existing tunnel is exposed within the east side of test pit at 300mm depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

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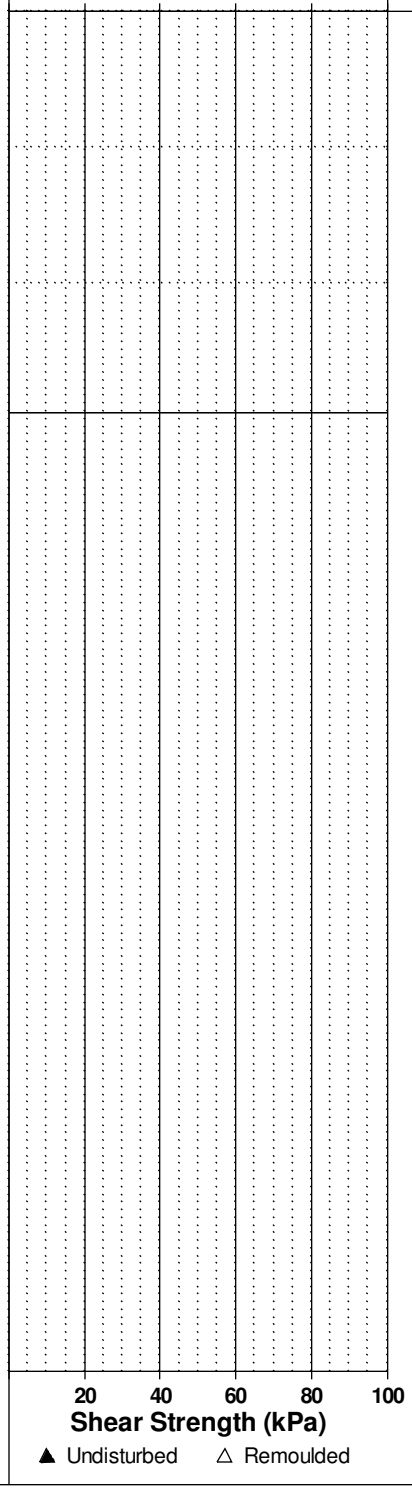
REMARKS

FILE NO. PG3172

HOLE NO. TP13B

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.71		
25mm Asphaltic concrete over crushed stone with silty sand									
0.18									
FILL: Brown silty sand with gravel, trace clay and cobbles									
0.59									
End of Test Pit TP terminated on bedrock surface at 0.59m depth (TP dry upon completion)									



patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP14C

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.70		
25mm Asphaltic concrete over crushed stone with silty sand									
0.18									
FILL: Brown silty sand with gravel, cobbles, trace clay									
0.91									
End of Test Pit TP terminated on top of concrete tunnel at 0.91m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP15B

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.63		
25mm Asphaltic concrete over crushed stone with silty sand									
0.13									
FILL: Brown silty sand with gravel, some clay, trace cobbles									
0.65									
End of Test Pit TP terminated on bedrock surface at 0.65m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

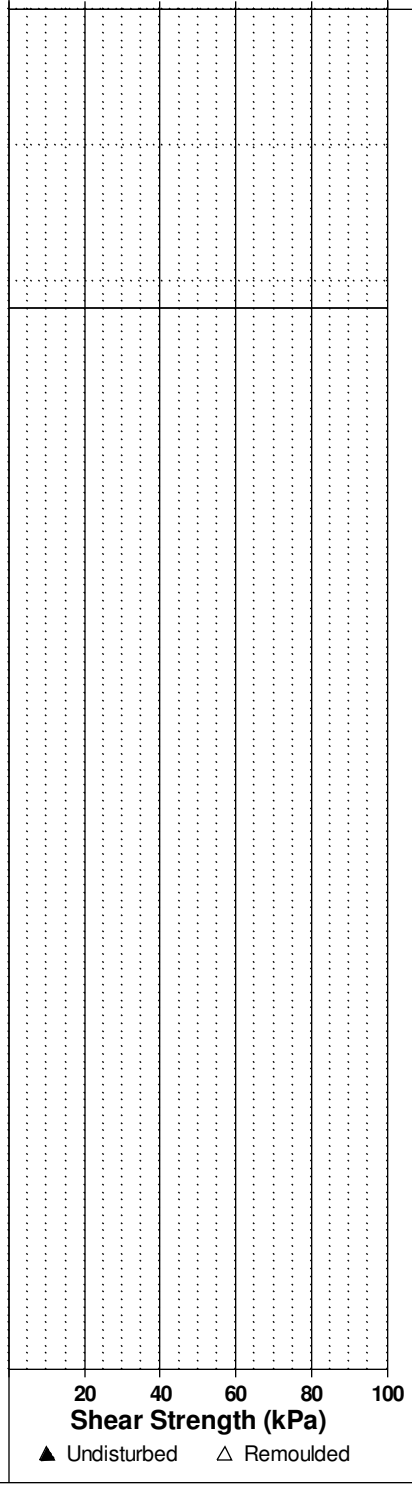
REMARKS

FILE NO. PG3172

HOLE NO. TP16E

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.66		
25mm Asphaltic concrete over crushed stone with silty sand									
0.13									
FILL: Brown silty sand with gravel, some clay, trace cobbles									
0.44									
End of Test Pit TP terminated on bedrock surface at 0.44m depth (TP dry upon completion)									



patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

REMARKS

FILE NO. PG3172

HOLE NO. TP19A

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.65		
Asphaltic concrete 0.05									
FILL: Crushed stone with silty sand 0.20									
FILL: Brown silty sand with gravel, trace clay and cobbles 0.58									
End of Test Pit TP terminated on bedrock surface at 0.58m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed North Perimeter Wall Rehabilitation Phase 3
Parliament Hill, Ottawa, Ontario

DATUM Ground surface elevations at the test hole locations were surveyed by Paterson Group personnel and referenced to a geodetic datum based on topographical information supplied by Adam Kasprzak Surveying.

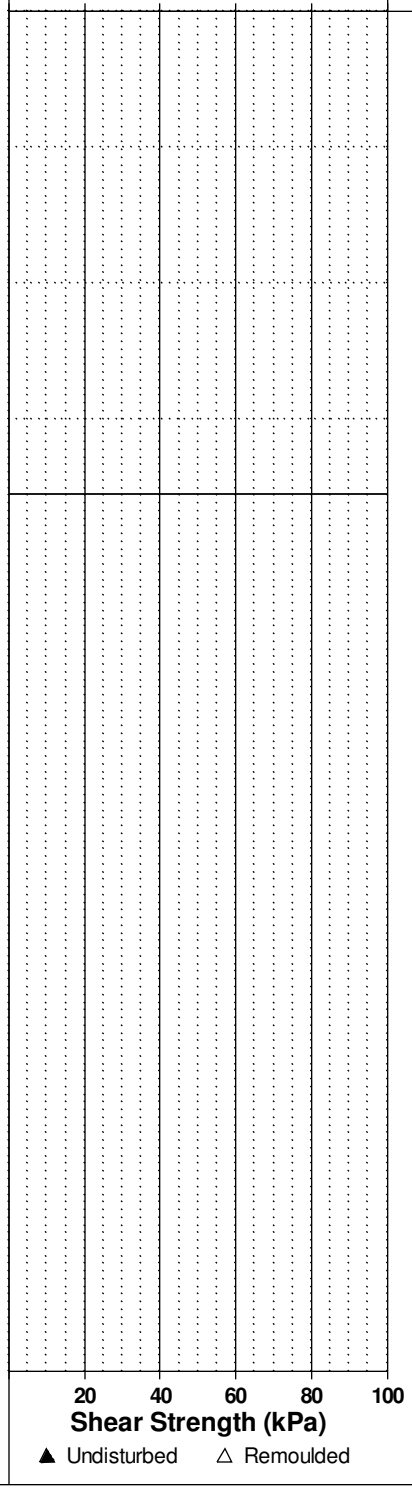
REMARKS

FILE NO. PG3172

HOLE NO. TP20B

BORINGS BY Backhoe **DATE** April 16, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.76		
Asphaltic concrete 0.05									
FILL: Crushed stone 0.20									
FILL: Brown silty sand 0.38									
FILL: Brown silty sand with gravel and roots 0.71									
End of Test Pit TP terminated on bedrock surface at 0.71m depth (TP dry upon completion)									



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

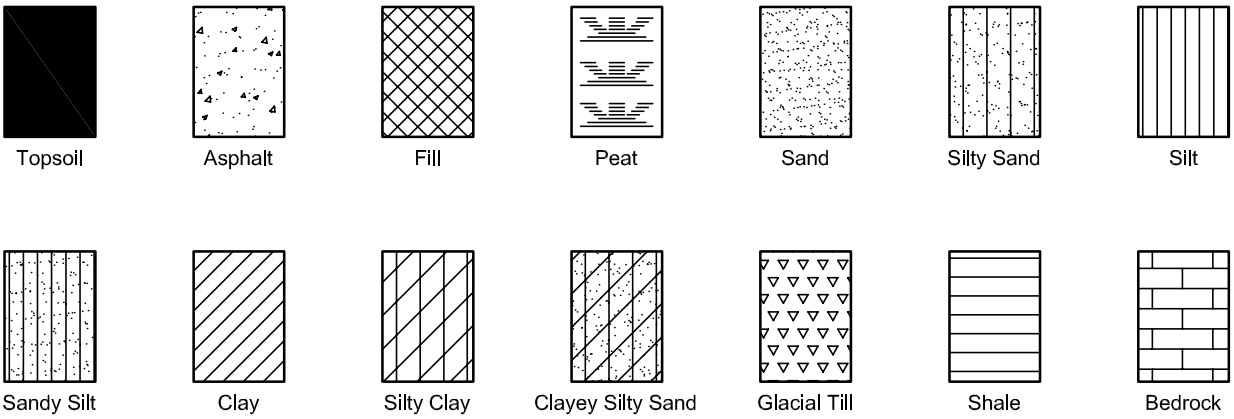
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

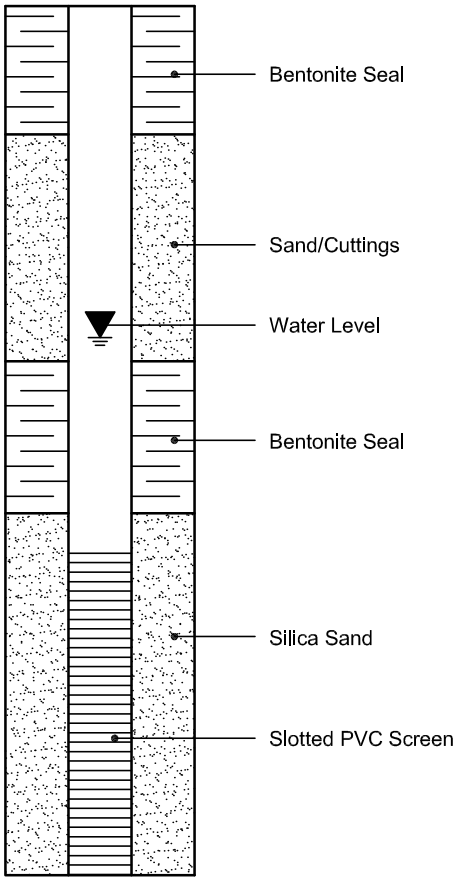
SYMBOLS AND TERMS (continued)

STRATA PLOT



MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION

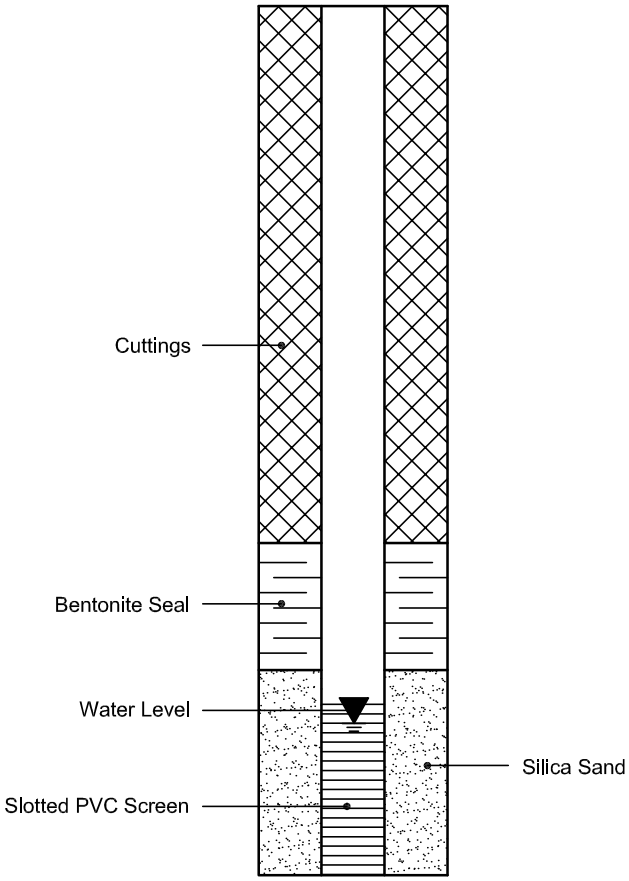


Photo 1 – Silty sand fill at base of test pit along with the existing perimeter wall foundation exposed at TP 1A.

Photo 2 – Existing foundation of monument structure exposed along east side of test pit at TP 3B.

Photo 3 - Soil profile along north side of test pit and existing wall foundation exposed at TP 7A.

Photo 4 - Exposed foundation wall and top of tunnel at TP 9C.

Photo 5 - Exposed corner of existing tunnel within east portion of TP 12D.

Photo 6 - Excavated sidewall at TP 14C.

Photo 7 - Grey limestone bedrock cored between 0.6 to 2.9 m depth at BH 2.

Photo 8 - Grey limestone bedrock cored between 0.8 to 3.1 m depth at BH 5.

Photo 9 - Grey limestone bedrock cored between 0.9 to 3.1 m depth at BH 7.

Photo 10 - Grey limestone bedrock cored between 0.6 to 3.0 m depth at BH 10.

Photo 11 - Grey limestone bedrock cored between 1.1 to 3.2 m depth at BH 13.

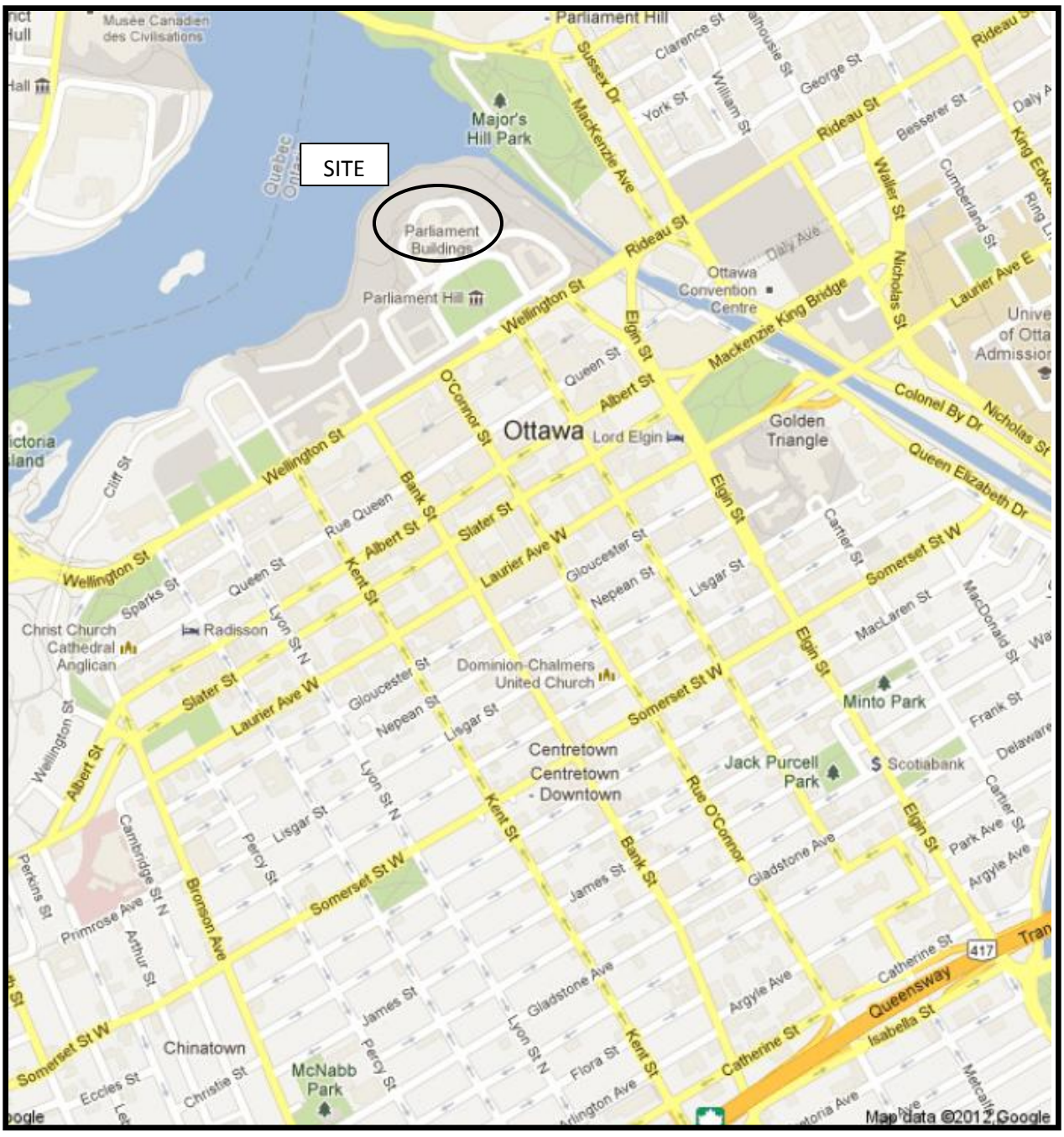
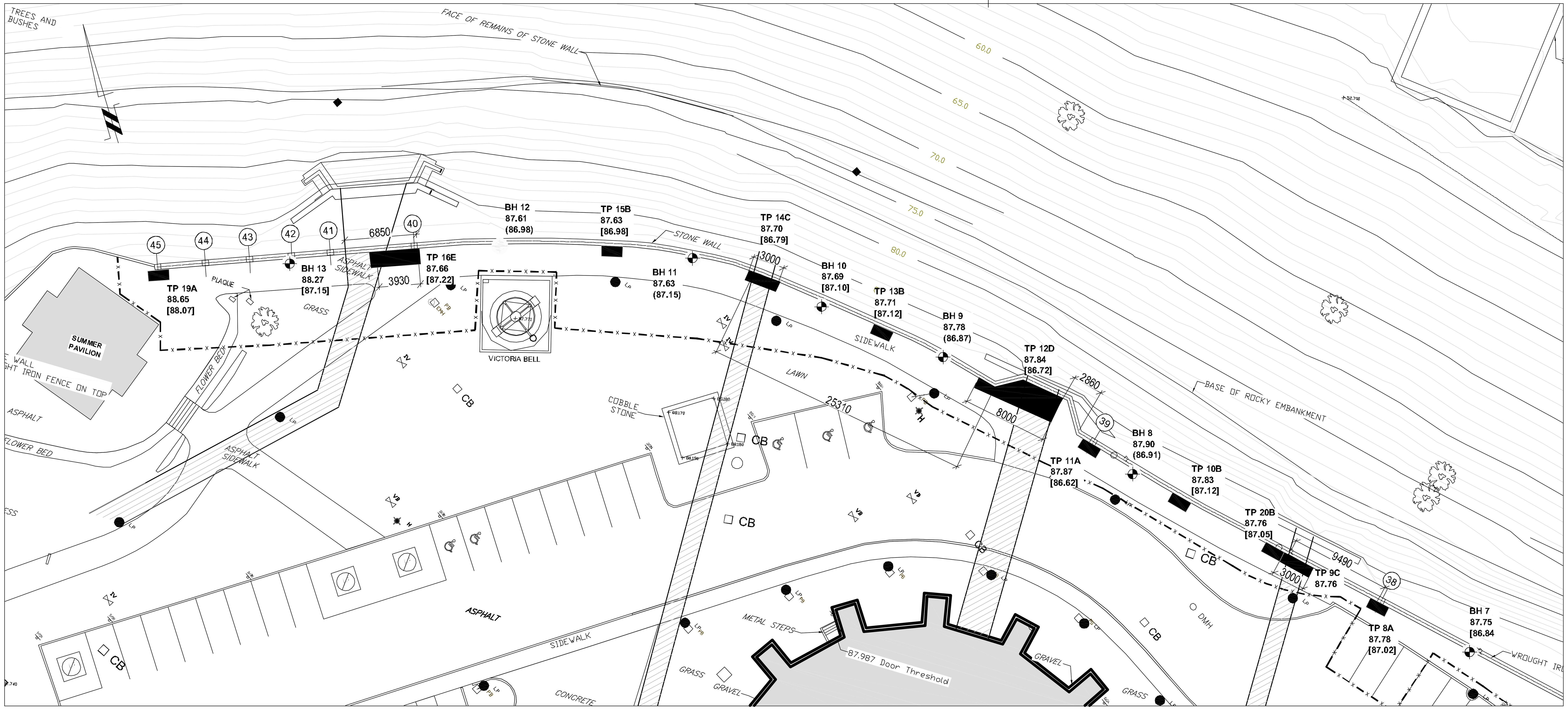
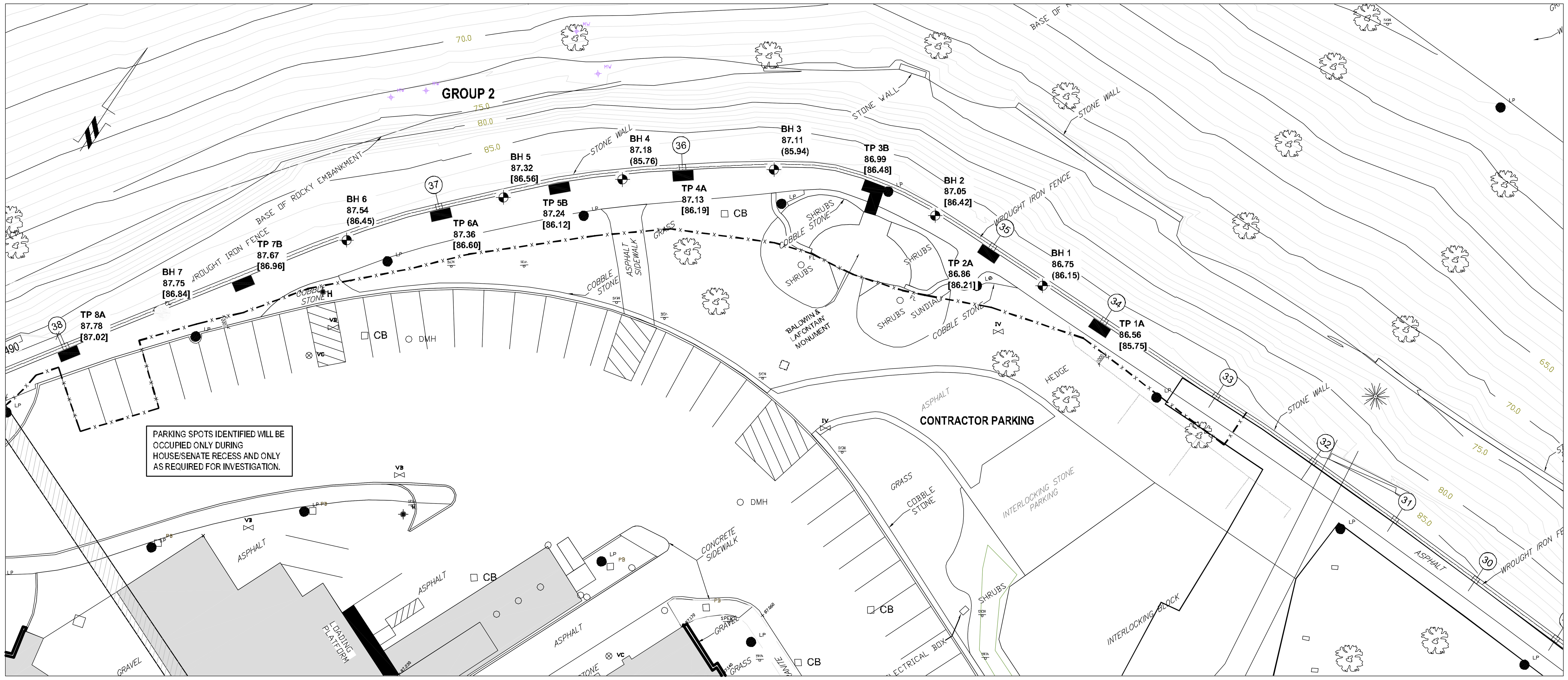


FIGURE 1

KEY PLAN



2 ENLARGED INVESTIGATIONS SITE PLAN - PIERS 38-45
A100 1 : 250



1 ENLARGED INVESTIGATIONS SITE PLAN - PIERS 33-38
A100 1 : 250

GENERAL NOTES

A. PROTECT MONUMENTS.

B. PROTECT LAMP POSTS, CATCH BASINS AND MANHOLES WITHIN WORK AREA.

C. MAINTAIN FIRE HYDRANTS OUTSIDE OF WORK AREA.

LEGEND

- CB CATCH BASIN
- LP LAMP POST
- H FIRE HYDRANT
- UNDERGROUND STRUCTURE
- WORK AREA
- BOREHOLE LOCATIONS
- APPROXIMATE TEST PIT LOCATIONS
- 99.95 GROUND SURFACE ELEVATION (m)
- [99.32] BEDROCK SURFACE ELEVATION (m)
- (99.05) PRACTICAL REFUSAL TO AUGERING ELEVATION (m)

LEGEND NOTES:

GROUND SURFACE ELEVATIONS AT THE TEST HOLE LOCATIONS WERE SURVEYED BY PATERSON GROUP PERSONNEL AND REFERENCED TO A GEODETIC DATUM BASED ON TOPOGRAPHICAL INFORMATION SUPPLIED BY ADAM KASPRZAK SURVEYING.

Publics Works and Government Services Canada
Travaux publics et services gouvernementaux Canada
Parliamentary Precinct Branch
Direction générale de la Cité parlementaire
Canada

paterson group
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Ottawa, Ontario, K2E 7J5
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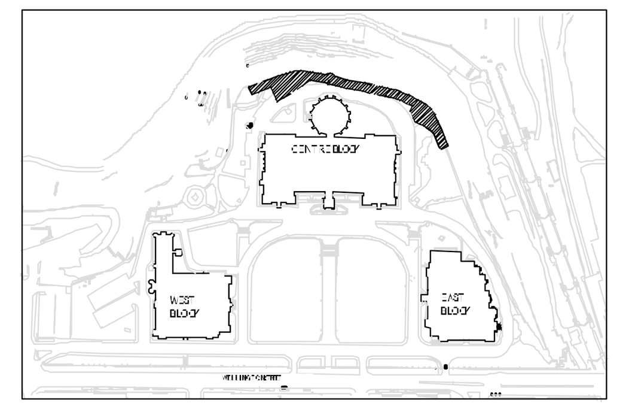

RMA
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mail@robertsonmartin.com

LOGO SEAL/ SCEAU

revision		date
0	GEOTECHNICAL REPORT	2014/05/13

A detail no. / no. du détail
B location drawing no. / no. de localisation
C drawing no. / no. du dessin

project / projet

NORTH PERIMETER WALL REHABILITATION
PHASE 3
PIERS 33 TO 45

Parliamentary Precinct, Parliament Hill, Ottawa

drawing / dessin

TEST HOLE LOCATION PLAN

Designed By	RMA	Conçu par
Date	2012 / 11 / 26	(yyyy/mm/dd)
Drawn By	RMA	Dessiné par
Date	2012 / 11 / 26	(yyyy/mm/dd)
Reviewed By	JAF/DJG	Examiné par
Date	2014-05-13	(yyyy/mm/dd)
Approved By	DJG	Approuvé par
Date	2014/05/13	(yyyy/mm/dd)
Tender		Soumission
Project Manager	OLIVER GOMES	Administrateur de projets
Project no.	R.011800.030	No. du projet
Drawing no.	PG3172	No. du dessin

PRINTED: Jun 04/2014 - 9:46AM BY: Mary

PWGSC PPB A1 (841x594)

0 10 20mm 40 60 80 100 120 140 160 180 200mm

Appendix B:

Class B Cost Estimate

NORTH PERIMETER WALL REHABILITATION: PIERS 33 TO 45 OTTAWA, ONTARIO

CLASS 'B' ESTIMATE

September 11, 2014
Revised: September 12, 2014

Hanscomb

NORTH PERIMETER WALL
REHABILITATION: PIERS 33 TO 45
OTTAWA, ONTARIO

CLASS 'B' ESTIMATE

Prepared For:

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Prepared by:

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151 SLATER ST., SUITE 605
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TEL: (613) 234-8089
FAX: (613) 234-4578
EMAIL: ottawa@hanscomb.com

September 11, 2014
Revised: September 12, 2014
PROJECT NUMBER: Ott5054

TABLE OF CONTENTS

Appendices

- A - Elemental Cost Comparison
- B - Detailed Elemental Cost Estimate

1. INTRODUCTION

1.1 Purpose: This Class 'B' Estimate is intended to provide a realistic allocation of direct and indirect construction costs for the North Perimeter Wall, Rehabilitation: Piers 33 to 45, located in Ottawa, Ontario, with exceptions of items listed in 1.5 below.

1.2 Description: This project is the partial rehabilitation of north perimeter wall of the Parliament Precinct, Parliament Hill, Ottawa, Ontario. The section being looked at is between piers 33 to 45, approximately 245 metres in length. The work includes full replacement of the foundations, rebuilding the exposed stone wall, and restoration of the iron fence. In addition, the asphalt pathway between piers 33 to 46 will be replaced with limestone paving and cut limestone curb.

1.3 Methodology: From the documentation and information provided, quantities of all major elements were assessed or measured where possible and priced at rates considered competitive for a project of this type under a stipulated lump sum form of contract in Ottawa, Ontario.

Pricing shown reflects probable construction costs obtainable in the Ottawa, Ontario area on the effective date of this report. This estimate is a determination of fair market value for the construction of this project. It is not a prediction of low bid. Pricing assumes competitive bidding for every portion of the work.

1.4 Specifications: For building components and systems where specifications and design details are not available, quality standards have been established based on discussions with the design team.

1. INTRODUCTION

1.5 Exclusions: This Class 'B' Estimate does not provide for the following, if required:

- Development charges
- Legal fees and expenses
- Right of way charges
- Easement costs
- Financing or fund raising costs
- Owner's staff and associated management
- Relocation of existing facilities, including furniture and equipment
- Professional fees and expenses
- Cost of contaminated soil removal, if required
- Overtime and restrictive working hours allowance
- Supply of the new face stone
- Cash allowances
- Phased construction premiums
- Construction contingency
- Preventative maintenance contracts
- Building permit
- Harmonized Sales Tax

2. DOCUMENTATION

This Class 'B' Estimate has been prepared from the following documentation:

- L100 – Draft Key Plan dated July 3, 2014
- L101 – Draft Landscape Plan dated July 3, 2014
- L102 – Draft Landscape Plan dated July 3, 2014
- L103 – Draft Elevation Plan dated July 3, 2014
- L110 – Elevation Path Side dated September 11, 2014
- L111 – Elevation Escarpment Side dated September 11, 2014
- A100 – Path Side Elevations dated September 11, 2014
- A101 – Slope Side Elevation dated September 11, 2014
- S101 – Plan dated September 11, 2014
- S102 – Plan dated September 11, 2014
- S103 – Wall Sections and Details dated September 11, 2014
- Design Development Preliminary Report dated Sept. 2, 2014

All of the above documentation was received from Robertson Martin Architects Incorporated and was supplemented with information gathered in meeting(s) and telephone conversations with the design team, as applicable.

Design changes and/or additions made subsequent to this issuance of the documentation noted above have not been incorporated in this report.

3. COST CONSIDERATIONS

3.1 Cost Base:

All costs are estimated on the basis of competitive bids (a minimum of six (6) general contractor bids and at least four (4) sub-contractor bids for each trade) being received in September 2014 from general contractors and all major sub-contractors and suppliers based on a stipulated lump sum form of contract.

If the minimum contractor/sub-contractor conditions are not met, the bids received could exceed the estimate.

3.2 Escalation:

A contingency of 0.9% has been included for construction cost escalation that may occur between September 2014 and the anticipated bid date of end of March 2015 for the project. Escalation during the construction period is included in the unit rates used in the estimate.

3.3 Contingencies:

A contingency of 5.0% has been included to cover design and pricing unknowns. This contingency is not intended to cover any program space modifications but rather to provide some flexibility for the designers and cost planners during the remaining contract document stages.

No contingency has been included to cover construction (post contract) unknowns. It is recommended that a provision for this item be included in the overall program budget.

3.4 Unit Rates:

The unit rates in the preparation of this Class 'B' Estimate include labour and material, equipment, subcontractor's overheads and profits.

3.5 Taxes:

No provision has been made for the Harmonized Sales Tax. It is recommended that the owner make separate provision for HST in the project budget.

3. COST CONSIDERATIONS

3.6 Statement of Probable Costs:

Hanscomb has no control over the cost of labour and materials, the contractor's method of determining prices, or competitive bidding and market conditions. This opinion of probable cost of construction is made on the basis of experience, qualifications and best judgment of the professional consultant familiar with the construction industry. Hanscomb cannot and does not guarantee that proposals, bids or actual construction costs will not vary from this or subsequent cost estimates.

Hanscomb has prepared this estimate in accordance with generally accepted principles and practices. Hanscomb's staff is available to discuss its contents with any interested party.

3.7 Ongoing Cost Control:

Hanscomb recommends that the Owner and design team carefully review this document, including line item description, unit prices, clarifications, exclusions, inclusions and assumptions, contingencies, escalation and mark-ups. If the project is over budget, or if there are unresolved budgeting issues, alternative systems/schemes should be evaluated before proceeding into the next design phase.

Requests for modifications of any apparent errors or omissions to this document must be made to Hanscomb within ten (10) days of receipt of this estimate. Otherwise, it will be understood that the contents have been concurred with and accepted.

It is recommended that a final update estimate be produced by Hanscomb using Bid Documents to determine overall cost changes which may have occurred since the preparation of this estimate. The final updated estimate will address changes and additions to the documents, as well as addenda issued during the bidding process. Hanscomb cannot reconcile bid results to any estimate not produced from bid documents including all addenda.

4. SITE DEVELOPED AREAS

SITE DEVELOPED AREA:

Description	m2
Area of Site Length of fence (245m)	1,740
Site Developed Area	**1,740**

Site Developed Area is the area of the site less the footprint area of the building.

The above areas have been measured in accordance with the third edition of the Canadian Institute of Quantity Surveyors' "Measurement of Buildings by Area and Volume".

5. CONSTRUCTION COST ESTIMATE SUMMARY

COST SUMMARY:

- New Construction	$655,000
- Site & Ancillary Work	$3,359,900
Total- Including Site	**$4,014,900**
- General Requirements	$602,200
- Fee	$138,500
Total- Excluding Contingencies	**$4,755,600**
- Design and Pricing Allowance	$237,800
- Escalation Allowance	$44,900
- Construction Allowance	$0
Total- Including Contingencies	**$5,038,300**
- Harmonized Sales Tax	$0
Total Construction Estimate	**$5,038,300**

NOTE:

1. An allowance for winter heat and enclosure is included above. The general contractor will be responsible on designing how they will achieve the requirements.

Appendix
A - Elemental Cost Comparison

Project : North Perimeter Walls
: Rehabilitation, Piers 33 to 45
Location : Parliament Hill
Owner : PWGSC
Client : Roberston Martin Architects

COMPARISON COST SUMMARY

Report Date: September 12, 2014

Element	Class C Estimate Option 3b July 24, 2014 Elemental Amount Sub-total	Class C Estimate Option 3b July 24, 2014 Elemental Amount Total	Class B Estimate September 12, 2014 Elemental Amount Sub-total	Class B Estimate September 12, 2014 Elemental Amount Total	Variance Sub-total	Variance Total
A SHELL		260,000		655,000		395,000
A1 SUBSTRUCTURE		260,000		655,000		395,000
A11 Foundations	0		0		0	
A12 Basement Excavations	0		0		0	
A13 Special Conditions	260,000		655,000		395,000	
A2 STRUCTURE		0		0		0
A21 Lowest Floor Construction	0		0		0	
A22 Upper Floor Construction	0		0		0	
A23 Roof Construction	0		0		0	
A3 EXTERIOR CLADDING		0		0		0
A31 Walls Below Grade	0		0		0	
A32 Walls Above Grade	0		0		0	
A33 Windows and Entrances	0		0		0	
A34 Roof Coverings	0		0		0	
A35 Projections	0		0		0	
B INTERIORS		0		0		0
B1 PARTITIONS & DOORS		0		0		0
B11 Partitions	0		0		0	
B12 Doors	0		0		0	
B2 FINISHES		0		0		0
B21 Floor Finishes	0		0		0	
B22 Ceiling Finishes	0		0		0	
B23 Wall finishes	0		0		0	
B3 FITTINGS & EQUIPMENT		0		0		0
B31 Fittings & Fixtures	0		0		0	
B32 Equipment	0		0		0	
B33 Elevators	0		0		0	
B34 Escalators	0		0		0	
C SERVICES		-		-		-
C1 MECHANICAL		0		0		0
C11 Plumbing & Drainage	0		0		0	
C12 Fire Protection	0		0		0	
C13 HVAC	0		0		0	
C14 Controls	0		0		0	
C2 ELECTRICAL		0		0		0
C21 Service & Distribution	0		0		0	
C22 Lighting & Power	0		0		0	
C23 Systems & Ancillaries	0		0		0	
NET BUILDING COST - EXCLUDING SITE		**$ 260,000**		**$ 655,000**		**$ 395,000**
D1 SITE WORK		3,347,700		3,359,900		12,200
D11 Site Development	3,347,700		3,359,900		12,200	
D12 Mechanical Site Services	0		0		0	
D13 Electrical Site Services	0		0		0	
D2 ANCILLARY WORK		0		0		0
D21 Demolition	0		0		0	
D22 Temporary Enclosures	0		0		0	
NET BUILDING COST - INCLUDING SITE		**$ 3,607,700**		**$ 4,014,900**		**$ 407,200**
Z1 GENERAL REQUIREMENTS & FEE		665,700		740,700		75,000
Z11 General Requirements	541,200		602,200		61,000	
Z12 Fee	124,500		138,500		14,000	
TOTAL EXCLUDING CONTINGENCIES		**$ 4,273,400**		**$ 4,755,600**		**$ 482,200**
Z2 ALLOWANCES		425,000		282,700		-142,300
Z21 Design contingency	341,900		237,800		-104,100	
Z22 Escalation contingency	83,100		44,900		-38,200	
Z23 Construction contingency	0		0		0	
TOTAL INCLUDING CONTIGENCIES		**$ 4,698,400**		**$ 5,038,300**		**$ 339,900**
__ **HARMONIZED SALES TAX EXCLUDED**		0		0		0
__ Harmonized Sales Tax	0		0		0	
TOTAL CONSTRUCTION ESTIMATE		**$ 4,698,400**		**$ 5,038,300**		**$ 339,900**

Gross Floor Area	245 m	245 m	- m2
Rate Per m2	$ 19,177.14 m2	$ 20,564.49 m2	$ 1,387.35 m2

Hanscomb

Appendix
B - Detailed Elemental Cost Estimate

Project	: North Perimeter Wall		Report date : 12 Sep 2014
	: Rehabilitation, Piers 33 to 45		Page No. : 1
Location	: Parliament Hill	ELEMENTAL COST SUMMARY	Bldg Type : 380
Owner	: PWGSC		C.T. Index : 0.0
Consultant	: Robertson Martin Architects		GFA : 245 m

Element	Ratio to GFA	Elemental Cost Quantity	Elemental Cost Unit rate	Elemental Amount Sub-Total	Elemental Amount Total	Rate per m Sub-Total	Rate per m Total	%
A SHELL		245 m			655,000		2,673.47	13.8
A1 SUBSTRUCTURE					655,000		2,673.47	13.8
A11 Foundations				0		0.00		
A12 Basement Excavation				0		0.00		
A13 Special Conditions	0.000	1 Sum	655,000.00	655,000		2,673.47		
A2 STRUCTURE					0		0.00	0.0
A21 Lowest Floor Construction				0		0.00		
A22 Upper Floor Construction				0		0.00		
A23 Roof Construction				0		0.00		
A3 EXTERIOR ENCLOSURE					0		0.00	0.0
A31 Walls Below Grade				0		0.00		
A32 Walls Above Grade				0		0.00		
A33 Windows & Entrances				0		0.00		
A34 Roof Coverings				0		0.00		
A35 Projections				0		0.00		
B INTERIORS		245 m			0		0.00	0.0
B1 PARTITIONS & DOORS					0		0.00	0.0
B11 Partitions				0		0.00		
B12 Doors				0		0.00		
B2 FINISHES					0		0.00	0.0
B21 Floor Finishes				0		0.00		
B22 Ceiling Finishes				0		0.00		
B23 Wall Finishes				0		0.00		
B3 FITTINGS & EQUIPMENT					0		0.00	0.0
B31 Fittings & Fixtures				0		0.00		
B32 Equipment				0		0.00		
B33 Elevators				0		0.00		
B34 Escalators				0		0.00		
C SERVICES		245 m			0		0.00	0.0
C1 MECHANICAL					0		0.00	0.0
C11 Plumbing & Drainage				0		0.00		
C12 Firo Protection				0		0.00		
C13 HVAC				0		0.00		
C14 Controls				0		0.00		
C2 ELECTRICAL					0		0.00	0.0
C21 Service & Distribution				0		0.00		
C22 Lighting, Devices & Heating				0		0.00		
C23 Systems & Ancillaries				0		0.00		
NET BUILDING COST - EXCLUDING SITE				**$**	**655,000**		2,673.47	13.8
D SITE & ANCILLARY WORK		245 m			3,359,900		13,713.88	70.7
D1 SITE WORK					3,359,900		13,713.88	70.7
D11 Site Development	7.100	1,740 m2	1,931.00	3,359,900		13,713.88		
D12 Mechanical Site Services				0		0.00		
D13 Electrical Site Services				0		0.00		
D2 ANCILLARY WORK					0		0.00	0.0
D21 Demolitions				0		0.00		
D22 Alterations				0		0.00		
NET BUILDING COST - INCLUDING SITE				**$**	**4,014,900**		16,387.35	84.4
Z1 GENERAL REQUIREMENTS & FEE					740,700		3,023.27	15.6
Z11 General Requirements		15.0 %		602,200		2,457.96		
Z12 Fee		3.0 %		138,500		565.31		
TOTAL CONSTRUCTION ESTIMATE - EXCLUDING ALLOWANCES				**$**	**4,755,600**		19,410.61	100.0
Z2 ALLOWANCES					282,700		1,153.88	
Z21 Design & Pricing Allowance		5.0 %		237,800		970.61		
Z22 Escalation Allowance		0.9 %		44,900		183.27		
Z23 Construction Allowance		0.0 %		0		0.00		
TOTAL CONSTRUCTION ESTIMATE - INCLUDING ALLOWANCES				**$**	**5,038,300**		20,564.49	
VALUE ADDED TAX (GST/HST)					0		0.00	
Value Added Tax (GST/HST)		0.0 %		0		0.00		
TOTAL CONSTRUCTION ESTIMATE				**$**	**5,038,300**	**$**	**20,564.49**	

A1 SUBSTRUCTURE	Quantity	Unit rate	Amount
A13 Special Conditions			
1 Insulated weatherproof enclosure winter - allowance - one season - entire length		allow	375,000
2 Winter heating and ventilation to above - allowance - 1 seasons - system	1 sum	160,000.00	160,000
3 Heating fuel - allowance - 1 season	6 months	20,000.00	120,000
A13 Special Conditions **TOTAL : $**	1 Sum	655,000.00	655,000

D1 SITE WORK		Quantity	Unit rate	Amount
D11	Site Development			
	Iron fencing			
1	Cut out lead filled sockets	300 no.	275.00	82,500
2	Label each component	245 m	150.00	36,800
3	Disassemble ironwork, protect and transport to shop for restoration	245 m	300.00	73,500
4	Clean, repair, fabricate replacement parts and paint in shop	245 m	1,500.00	367,500
5	Reassemble ironwork	245 m	500.00	122,500
6	Fill spear sockets with lead, tooled to promote water run-off	300 no.	400.00	120,000
	Removals			
7	Clear site, prepare for removal of existing stone and concrete fence	1,740 m2	20.00	34,800
8	Dismantle existing wall and foundations, retain sound face stones for reuse, remove cap stone and pier stones	234 m	1,500.00	351,000
9	Allowance for identification and protection of existing underground services		allow	5,000
	Wall Rehabilitation			
10	Mud slab over exposed rock	192 m2	25.00	4,800
11	Compacted granular base over native soil, allow	75 m3	45.00	3,400
12	Reinforced concrete strip footing 500mm thick 1.4m wide	234 m	633.30	148,200
	- Concrete supply	164 m3	210.00	34,400
	- Concrete placement	164 m3	55.00	9,000
	- Rebar	12,300 kg	5.00	61,500
	- Formwork	234 m2	185.00	43,300
			Carried Forward :	1,350,000

D1 SITE WORK		Quantity	Unit rate	Amount
D11 Site Development	(Continued)		**Brought Forward :**	1,350,000
13 Reinforced concrete foundation wall		397 m2	848.90	337,000
- Concrete supply		213 m3	210.00	44,700
- Concrete placement		213 m3	55.00	11,700
- Rebar		26,743 kg	5.00	133,700
- Formwork		794 m2	185.00	146,900
14 Allowance for modifications to existing wall at C1, C2, C3 & C4		4 no.	15,000.00	60,000
15 Allowance for connection of new foundation to existing		8 no.	1,500.00	12,000
Stone supply to above items provided by PWGSC				
16 Fall anchors		45 no.	650.00	29,300
17 Cut stone piers c/w stainless steel pins - retangular		12 no.	5,500.00	66,000
18 Cut stone piers c/w stainless steel pins - custom		4 no.	7,000.00	28,000
19 Cut stone face to wall, 150mm thick c/w stainless steel clamps, etc.,		120 m2	275.00	33,000
20 Cut stone wall cap c/w drip edge, stainless steel pins, etc.,		270 m	900.00	243,000
21 Excavation and backfill		245 m	275.50	67,500
- Excavation for foundations and working spaces		980 m3	25.00	24,500
- Backfill with excavated material		603 m3	20.00	12,100
- Excavation of weathered rock		98 m3	300.00	29,400
- Granular backfill, included with walkway			nil	
- Excavation to lower pathway		60 m3	25.00	1,500
22 Drainage		245 m	381.20	93,400
- Damproof membrane		500 m2	25.00	12,500
- Drainage layer		500 m2	15.00	7,500
- Continuous 150mm drain c/w filter sock, clear granular cover		245 m	50.00	12,300
- Connect last to existing catch basin			allow	2,000
- 150mm non-perforated drains		150 m	250.00	37,500
	(Continued)			
			Carried Forward :	2,319,200

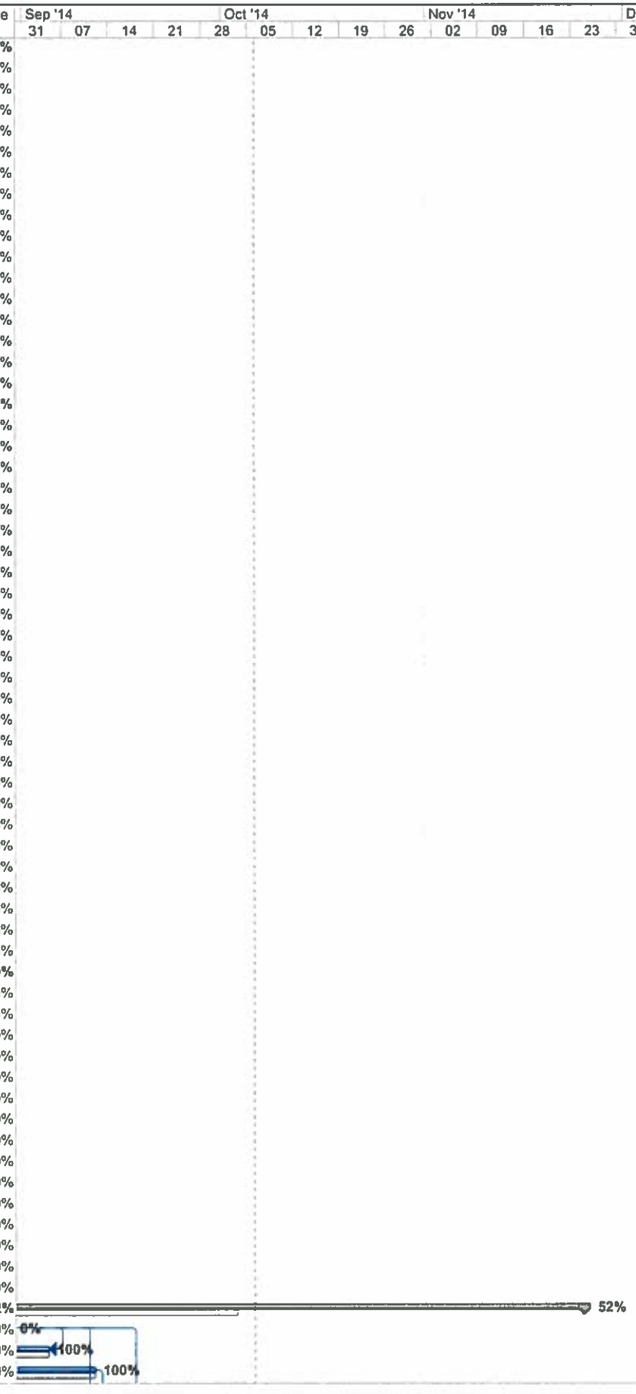
D1 SITE WORK		Quantity	Unit rate	Amount
D11 Site Development	(Continued)		**Brought Forward :**	2,319,200
22 Drainage	(Continued)			
- Connect last to existing storm manhole			allow	2,000
- New catchbasin		7 no.	2,800.00	19,600
Site Restoration				
23 Limestone pavers c/w base around Summer Pavillion, 150mm thk		275 m2	600.00	165,000
24 Limestone pavers c/w base along perimeter wall, 100mm thk		552 m2	550.00	303,600
25 Limestone pavers c/w base at Lookout, 150mm thk		35 m2	600.00	21,000
26 Limestone curb to above c/w poured concrete base		274 m	750.00	205,500
27 New concrete curbs		152 m	125.00	19,000
28 Extend granite border and pavers to new pathway at Victoria bell		7 m2	750.00	5,300
29 Repair/adjust asphalt paving		57 m2	150.00	8,600
30 Pathway extension, asphalt paving		17 m2	150.00	2,600
31 Linear trench drain connected to weeping tile		8 m	450.00	3,600
32 Grass swales		172 m	40.00	6,900
33 Sod c/w topsoil		462 m2	20.00	9,200
34 Allowance for shrubs along the escarpment side to provide plant cover on the areas where vegetation will be eliminated by construction work		1 sum	20,000.00	20,000
35 Remove existing asphalt driveway		462 m2	35.00	16,200
36 Remove existing asphalt pathway along perimeter wall		474 m2	35.00	16,600
			Carried Forward :	3,122,300

D1 SITE WORK		Quantity	Unit rate	Amount
D11 Site Development	(Continued)		**Brought Forward :**	3,122,300
37 Remove existing cobblestones		15 m2	25.00	400
38 Remove existing concrete curb		140 m	35.00	4,900
39 Relocate existing signs		4 no.	200.00	800
40 Lower lamp post		1 no.	500.00	500
41 Lower sun dial monument by about 300mm		1 no.	2,000.00	2,000
42 Allowance for protection of existing monuments		2 no.	2,000.00	4,000
43 Allowance for protection and shoring of existing monuments		5 no.	15,000.00	75,000
44 Allowance for slope side access and protection		1 sum	150,000.00	150,000
D11 Site Development	**TOTAL : $**	1,740 m2	1,930.98	3,359,900

Appendix C:

Schedule

ID	Task Name	Baseline Duration	Baseline Start	Baseline Finish	Actual Duration	Actual Start	Actual Finish	Predecessors	Successors	% Complete
1	**RS 2 Pre-Design Services (6 months max = 132 WD)**	**166 days**	**Fri 29/11/13**	**Fri 01/08/14**	**166 days**	**Fri 29/11/13**	**Fri 01/08/14**			**100%**
2	Start-up meeting	1 day	Fri 29/11/13	Fri 29/11/13	1 day	Fri 29/11/13	Fri 29/11/13		3,4	100%
3	Obtain and review background information (existing dwgs, survey, etc.)	10 days	Fri 29/11/13	Thu 12/12/13	10 days	Fri 29/11/13	Thu 12/12/13	2	5,12,13	100%
4	Prepare and Submit draft project control/administration documents- Schedule, Cash Flow, Monthly Progre:	10 days	Fri 29/11/13	Thu 12/12/13	10 days	Fri 29/11/13	Thu 12/12/13	2		100%
5	Consultant core team meetings, communications	5 days	Fri 13/12/13	Thu 19/12/13	5 days	Fri 13/12/13	Thu 19/12/13	3	6	100%
6	Preliminary wall inspections	1 day	Fri 20/12/13	Fri 20/12/13	1 day	Fri 20/12/13	Fri 20/12/13	5	7,12,13	100%
7	Detailed Field Investigation and Testing Plan	5 days	Fri 27/12/13	Fri 03/01/14	5 days	Fri 27/12/13	Fri 03/01/14	6	8	100%
8	Field Investigation and Testing Plan Review and acceptance by PWGSC	8 days	Mon 06/01/14	Wed 15/01/14	8 days	Mon 06/01/14	Wed 15/01/14	7	9,10,19	100%
9	Site Specific Safety Plan Review and Approval by PWGSC	5 days	Thu 16/01/14	Wed 22/01/14	5 days	Thu 16/01/14	Wed 22/01/14	8	19	100%
10	Define scopes of work and solicit fee proposals for surveying, geotechnical, archaeological	10 days	Thu 16/01/14	Wed 29/01/14	10 days	Thu 16/01/14	Wed 29/01/14	8		100%
11	Lessons Learned Session	0 days	Mon 27/01/14	Mon 27/01/14	0 days	Mon 27/01/14	Mon 27/01/14		46	100%
12	Prepare Pre-Design CAD Dwgs and Graphics	10 days	Fri 27/12/13	Fri 10/01/14	10 days	Fri 27/12/13	Fri 10/01/14	3,6	13	100%
13	Prepare Draft Pre-Design Report	10 days	Mon 20/01/14	Fri 31/01/14	10 days	Mon 20/01/14	Fri 31/01/14	12,3,6	14	100%
14	Submit Draft PreDesign Report	0 days	Mon 03/02/14	Mon 03/02/14	0 days	Mon 03/02/14	Mon 03/02/14	13	15	100%
15	PWGSC Review and Return Comments to Draft Pre-Design Report	10 days	Mon 10/02/14	Mon 24/02/14	10 days	Mon 10/02/14	Mon 24/02/14	14	46,16	100%
16	Consultant response to predesign Client Comments	5 days	Tue 25/02/14	Mon 03/03/14	5 days	Tue 25/02/14	Mon 03/03/14	15		100%
17	Provide Draft communique to PM	0 days	Mon 03/03/14	Mon 03/03/14	0 days	Mon 03/03/14	Mon 03/03/14			100%
18	**Site Investigations**	**41 days**	**Wed 05/03/14**	**Fri 02/05/14**	**41 days**	**Wed 05/03/14**	**Fri 02/05/14**			**100%**
19	PWGSC Issue Communique to Stakeholders for site work	0 days	Wed 05/03/14	Wed 05/03/14	0 days	Wed 05/03/14	Wed 05/03/14	8,9	28,20FS+10 days	100%
20	Site Investigations - Test pits and wall openings by Plouffe Park (Assume staggered groupings follow	8 days	Thu 10/04/14	Wed 23/04/14	8 days	Thu 10/04/14	Wed 23/04/14	19FS+10 days	S+1 day,28SS,29	100%
21	Site Investigations- Test Pits Archaeological Monitoring	5 days	Thu 10/04/14	Wed 16/04/14	5 days	Thu 10/04/14	Wed 16/04/14	20SS,19FS+10 days	29	100%
22	Site Investigations - Arch./Structural	5 days	Thu 10/04/14	Wed 16/04/14	5 days	Thu 10/04/14	Wed 16/04/14	20SS,19FS+10 days	33,34,35	100%
23	Site Investigations - Stone Conservator	2 days	Fri 11/04/14	Mon 14/04/14	2 days	Fri 11/04/14	Mon 14/04/14	20SS+1 day,19	35	100%
24	Site Investigations - Metal Conservator	2 days	Thu 10/04/14	Fri 11/04/14	2 days	Thu 10/04/14	Fri 11/04/14	20SS,19	34,35	100%
25	Site Investigations - Geotechnical monitoring of test pits	3 days	Fri 11/04/14	Tue 15/04/14	3 days	Fri 11/04/14	Tue 15/04/14	20SS+1 day,19	30	100%
26	Site Investigations-Geotechnical boreholes	2 days	Thu 24/04/14	Sat 26/04/14	2 days	Thu 24/04/14	Sat 26/04/14	19	30	100%
27	House Recess	8 days	Mon 14/04/14	Fri 25/04/14	8 days	Mon 14/04/14	Fri 25/04/14			100%
28	Site Surveys - Surveyor	5 days	Mon 28/04/14	Fri 02/05/14	5 days	Mon 28/04/14	Fri 02/05/14	20SS,19	31	100%
29	Site Investigations Finish - Backfill foundation test pits, make good site- By Plouffe Park	4 days	Thu 24/04/14	Tue 29/04/14	4 days	Thu 24/04/14	Tue 29/04/14	20,21	75	100%
30	Site Investigations-- Geotechnical Report	10 days	Mon 28/04/14	Fri 09/05/14	10 days	Mon 28/04/14	Fri 09/05/14	25,26	35	100%
31	Site Survey- Surveyor Documentation	10 days	Mon 05/05/14	Fri 16/05/14	10 days	Mon 05/05/14	Fri 16/05/14	28	47FF,35	100%
32	Send samples of wall foundation and brick cores for testing if required	10 days	Thu 24/04/14	Wed 07/05/14	10 days	Thu 24/04/14	Wed 07/05/14			100%
33	Transfer site assessments to CAD Dwgs/Update HCD Heritage Record Drawings	5 days	Thu 17/04/14	Fri 25/04/14	5 days	Thu 17/04/14	Fri 25/04/14	22	34,35	100%
34	Prepare Summary Field Investigation and Testing and Foundation Analysis Report	5 days	Mon 28/04/14	Fri 02/05/14	5 days	Mon 28/04/14	Fri 02/05/14	33,22,24	38,35	100%
35	Pre-Design Report, and Input to Class "D" Estimate	6 days	Tue 20/05/14	Tue 27/05/14	6 days	Tue 20/05/14	Tue 27/05/14	22,24,33,23,30,31,34	I,41,48FF+3 days	100%
36	Cost Consultant prepares Class "D" Estimate	10 days	Wed 28/05/14	Tue 10/06/14	10 days	Wed 28/05/14	Tue 10/06/14	35	37,38,41	100%
37	Submit Pre-Design Report and Class 'D' Cost Estimate	0 days	Tue 10/06/14	Tue 10/06/14	0 days	Tue 10/06/14	Tue 10/06/14	36,35	43,50	100%
38	Prepare Risk Management Template	5 days	Wed 11/06/14	Tue 17/06/14	5 days	Wed 11/06/14	Tue 17/06/14	34,35,36	39	100%
39	Submit Risk Management Template	0 days	Tue 17/06/14	Tue 17/06/14	0 days	Tue 17/06/14	Tue 17/06/14	38	40	100%
40	PWGSC review Risk Management Template	32 days	Wed 18/06/14	Fri 01/08/14	32 days	Wed 18/06/14	Fri 01/08/14	39		100%
41	Prepare Pre-Design Report Presentation	5 days	Wed 11/06/14	Tue 17/06/14	5 days	Wed 11/06/14	Tue 17/06/14	35,36	42	100%
42	Pre-Design Report Presentation	0 days	Tue 17/06/14	Tue 17/06/14	0 days	Tue 17/06/14	Tue 17/06/14	41		100%
43	PWGSC, HCD, HoC, RCMP, NCC Review Pre-Design Design Report and response to Consultant	10 days	Wed 11/06/14	Tue 24/06/14	10 days	Wed 11/06/14	Tue 24/06/14	37	44,50	100%
44	Consultant response to RS2 Client Comments	6 days	Wed 25/06/14	Thu 03/07/14	6 days	Wed 25/06/14	Thu 03/07/14	43		100%
45	**RS 3 Schematic Design Development (1 month max = 22 WD)**	**73 days**	**Mon 05/05/14**	**Mon 18/08/14**	**73 days**	**Mon 05/05/14**	**Mon 18/08/14**			**100%**
46	Meet with PWGSC for Schematic Design Approaches	0 days	Wed 07/05/14	Wed 07/05/14	0 days	Wed 07/05/14	Wed 07/05/14	15,11		100%
47	Prepare 3 Design Options	10 days	Mon 05/05/14	Fri 16/05/14	10 days	Mon 05/05/14	Fri 16/05/14	31FF	48FF	100%
48	Prepare Schematic Design Report and Input to Class "C" Estimate	15 days	Fri 09/05/14	Fri 30/05/14	15 days	Fri 09/05/14	Fri 30/05/14	47FF,35FF+3 days	49FF,50,53	100%
49	Prepare and Submit updated project control/administration documents- risk, schedule etc.	5 days	Mon 26/05/14	Fri 30/05/14	5 days	Mon 26/05/14	Fri 30/05/14	48FF		100%
50	Cost Consultant prepares Class "C" Estimate	21 days	Wed 09/07/14	Thu 07/08/14	21 days	Wed 09/07/14	Thu 07/08/14	37,43,48	51,53	100%
51	Submit Schematic Design Development Report package and Class 'C' Cost Estimate	1 day	Wed 09/07/14	Thu 10/07/14	1 day	Wed 09/07/14	Thu 10/07/14	50	52	100%
52	PWGSC, HCD, HoC, RCMP, NCC and O&M Review	14 days	Thu 10/07/14	Tue 29/07/14	14 days	Thu 10/07/14	Tue 29/07/14	51	57	100%
53	Prepare Powerpoint Presentation	5 days	Fri 08/08/14	Thu 14/08/14	5 days	Fri 08/08/14	Thu 14/08/14	48,50	55FS+2 days	100%
54	Submit report on tree removals	9 days	Wed 16/07/14	Mon 28/07/14	9 days	Wed 16/07/14	Mon 28/07/14			100%
55	Powerpoint Presentation presentation to stakeholders	0 days	Mon 18/08/14	Mon 18/08/14	0 days	Mon 18/08/14	Mon 18/08/14	53FS+2 days		100%
56	FHBRO Review	25 days	Mon 09/06/14	Mon 14/07/14	25 days	Mon 09/06/14	Mon 14/07/14			100%
57	Revise and resubmit Schematic Design Development Report package.	5 days	Wed 30/07/14	Wed 06/08/14	5 days	Wed 30/07/14	Wed 06/08/14	52	58	100%
58	PWGSC, HCD, HoC, RCMP, NCC Review Pre-Design Design Report and response to Consultant	5 days	Thu 07/08/14	Wed 13/08/14	5 days	Thu 07/08/14	Wed 13/08/14	57	59,60	100%
59	Consultant response to RS3 Client Comments	3 days	Thu 14/08/14	Mon 18/08/14	3 days	Thu 14/08/14	Mon 18/08/14	58		100%
60	PWGSC Approval to proceed to RS4	0 days	Wed 13/08/14	Wed 13/08/14	0 days	Wed 13/08/14	Wed 13/08/14	58	62	100%
61	**RS 4 Design Development (1 month max = 22 WD)**	**70 days**	**Thu 14/08/14**	**Mon 24/11/14**	**36.5 days**	**Thu 14/08/14**	**NA**			**52%**
62	Prepare Design Development Report	10 days	Thu 14/08/14	Wed 27/08/14	10 days	Thu 14/08/14	Wed 27/08/14	60	days,64,65,67,66	100%
63	Prepare and Submit updated project control/administration documents- risk, schedule etc.	5 days	Thu 28/08/14	Thu 04/09/14	5 days	Thu 28/08/14	Thu 04/09/14	62FF+5 days		100%
64	Cost Consultant prepares Class "B" Estimate	10 days	Thu 28/08/14	Thu 11/09/14	10 days	Thu 28/08/14	Thu 11/09/14	62	66,73	100%



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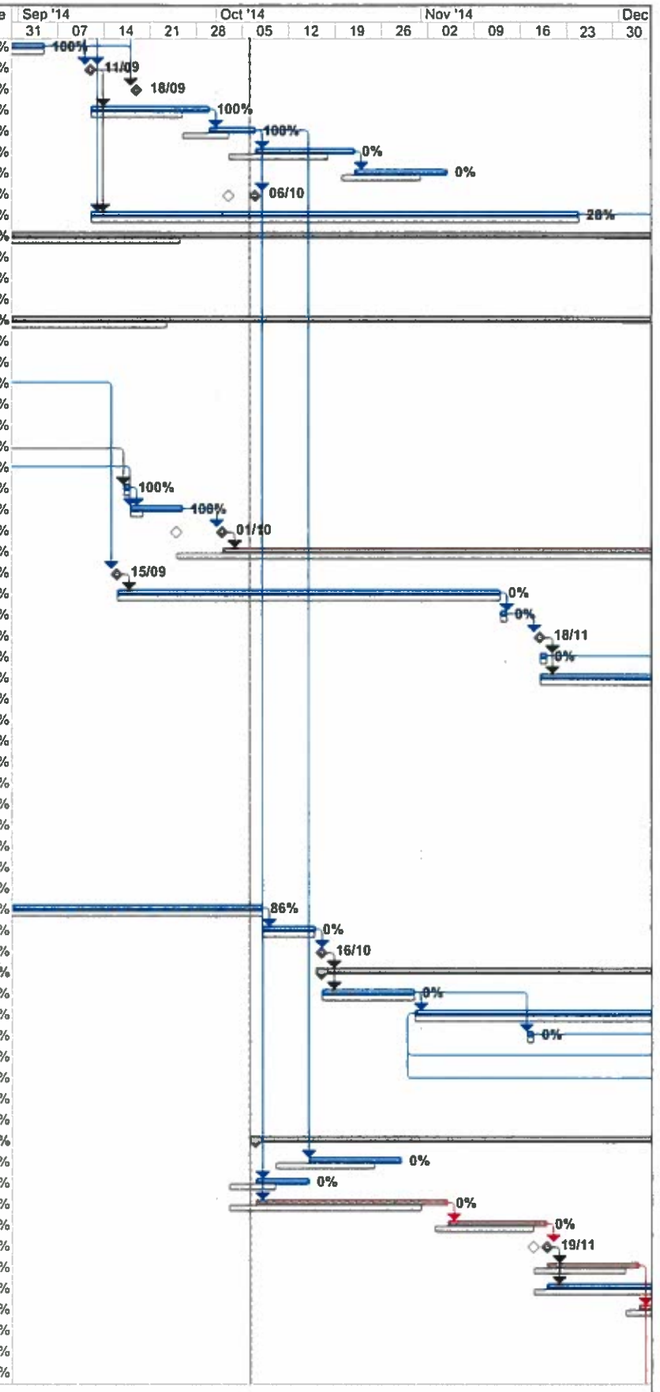
Critical — Task — Baseline — Milestone — Project Summary — Deadline
Critical Split — Split — Baseline Split — Summary Progress — External Tasks
Critical Progress — Task Progress — Baseline Milestone — Summary — External Milestone

ID	Task Name	Baseline Duration	Baseline Start	Baseline Finish	Actual Duration	Actual Start	Actual Finish	Predecessors	Successors	% Complete
65	Prepare Powerpoint Presentation	5 days	Thu 28/08/14	Thu 04/09/14	5 days	Thu 28/08/14	Thu 04/09/14	62	67	100%
66	Submit Schematic Design Development Report package and Class 'B' Cost Estimate	0 days	Thu 11/09/14	Thu 11/09/14	0 days	Thu 11/09/14	Thu 11/09/14	64,62	,67FS+5 days,68	100%
67	Powerpoint Presentation presentation to stakeholders	0 days	Thu 18/09/14	Thu 18/09/14	0 days	Thu 18/09/14	Thu 18/09/14	62,65,66FS+5 days		100%
68	PWGSC, HCD, HoC, RCMP, NCC Review Pre-Design Design Report and response to Consultant	10 days	Fri 12/09/14	Thu 25/09/14	12 days	Fri 12/09/14	Mon 29/09/14	66	69	100%
69	Consultant response to RS4 Stakeholder Comments, Revise and resubmit Design Development Report pa	5 days	Fri 26/09/14	Thu 02/10/14	5 days	Tue 30/09/14	Mon 06/10/14	68	+5 days,119,120	100%
70	PWGSC, HCD,HoC, RCMP, NCC and O&M Update Review	10 days	Fri 03/10/14	Fri 17/10/14	0 days	NA	NA	69	71	0%
71	Consultant response to RS4 Client Comments	10 days	Mon 20/10/14	Fri 31/10/14	0 days	NA	NA	70		0%
72	PWGSC Approval to proceed to RS5 in writing.	0 days	Thu 02/10/14	Thu 02/10/14	0 days	NA	NA	69		0%
73	PWGSC prepare IAR for EPA Approval. EPA process	50 days	Fri 12/09/14	Mon 24/11/14	14 days	Fri 12/09/14	NA	64,66	138	28%
74	**RS 5.1 Stone Pre-Purchase Procurement Construction Documents**	**395 days**	**Wed 30/04/14**	**Fri 27/11/15**	**65.73 days**	**Wed 30/04/14**	**NA**			**17%**
75	99% Construction drawings & specifications Stage. Submit to HCD, PWGSC for review.	10 days	Wed 30/04/14	Tue 13/05/14	10 days	Wed 30/04/14	Tue 13/05/14	29	76,77	100%
76	Prepare 'Class A' Estimate	10 days	Wed 14/05/14	Wed 28/05/14	10 days	Wed 14/05/14	Wed 28/05/14	75	79	100%
77	99% Construction drawings & specifications translation	10 days	Wed 14/05/14	Wed 28/05/14	10 days	Wed 14/05/14	Wed 28/05/14	75	79,100	100%
78	**Stone Sourcing**	**260 days**	**Thu 19/06/14**	**Mon 06/07/15**	**28.48 days**	**Thu 19/06/14**	**NA**			**11%**
79	Prepare fee proposal for the additional activities required for stone sourcing	1 day	Thu 19/06/14	Thu 19/06/14	1 day	Thu 19/06/14	Thu 19/06/14	77,76	80	100%
80	Approval to proceed	9 days	Fri 20/06/14	Thu 03/07/14	9 days	Fri 20/06/14	Thu 03/07/14	79	81,82FS+12 days	100%
81	Research testing requirements + benchmarks, sources of stone & labs	8 days	Fri 04/07/14	Tue 15/07/14	8 days	Fri 04/07/14	Tue 15/07/14	80	90FS+42 days	100%
82	Coordinate team visit to Montreal quarry	1 day	Mon 21/07/14	Mon 21/07/14	1 day	Mon 21/07/14	Mon 21/07/14	80FS+12 days	83	100%
83	Team visit to Montreal quarry	1 day	Tue 22/07/14	Tue 22/07/14	1 day	Tue 22/07/14	Tue 22/07/14	82	ys,85FS+20 days	100%
84	Plouffe Park pick-up stone from St. Constant quarry	0 days	Fri 25/07/14	Fri 25/07/14	0 days	Fri 25/07/14	Fri 25/07/14	83FS+3 days	86FS+30 days	100%
85	Plouffe Park to pick up stone from St. Marc's	1 day	Fri 22/08/14	Fri 22/08/14	1 day	Fri 22/08/14	Fri 22/08/14	83FS+20 days	87	100%
86	Plouffe Park to pick-up additional blocks from St. Constant quarry	1 day	Wed 17/09/14	Wed 17/09/14	1 day	Wed 17/09/14	Wed 17/09/14	84FS+30 days	87	100%
87	Plouffe Park to prepare St. Constant and St. Marc stone samples as per identified testing procedures	2 days	Thu 18/09/14	Fri 19/09/14	6 days	Thu 18/09/14	Thu 25/09/14	86,85	88	100%
88	Plouffe Park to send stone samples to designated lab	3 days	Mon 22/09/14	Wed 24/09/14	3 days	Fri 26/09/14	NA	87	89	75%
89	Lab testing - ASTM and durability evaluation on St. Constant and St. Marc (excluding freeze thaw) - a	50 days	Thu 25/09/14	Fri 05/12/14	0 days	NA	NA	88	96	0%
90	Order samples from Belgium quarry	0 days	Mon 15/09/14	Mon 15/09/14	0 days	NA	NA	81FS+42 days	91	0%
91	Belgium samples delivered to Plouffe Park	40 days	Tue 16/09/14	Wed 12/11/14	0 days	NA	NA	90	92	0%
92	Plouffe Park to prepare Belgium stone samples as per identified testing procedures	1 day	Thu 13/11/14	Thu 13/11/14	0 days	NA	NA	91	93	0%
93	Plouffe Park to send stone samples to designated lab	3 days	Fri 14/11/14	Tue 18/11/14	0 days	NA	NA	92	94,95	0%
94	Plouffe Park to prepare mockup of all stone samples as per identified aesthetic assessment procedur	1 day	Wed 19/11/14	Wed 19/11/14	0 days	NA	NA	93	97	0%
95	Lab testing - ASTM and durability evaluation of Belgium stone; freeze thaw on all three types - assum	95 days	Wed 19/11/14	Wed 08/04/15	0 days	NA	NA	93	96	0%
96	Lab testing - final investigations on all three stone types - assume 9 weeks	45 days	Thu 09/04/15	Thu 11/06/15	0 days	NA	NA	95,89	97	0%
97	Consultant Team to analyze and prepare recommendations based on lab results & St. Marc's tender	5 days	Fri 12/06/15	Thu 18/06/15	0 days	NA	NA	96,94	98	0%
98	Submit justification letter on recommended source of stone	1 day	Fri 19/06/15	Fri 19/06/15	0 days	NA	NA	97	99	0%
99	PWGSC, HCD, FHBRO, RPCD review & response to Consultant	10 days	Mon 22/06/15	Mon 06/07/15	0 days	NA	NA	98	115	0%
100	100% Construction drawings & specifications translation for St. Marc's purchase	7 days	Wed 30/07/14	Fri 08/08/14	7 days	Wed 30/07/14	Fri 08/08/14	77	101	100%
101	Submit 100% Documents for Tender and revised Class 'A' Estimate	0 days	Fri 08/08/14	Fri 08/08/14	0 days	Fri 08/08/14	Fri 08/08/14	100	102,103	100%
102	Revise 'Class A' Estimate	3 days	Mon 11/08/14	Wed 13/08/14	3 days	Mon 11/08/14	Wed 13/08/14	101		100%
103	HCD, PWGSC, RPCD review of 100% documents	5 days	Mon 11/08/14	Fri 15/08/14	5 days	Mon 11/08/14	Fri 15/08/14	101	104	100%
104	Prepare final tender documents	2 days	Mon 18/08/14	Tue 19/08/14	2 days	Mon 18/08/14	Tue 19/08/14	103	105	100%
105	Approval to proceed to tender	1 day	Wed 20/08/14	Wed 20/08/14	1 day	Wed 20/08/14	Wed 20/08/14	104	106	100%
106	Tender Phase Services	29 days	Wed 27/08/14	Tue 07/10/14	25 days	Wed 27/08/14	NA	105	107	86%
107	Bid review	5 days	Wed 08/10/14	Wed 15/10/14	0 days	NA	NA	106	108	0%
108	Contract Award	1 day	Thu 16/10/14	Thu 16/10/14	0 days	NA	NA	107	109,110	0%
109	**Construction Phase**	**278 days**	**Fri 17/10/14**	**Fri 27/11/15**	**0 days**	**NA**	**NA**	**108**		**0%**
110	Stone shop drawings/contractor submittals	10 days	Fri 17/10/14	Thu 30/10/14	0 days	NA	NA	108	1,112FS+10 days	0%
111	Stone quarrying and cutting	145 days	Fri 31/10/14	Tue 02/06/15	0 days	NA	NA	110	114SS+130 days	0%
112	Consultant Review of rough stone blocks	1 day	Mon 17/11/14	Mon 17/11/14	0 days	NA	NA	110FS+10 days	113	0%
113	Quality Control inspection 50% cut six-side blocks	1 day	Thu 12/02/15	Thu 12/02/15	0 days	NA	NA	111SS+70 days,112	114	0%
114	Quality Control inspection 100% cut six-side blocks	1 day	Tue 12/05/15	Tue 12/05/15	0 days	NA	NA	113,111SS+130 days	116,115	0%
115	Contingency for supplying stone from alternative source if St. Marc's not acceptable	100 days	Tue 07/07/15	Fri 27/11/15	0 days	NA	NA	99,114	147FS-135 days	0%
116	Stone delivery and PWGSC Review	1 day	Wed 03/06/15	Wed 03/06/15	0 days	NA	NA	111,114	147FS-13 days	0%
117	**RS 5.2 Construction Documents (5 months max = 110 WD)**	**113 days**	**Fri 03/10/14**	**Wed 18/03/15**	**0 days**	**NA**	**NA**			**0%**
118	Construction Implementation Plan	10 days	Fri 10/10/14	Fri 24/10/14	0 days	NA	NA	69FS+5 days		0%
119	Prepare and Submit updated project control/administration documents- risk, schedule etc.	5 days	Fri 03/10/14	Thu 09/10/14	0 days	NA	NA	69		0%
120	66% Construction Drawings & Specifications Stage	20 days	Fri 03/10/14	Fri 31/10/14	0 days	NA	NA	69	121	0%
121	Prepare updated 'Class B' Estimate	10 days	Mon 03/11/14	Mon 17/11/14	0 days	NA	NA	120	122	0%
122	Submit 66% Construction Documentation package, Class 'B' Cost Estimate, and associated plans	0 days	Mon 17/11/14	Mon 17/11/14	0 days	NA	NA	121	123,124	0%
123	PWGSC, HCD, HoC, RCMP, NCC Review	10 days	Tue 18/11/14	Mon 01/12/14	0 days	NA	NA	122	125,131	0%
124	FHBRO Review and Consultant response	25 days	Tue 18/11/14	Mon 22/12/14	0 days	NA	NA	122		0%
125	99% Construction drawings & specifications Stage	10 days	Tue 02/12/14	Mon 15/12/14	0 days	NA	NA	123	126	0%
126	Prepare 'Class A' Estimate	10 days	Tue 16/12/14	Wed 31/12/14	0 days	NA	NA	125	127	0%
127	Submit 99% Construction Documentation package, Class 'A' Cost Estimate	0 days	Wed 31/12/14	Wed 31/12/14	0 days	NA	NA	126	128,129,130	0%
128	Translate Tender Documents	10 days	Fri 02/01/15	Thu 15/01/15	0 days	NA	NA	127	133	0%



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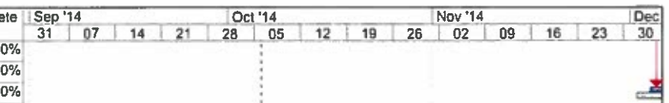
Critical — Task — Baseline — Milestone — Project Summary — Deadline
Critical Split — Split — Baseline Split — Summary Progress — External Tasks
Critical Progress — Task Progress — Baseline Milestone — Summary — External Milestone

ID	Task Name	Baseline Duration	Baseline Start	Baseline Finish	Actual Duration	Actual Start	Actual Finish	Predecessors	Successors	% Complete
129	Fairness Monitor Call-up	15 days	Fri 02/01/15	Thu 22/01/15	0 days	NA	NA	127		0%
130	PWGSC, HCD, HoC, RCMP, NCC Review	10 days	Fri 02/01/15	Thu 15/01/15	0 days	NA	NA	127	132,133	0%
131	Prepare As-Found Heritage Recording Documentation package	15 days	Tue 02/12/14	Mon 22/12/14	0 days	NA	NA	123		0%
132	Prepare Tender Documents (100% Dwgs & Specs)	8 days	Fri 16/01/15	Tue 27/01/15	0 days	NA	NA	130	133	0%
133	Submit 100% Translated Documents for Tender and Class 'A' Estimate, and As-Found Heritage Recording	0 days	Tue 27/01/15	Tue 27/01/15	0 days	NA	NA	128,130,132	134	0%
134	HCD, PWGSC, RPCD review	20 days	Wed 28/01/15	Wed 25/02/15	0 days	NA	NA	133	135	0%
135	Revise to 100% Tender Ready for posting to Buy and Sell for RPCD Review	5 days	Thu 26/02/15	Wed 04/03/15	0 days	NA	NA	134	136	0%
136	Submit to PWGSC 100% Tender Ready for posting to Buy and Sell for RPCD Review	0 days	Wed 04/03/15	Wed 04/03/15	0 days	NA	NA	135	137	0%
137	RPCD review of 100% Tender Ready for posting to Buy and Sell	10 days	Thu 05/03/15	Wed 18/03/15	0 days	NA	NA	136	138,140,141	0%
138	PWGSC approval to proceed to RS 6	0 days	Wed 18/03/15	Wed 18/03/15	0 days	NA	NA	137,73		0%
139	**RS 6 Contract Tender Call (3 months max = 66 WD)**	**42 days**	**Mon 16/03/15**	**Thu 14/05/15**	**0 days**	**NA**	**NA**			**0%**
140	Consultant Tender Support Services	40 days	Mon 16/03/15	Wed 13/05/15	0 days	NA	NA	137		0%
141	RPCD Tender Doc Preparation	15 days	Thu 19/03/15	Fri 10/04/15	0 days	NA	NA	137	142	0%
142	Posting on Buy and Sell	16 days	Mon 13/04/15	Mon 04/05/15	0 days	NA	NA	141	143	0%
143	Envelope 1 - Technical Evaluation	3 days	Tue 05/05/15	Thu 07/05/15	0 days	NA	NA	142	144	0%
144	Envelope 2 - Price	5 days	Fri 08/05/15	Thu 14/05/15	0 days	NA	NA	143	145	0%
145	Construction Contract Award	0 days	Thu 14/05/15	Thu 14/05/15	0 days	NA	NA	144	147	0%
146	**RS 7 Construction and Contract Administration (12 month allocation)**	**371 days**	**Fri 15/05/15**	**Fri 28/10/16**	**0 days**	**NA**	**NA**			**0%**
147	Construction Phase 2015/2016- Site supervision and Support Services	252 days	Fri 15/05/15	Mon 16/05/16	0 days	NA	NA	145,115FS-135 days,116	148	0%
148	Construction Phase Contingency Summer 2016 - Site supervision and Support Services	104 days	Tue 17/05/16	Fri 07/10/16	0 days	NA	NA	147	149	0%
149	As-Built Drawings and Close Out Documentation	15 days	Mon 10/10/16	Fri 28/10/16	0 days	NA	NA	148	150	0%
150	Submit As-Built Drawings	0 days	Fri 28/10/16	Fri 28/10/16	0 days	NA	NA	149		0%



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Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Project Summary
External Tasks
External Milestone
Deadline

Appendix D:

Structural Report

1. FOUNDATIONS

The preliminary structural foundation drawings can be found on S101, S102, and S103.

Typically new retaining walls will be required for the extent of the Phase 3 contract. Over the C-1, C-3, and C-4 tunnels the possibility of leaving the existing foundation wall is being reviewed with the design team.

The Phase 3 retaining walls are very similar in design to the Phase 2 walls, however the requirement for insulation has been deleted from this phase of the work. A maximum difference in grade between the two sides of the retaining wall was taken as 300mm, this will need to continue to be coordinated with the landscape consultant, as it is critical to the design of the structural foundations. A surcharge of 4.8kPa was used along the back of the retaining wall, to simulate trucks driving along the side of the retaining wall or pedestrian crowds gathering.

Over the exhaust tunnels, the existing as-built drawings detail a cast-in place concrete wall which is reinforced with 15Ms or 20Ms at 300mm c/c. The core taken at this location confirms the concrete extent.

For the exhaust tunnel C3, the perimeter wall is shown entirely as stone, which sits on a reinforced concrete structural wall. The walls below the tunnel roof are cast-in place reinforced concrete.

Fall protection anchor locations are indicated on the drawing plans. These anchor locations are typically spaced at 5m c/c however over tunnels they are spaced further apart to ensure no new lateral loading on the tunnels.

For this phase, at each end of the wall, the new foundations will be tied into the existing foundations by way of dowels through the existing foundation wall and footing. Or a construction joint can be installed. Allowances will be made to step foundations to meet existing.

2. DISCLAIMER AND LIMITATIONS

This report is based on and limited to verbal information supplied to John G. Cooke & Associates Ltd. by the representative of RMA and by observations made during walk-through inspections of the North Perimeter Wall Phase 3. Only those items that are capable of being observed and are reasonably obvious to John G. Cooke & Associates Ltd. or have been otherwise identified by other parties and detailed during this investigation can be reported.

There is no warranty expressed or implied by John G. Cooke & Associates Ltd. that this investigation will uncover all potential deficiencies and risks of liabilities associated with the subject property. John G. Cooke & Associates Ltd. believes, however, that the level of detail carried out in this investigation is appropriate to meet the objectives as outlined in the Terms of Reference. We cannot guarantee the completeness or accuracy of information supplied by any third party.

This report has been produced for the sole use of PWGSC, and cannot be reproduced or otherwise used by any third party unless approval is obtained from John G. Cooke & Associates Ltd.

We trust that this report covers the scope of work as outlined in our Terms of Reference. Should there be any questions regarding this report, or if we can be of any further assistance to you, please contact us.

Yours truly,

JOHN G. COOKE & ASSOCIATES LTD.

Lisa Nicol, P.Eng.
Associate

LN/ln
14101/Foundation Report DD

Appendix E:

QADR Comments and Consultant Responses

	QUESTIONS/COMMENTS	RESPONSES	STATUS
* items in red are outstanding or recently answered			
Stage: Final Schematic Design Report *(Aug 6 2014)*			
	HCD Design Manager: John Zvonar	*Consultant:*	
6.0	*(Aug 13 2014)* Final Schematic Design Report I have reviewed the specs (incl. photos and drawing sheet) and find them in good order. The 'track changes' helped. And given the review that Jocelyn had previously undertaken, I believe you are 'good to go.' QADR at 66% I have also reviewed this document (pp. 41-62) and in particular HCD's comments, pp.56-62 (and RMA's responses). With some exceptions, most of HCD's comments have been noted/revised or will be taken into consideration by RMA at the Design Development (DD) stage. The exceptions, eg. 5.39, 5.40, and 5.56, are suitably explained. The concept of mock-ups is roundly supported. Points 5.44 and 5.46 are related to the options presented, although it appears that the generally preferred option, 3B, will be pursued. HCD is in support of this direction. The on-going question of the 'final' pathway material (5.50) is also to be resolved at the DD	*(Aug 13 2014) PM:* No action required. As indicated by HCD comments, outstanding issues to be addressed in Design Development documents.	Closed

	stage. The explanation for 5.64 (pier 'double stones) is appropriate. The rejoinder to remarks about the cost estimate (5.68, 5.69, 5.74) appears to be reasonable.		
Stage: 66% Design Development Report *(Sep 11 2014)*			
	Planning & Integration: Daniel Hache	*Consultant:*	
7.0	*(Sep 19 2014) Centre Block Rehabilitation Overlap:* • The Centre Block will need a perimeter access road for emergency and delivery vehicles; this will be along the north and east edges around CB the temporary loading dock will be situated south of the Summer Pavilion (see Option 2 plan from Access and Loading Dock Feasibility Study Apr 2014 by WMTA); • What are the effects of lowering the path on the proposed construction site? Do you foresee any additional costs down the road for the construction site?; • Has the question of perception of the public on PWGSC undoing/modifying new construction 2 years after completion?	*(Sep 19 2014) PM:* • Refer to minutes and action items from Sep 19 meeting with Planning & Integration and West Block. *(Oct 3 2014) PM:* • A width of 7.5m will be maintained for the road behind Centre Block to allow for two-way construction traffic. • An alternative pedestrian path will be provided during construction. • All underground infrastructure related to drainage and under the proposed service road for Centre Block rehabilitation, will be protected.	Closed
	Lead, CB Program of Work, Senate: Corey Doering	*Consultant:*	
7.1	*(Sep 24 2014)* 1. Noise - What is the anticipated level of noise associated with this project on a day-to-day basis? Is the contractor obligated to conduct all noise causing work after hours,	*(Sep 30 2014) RMA:* 1. Similar as for the Phase 1 and Phase 2 projects. Noise-generating activities will be carried out after hours (e.g. rock excavation). The GC will produce a noise pollution control plan as per	Closed

	as per the House of Commons directive on Working In and Around HoC Occupied Buildings (the Senate has also adopted these guidelines). 2. Visual Impact - Will any of the construction hoarding etc. be visible from the Senate side of the building. Will it block the view of any main Senate spaces (e.g., offices). Is it expected that the planned replacement shrubs, bushes etc. will alter the general "look and feel" of the vista? If so, how? 3. Traffic - How will the traffic flow be affected on a day-to-day basis (e.g., Will Senators be asked to take an alternate route around the construction site?) 4. Parking - I noted in the presentation that while none of the existing parking spaces will be eliminated, they will be moved back about 2 ft. I believe these are all House of Commons spaces, can you confirm that for me. How will the adjustment of the parking spaces affect the overall flow of traffic in that area? 5. Heritage - Will any "heritage" elements or "special" elements be affected as a result of this project (e.g., trees, bushes).	Phase 2. 2. No. Hoarding should not block the view of Senate spaces as it will be mostly to the north of the Library. Hoarding will be semi-transparent as per Phase 2. Replacement of shrubs on the escarpment will improve the vista since we are planning on using low shrubs or ground covers 3. A minimum of 7.5m will be maintained for the roadway within project limits, with a 1.2m sidewalk. See revised mobilization plan A100 for proposed circulation pattern. 4. See point above. The 7.5m wide roadway allows two-way construction traffic and access to the parking. The adjustment to the parking will create a standard situation where people coming out of the parking will shortly block the traffic on Library Drive in order to maneuver out of their parking space. This should not have a major impact on the overall traffic flow. The roadway becomes narrower next to the Vent Towers project going east, however we are maintaining the existing condition and any changes to that area fall outside of NPW3 project area. We understand a traffic consultant is being engaged to address ongoing traffic concerns on the Hill. With the exception of the western-most parking space which is PWGSC (on loan from Senate), all other parking spaces affected are for the House	

	6. Alignment with other initiatives - The completion date of this project is very close to the anticipated closure of the Centre Block. How will the eventual construction site for the Centre Block Rehabilitation impact the work that is completed on this project?	of Commons. 5. Two trees will be removed on the north-east side, close to Pier 34. Lilacs on the escarpment side will also be removed for about 1m behind the wall. The lilacs are non-indigenous and will be replaced with indigenous shrubs. Neither the trees nor the lilacs are considered heritage. Impact on the wall itself is described in the report. 6. It is expected there will be approximately 2 years between end of the NPW3 project and start of the Centre Block Major Rehab (CBMR) project. Work is being coordinated with known information about the CBMR hoarding area and access road to minimize impact on infrastructure. See drawings C101-C102. The concrete curb and parking spots will be removed when CBMR starts, but this will not be addressed in the NPW3 project, given that the site will remain open to the public for two years in between the projects.	
	HCD Conservation Architect: Sanskriti Singh	*Consultant:*	
7.2	*(Sep 26 2014)* According to item 5.46, the consultants will be revising the report to include a clarification of option 3a and 3b and a schematic design proposal of the Lookout design. Review of the clarified options 3a and 3b and the proposed (schematic) design of the Lookout for minimum intervention	*(Sep 30 2014) RMA:* This was done in the Revised Schematic Design Report. See comment 6.0 above. The Consultants were given direction to proceed with Option 3B. *(Oct 3 2014) PM:* See FHBRO comments below.	Closed

	approach is recommended before the finalization of the preferred option.		
	HCD Conservation Metal: Rebecca Casagrande	*Consultant:*	
7.3	*(Sep 26 2014)* Item 5.61: The proposal to modify the fence in order to introduce gates at various locations is not recommended. This proposed intervention will result in major modifications to both the ironwork and the coping stones which will greatly alter the appearance of the character defining historic fence. This proposal does not follow conservation best practices and an alternate solution should be provided. Consideration as to how often the anchor will need to be accessed and the use of a temporary access point over the fence as required should be reviewed. Will there be an alternate solution?	*(Sep 30 2014) RMA:* Given that the proposal to alter the iron fence to install gates for access to the slope is found unacceptable, the proposed alternative is for solid double ladders to be used to gain access to the slope side. Potentially, a gate should be installed to the West of Pier 45, in the low iron fence surrounding the Summer Pavilion. However, modifications to said iron fence fall outside of the scope of work of the Consultants and would also result in a visible alteration to the existing condition. The use of ladders would constitute the least intrusive option. It is proposed that the area right next to the wall on the slope side will be flat for about 1m; this will make the use of ladders safer as they will bear on a flat surface.	Closed
	COE Geotechnical Engineer: Zoheir Zendagui	*Consultant:*	
7.4	*(Sep 26 2014)* (Report: 8.4) Is the slope stable after the construction of the wall, whether it will be founded on rock or on soil?	*(Oct 2 2014) Paterson:* The wall location founded either on soil or bedrock will not have a negative impact on the overall slope stability. The wall will be founded on soil in limited areas along the subject section of the wall and it is expected that the wall load will be supported directly on bedrock on either side of these limited areas. So the limited soil pressure that the wall will impose on the slope will be limited to isolated areas over relatively shallow depths of soil, which will not be significant enough to negatively impact the overall slope stability.	Closed
7.5	*(Sept 26 2014)*	*(Oct 1 2014) RMA:*	Closed

	(Report: Appendix B - Cost Estimate B) R 2.1) Does item 21 correspond to the backfill area and excavation area of Drawing L 111? R 2.2) The depth and items related to excavation and earthwork to be reviewed in the next stages.	Item 21 refers to backfill and excavation on both sides. Given that the pathway material has not been finalized yet, no details could be provided for the installation of the pathway material. As such, the Cost Consultant has allowed for additional back filling on the path side. This will be updated for the revised Class B estimate to be submitted with 66% Construction Documents, once the pathway material is approved.	
7.6	*(Sept 26 2014)* (Drawing: S103) Is the wall stable laterally for the horizontal forces (seismic load, earth load…)? If not, can the consultant propose solutions?	*(Oct 1 2014) JCAL:* Yes, the wall is stable laterally. The details shown are the proposed solutions. The retaining walls shown retain the earth and can adequately support the lateral loads on the walls.	Closed
7.7	*(Sept 26 2014)* (Drawing: A201, A200, L110, L111) Can the consultant put some elevation on the right of the drawing (vertical axis) so we can interpolate to determine any elevation of tunnels, bedrock, etc.?	*(Oct 1 2014) RMA:* Drawings L110 and L111 contain elevations at all pier locations and every 10m along the wall. The Consultants believe this information is sufficient for determining all elevations.	Closed
	HCD Landscape Architect: John Zvonar	*Consultant:*	
7.8	*(Sept 26, 2014)* 8.3 Small Landscape Elements (and 8.3.1 Monuments): Suggestions for adjustments to the monuments near to the wall/path have been made to accommodate the anticipated work and are appropriate. The use of granite cobbles is to be minimized – if not entirely avoided and removed where possible – as they do not fall into the list of approved ground plane materials cited in the 2000/2013 Landscape Plan.	*(Sep 30 2014) BC2:* Cobblestones will be removed in all existing location of the project. *(Oct 3 2014) PM:* Consultant to confirm what this material will be replaced with. (Oct 06 2014) RMA: This is shown on the revised drawings. Depending on location the cobblestones will be replaced with the	Closed

		material of the adjacent area (e.g. grass if outside the pathway; the approved pathway material if on the pathway).	
7.9	*(Sept 26, 2014)* 8.3.3 Escarpment (Library) Drive: The width of the vehicular lane to the rear of the Centre Block has been reduced to 6.5 metres (but may be increased to 7.5 metres to better accommodate construction vehicles, eg. dump trucks). Future work at the Centre Block will necessitate a more focused consideration of traffic flow, parking and pedestrian movement through this area. In either case, the resultant larger expanse of green space adjacent to the perimeter pathway is supported and should provide a more pleasant experience for pedestrians in its 'buffer' function from parked vehicles. There remains, however, the larger issue about the on-going safety issue resulting from continued parking in this area. Given the inevitable permanent removal of parking in the future, PPB is encouraged to use this opportunity to move up the time table for (a partial) implementation of the Perimeter Plateau 'end state'.	*(Sep 30 2014) RMA:* The roadway will be 7.5m as agreed at project meeting on Sept 24, 2014. See point 7.1 above. We understand a traffic consultant is being engaged to address ongoing traffic concerns on the Hill. We agree that removing the parking would help solve many of the current traffic and safety issues in the area, however that falls outside of project scope. Overall pedestrian and traffic control in the Hill is beyond the scope of our project.	Closed
7.10	*(Sept 26, 2014)* (18/30) 5. Lookout: The Lookout, a natural vantage point over the Ottawa River, is to be raised approx. 400mm to avoid conflict with the tunnel below. The layout of the Lookout will also be rationalized with the addition of pentagonal piers as well as a more proportional arrangement (close to original	*(Sep 30 2014) RMA:* Noted.	Closed

	dimensions) of the ironwork to correct distortions. Since these interventions will help to reinforce this node, they are supported. Given the 'temporary' roadway that will be necessary for the anticipated work through this area over the forseeable future – with its required security fencing – this modest respite for users of the pathway (especially as a gathering place in the busy summer months) will help in enhancing the visitor experience.		
7.11	*(Sept 26, 2014)* 8.1 Pathway Material: A key goal for this project – and within the Perimeter Plateau/Pleasure Grounds zone – is to achieve a better pedestrian pathway with the user experience as the catalyst (especially what may be perhaps 20 years). More recent explorations towards achieving a stabilized surface for pedestrians within the Perimeter Plateau aimed to respect the intended hierarchy of circulation materials first established in the 2000 Landscape Plan. A consolidated material, such as a polymer-bound aggregate, was attempted in recent times but did not meet expectations (visually, physically, operationally). A more noble material, for example the St-Marc stone of Phase 1 (8.1.1 Lessons Learned from Phase 1) – or a suitable alternative – will provide the dignified appearance, compatible fit, and lends itself towards a more pleasant pedestrian experience. (Nota bene: A note of caution is necessary given certain of the Phase 1 pilot's	*(Oct 02 2014) BC2:* 8.1 Pathway material: Final choice of material for the main path is still to be confirmed, but it is noted that regular asphalt is not acceptable. However, regular asphalt will be used for the secondary paths, since they will be used only for the short period between the end of this project and the beginning of Center Block mobilization. 8.2.2 Width: We agree that there might be some congestion on the path during the period during which the path will be enclosed by the protective fencing for Center Block hoarding. As such, it might be advisable to review the width of 2m proposed the 2013 PHLPISG to provide more space for pedestrian coming in opposite direction or groups. A width of 2,5 meters is possible and would be better than punctual enlargements, however it would entail some additional modifications to landscape elements, particularly lowering lamp posts and one fire hydrant.	Closed

	'lessons learned' (there apparently have been breakage of units due to the polymer bond when attempting repairs; also, leveling issues). In any event, standard asphalt will not be supported. 8.2.2 Layout/Width: The perimeter pathway along the wall is recommended at a two (2) metre width for most of its length. This standardized approach is supported but may result in 'pinch points' in the vicinity of the Lookout particularly when protective 'separation' fencing is established for the 'Escarpment Drive' roadway. There may need to be some consideration given to increasing the width of the path at certain points along its length.	*(Oct 2 2014) RMA:* *Phase 1 pilot:* The team is preparing a brief lessons learned report from the Phase 1 project. These will be discussed and implemented in Construction Documents phase. *Width:* The relation between the perimeter pathway and the Centre Block hoarding will ultimately depend on the final design for the Centre Block hoarding area. It is our recommendation that the Centre Block mobilization area leave the lamp posts next to the pathway outside of the hoarding area, as the pathway will need to be lit for the safety of the public. If the lamp posts are excluded from the mobilization area that would leave a larger space between the Perimeter Wall and the Centre Block fence. *(Oct 3 2014) PM*: As not enough information is known about the Centre Block project and as per the 2013 PHLPISG, the path width of 2m will be maintained. Limestone pavers will be installed for the path.	
7.12	*(Sep 26, 2014)* 8.2.1 Summer Pavilion: In sync with the broader use of a more refined ground plane treatment through this zone, and with the Summer Pavilion serving as an obvious node, the use of limestone paving per the Phase 1 pilot is supported. The pattern alignment needs to correspond to the building footprint.	*(Sep 30, 2014) RMA:* Noted. As noted on the drawings the pattern shown does not represent the actual paving orientation, but is meant only to differentiate between types of finishes. Pattern alignment will be developed during construction drawings. Adjustments around the Summer Pavilion will be made according to this comment.	Closed
7.13	*(Sep 26, 2014)*	*(Oct 2 2014) BC2:*	Closed

	8.5 Planting Material: As noted in a previous review, the full-scale removal of lilacs from atop the escarpment slope is not recommended. However, efforts must be made to begin the transition towards a more sustainable biodiversity of plant material. Suitable 'native' shrubs and groundcovers can be judiciously employed to fill the gap that will be left with the necessary removal of some of the over-mature (over-maintained) lilacs to work alongside the wall. The intention is to create a 'naturalistic' addition to the slope's vegetative community (as if it had always been there). Lessons learned from both the on-going West Slope Staircase project not to mention the Slope Vegetation Management Plan for the broader Escarpment will be instructive (in regards to suitable plant species; planting strategies, etc.). Maintenance Practices: PPB is encouraged to continue deliberations as to how the path will be maintained through four seasons. Given 'zero tolerance' for snow on the path through the winter, the new non-asphaltic path surface needs to be respected and reflected in updated, 'progressive' maintenance practices. For example, the use of silicon snowplough blade edges to minimize friction/scraping of limestone pavers would be desirable.	Planting Material: We agree with that recommendation and will request the two studies in order to coordinate with what was already proposed in terms of planting in the escarpment.	
	PM: Oliver Gomes	*Consultant:*	
7.14	*(Sep 26 2014) General:* • Please correct grammar, punctuation,	*(Sep 30 2014) RMA:* Revised.	Closed

	spelling and formatting of report for final edition. • Avoid use of acronyms (but if required, make sure that there is an explanation of what the acronym stands for). • Make sure the report includes the revised Class B cost estimate and that all references to cost refer to this revised estimate.		
7.15	*(Sep 26 2014) Project Coordination and Mobilization Plan:* As per the coordination meeting with Centre Block Rehabilitation and MCP project teams: • increase the width of Escarpment Drive to 7.5m and confirm that this has no impacts on the rest of the site (e.g. alteration of lamp post elevation, reduction in number of parking spots, etc); • review the overlap of CB proposed service road and, where possible, mitigate the need for re-work of infrastructure installed by NPW3 (e.g. lower catch basins to avoid conflict with future road). • append this new drawing information to the final Design Development Report.	*(Sep 30 2014) RMA:* Revised. Revised drawings showing impact of Centre Block access road on utilities included.	Closed
7.16	*(Sep 26 2014) 6.1 (p20):* • make sure that the assumption that the wall will bear mostly on bedrock is adequately captured in the Risk Management Plan (should it not be the case); the risk may be minimal as a result of	*(Sep 30 2014) RMA:* Noted. Construction documents will include a clear set of details for the foundation details above the tunnels and where the new foundations meet the existing.	Closed

	site investigations but it should be an RMP component especially for the north-east corner of the site; this RMP item may also include removal of weathered bedrock. • more detail is required at next phase for foundation details and tunnels and where existing foundations meet new; this should be one of the first tasks in the construction drawing phase.		
7.17	*(Sep 26 2014) 6.2 (p20):* *"The stakeholders will have to review these and confirm if the location meets with their operation requirements."* Please refer back to the workshop that was conducted for Phase 2 and append the outcome of this workshop to this document. Phase 3 will follow the precedent set by Phase 2 for the anchors.	*(Sep 30 2014) RMA:* Noted. As mentioned in the report the typical anchor placement is 5m as was done for Phase 2. However, no anchors are provided above the tunnel locations which leads to a 14m spacing at the Lookout and 10m spacing at the CBUS exhaust tunnel. The Phase 2 project did not have to accommodate anchors across wide tunnels and a similar Lookout, and the escarpment slope for the Phase 2 project was not as steep. As a result, the Phase 2 project was able to maintain a 5m spacing for the anchors for the full length of the wall. Because of these dissimilarities between the two projects we believe stakeholders should review and agree to our proposed anchor locations prior to construction. Anchors at tunnel locations could potentially be supplied using rock anchors but that will increase the total project cost. *(Oct 3 2014) PM*: PWGSC H&S has endorsed the spacing as noted in the Design Development Report. Recommendations from the Phase 2 study will be used for this project.	Closed
7.18	*(Sep 26 2014) 8.3.1 (p26):*	*(Sep 30 2014) RMA:*	Carried

	• "The cobble stone paving between the path and the monument should be eliminated." The drawings state that the cobblestones should be restored. Please provide clear direction as to the fate of the cobblestones. I believe that HCD (John Zvonar) was of the opinion that the cobblestones should be removed from the Hill as they are not part of the pallet of materials described in the Plan. • New monuments: the consultant team have been given the new monument information from Cooke & Associates. More detail is required from the consultant on how these new installations will be handled in the design.	1. See point 7.8 above. 2. Two drawings were received for the concrete bases of the Cartier and Mackenzie monuments. The drawings received do not include any information on grading or elevations at which the monuments will be installed, nor exact position of the monuments on site, in relation to the pathway. No as-builts, CAD drawings, or topographic info were received for the relocated monuments. It should also be noted that the monuments, as well as the east parking, were completed after the topographic survey by the NPW3 surveyor was finalized. It is not estimated that the proposed work for the NPW3 project will have a significant impact on these monuments, but the final mitigation strategies will be detailed in construction drawings. *(Oct 3 2014) PM:* A request for this information has been made from the respective project teams.	
7.19	*(Sep 26 2014) A100:* *In addition to project coordination notes above:* • Remove extraneous information from the plan (e.g. BH); • Make sure that ALL monuments are correctly labelled and located; • Lines showing parking spots on east side are confusing (seems that there are too many lines); please alter;	*(Sep 30 2014) RMA:* Revised.	Closed

	• Mobilization plan should show the alternative pedestrian routes including cross walks; • It should be assumed that all three monuments to the south of the Victoria Bell monument will be left open to the public; please alter the construction fence; • The consultant to recommend the location for the construction trailer; • The consultant to provide direction on how underground utilities (including tunnels) are to be protected during construction.		
7.20	*(Sep 26 2014) Landscape Plans:* • All surface material for secondary paths should be clearly identified; • Missing existing vegetation (shrubs) around the Baldwin/Lafontaine monument; • Missing small NCC interpretative plaque for Baldwin monument; • Show width of parking spots.	*(Oct 2 2014) BC2:* Drawings revised. Surface material for secondary path will be regular asphalt (see answer to comment 7.11).	Closed
	PWGSC PFM: Benoit Boivin	*Consultant:*	
7.21	*(Sep 26 2014) Summer Pavilion:* Can the Summer Pavilion stay open until Oct 1, 2015?	*(Sep 30 2014) RMA:* This is currently being reviewed. It might be possible to leave the Summer Pavilion open until October 1, 2015 but there is some concern this might impact the project schedule. The GC's mobilization area is very tight as it is. At any rate, the specs will capture the dates when the Summer Pavilion needs to be open to the public and special dates when there will need to be a work stoppage.	Closed

		(Oct 3 2014) PM: The Summer Pavilion (with access from the south stairs only) will remain open to the general public until Oct 1, 2015 to accommodate activities related to the memorial service at the Police and Peace Officers' Memorial. As of Oct 1, 2015 until the end of the project, the general contractor will gain control of the Summer Pavilion. The Consultant is to include this information in the drawings and specifications.	
	FHBRO: MC. Quessy, L. Blanchet & G. LeParlouer	*Consultant:*	
7.22	*(Sep 29 2014) Refer to FHBRO ROI Report:* Lookout: It is recommended that the design team continue with the same conservation approach while ensuring that the new Lookout does not detract from the general composition of the North Perimeter Wall. (Oct 1 2014) With respect to the point 7.22, FHBRO understands the existing condition. The point was to ensure that the proposed changes for the lookout would be as much as possible discrete in the general composition of the North Perimeter Wall.	*(Sep 30 2014) RMA:* Noted. Please note that the north side of the Lookout is not parallel to the pathway in the existing condition. This will not be changed in the proposed design. The Lookout is a skewed trapezoid because of the need for the north side of the Lookout to remain parallel to the tunnel portal, and the spring points of the Lookout on the Perimeter Wall. This relationship will not be changed in the proposed design.	Closed
7.23	*(Sep 29 2014) Refer to FHBRO ROI Report:* Masonry Details: It is recommended that the drawings for the masonry details be presented to FHBRO before final submission.	*(Sep 30 2014) RMA:* Masonry details follow the same approach as per the approved Phase 2 design, reviewed by the FHBRO. Full masonry details will be included in the 66% Construction Documents. *(Oct 1 2014) PM:* The masonry details will be presented to FHBRO before	Closed

		final submission.	
7.24	*(Sep 29 2014) Refer to FHBRO ROI Report:* Pathway: It is recommended that more studies be done to research a suitable informal pathway material. *(Oct 3 2014)* Following our conversation on the phone two days ago, and due to the coming rehabilitation project for the Centre Block which forsee a 20-year period of work, FHBRO understands due to the current context, the limestone pavers are offered as an alternative solution for the pathway which is most appropriate than the asphalt. Having said that, when it is time to implement the other components of the master plan, such as the cantilevered walkway, FHBRO would like to encourage PPB to reconsider researching a more suitable material for this area in order to respect the original heritage character of the pleasure grounds which is described as 'informal' in the HCS: «These northern spaces were developed in the gardenesque tradition, and complemented Major's Hill Park, which was designed at the same time in the same tradition. These were pleasure grounds offering informal, but cultivated, delight in contrast with the formality of the parliamentary lawns on the one side and picturesque wildness of the cliffs on the other. »	*(Oct 1 2014) PM:* As per the Design Development Report and Consultant recommendation, limestone pavers are proposed for the path finish. As per the Parliament Hill Landscape Plan Implementation Strategies and Guidelines, Guideline 103, "a 2m wide limestone path" will be installed. Please refer to HCD's comments below on the subject. In addition, conducting studies to research another type of material represents a substantial change in scope of work for the project with increased cost. In addition, there is a risk of schedule delays. Since the NPW3 project must vacate the site prior to the start of the Centre Block major rehabilitation, all scheduling risks should be avoided altogether.	Closed

7.25	*(Sep 29 2014) Refer to FHBRO ROI Report:* Exterior Lighting Master Plan: It is recommended that the new Exterior Master Lighting Plan for the Parliamentary Precinct be considered during the next phase of design development. *(Oct 1 2014)* Finally, with respect to the point 7.25, FHBRO's comment was only to ensure that in-ground conduits will be installed. Then, when the Exterior Lighting Master Plan will be ready to be implemented, the in-ground conduits will have already been installed. The recommendation was not to implement this plan which is not officially approved by the stakeholders.	*(Oct 1 2014) PM:* The project team was only recently (Sep 2014) given a copy of the Lighting Plan and incorporation of this plan into the NPW3 design was never part of the original scope of work. This represents a change in scope of work with increased cost and schedule delays. In addition, the extent and scope of work for Centre Block major rehabilitation is unknown at this time. As a result, there is a real risk that some of the work done for NPW3 will be demolished, removed and/or dismantled. The NPW3 project will focus on the wall and related elements which represent 90% of the work for the project. *(Oct 3 2014) PM:* As mentioned, not enough is known about the future lighting requirements and Centre Block intervention. In addition, this work is beyond the scope of NPW3.	Closed
7.26	*(Sep 29 2014) Refer to FHBRO ROI Report:* New Plant Material: When selecting new plant material next to the wall, it is recommended to take into consideration the views through the iron fence onto the river from the pathway.	*(Sep 30 2014) RMA:* Noted and agreed. The intent is that the new plantings will be lower than existing lilacs.	Closed

Appendix F:

Design Development Presentation Minutes

Titre du projet / Project Title : **North Perimeter Wall Phase 3: Piers 33 to 45**	N° de projet – Project N°: **R.011800.030**
Lieu du projet / Project Location : **Parliament Hill Grounds, Ottawa**	N° de dossier – File N°: **RMA : 13378**
Lieu de la réunion / Meeting Location : **NCR PPD Boardroom 200, 107 Sparks Street, Ottawa**	Date : **September 18, 2014, 10:00 hrs**
Prochaine réunion / Next Meeting: **TBC**	N° de Réunion / Meeting N° : **03 – R0**

Présents / Attendees	Nom / Name		Titre /Title/	Représentant / Representing	N° Téléphone / Phone N°	Email
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√	**Lisa Nicol**	**LN**	Structural Engineer	JCAL		lnicol@jgcooke.com

These "Minutes" record only action items and are not intended to relay the full scope of discussions unless it is required for the full understanding of the work needed to advance the project. For the Team's convenience, issues, which arose after the meeting, may be included and identified in [square brackets]. As well, items considered to be NOTES and resolved issues have been deleted from these minutes. Any errors or omissions should be reported to me or if not pressing, raised at the next meeting.

Item #	Description	Action by
3.1	**Introduction** The purpose of the meeting was for the design team to present design development advancement to stakeholders. A brief introduction to the project by OG was followed by roundtable introductions, design team presentation and roundtable questions from the stakeholders	**Info**
3.2	**Project background** OG gave a brief introduction to the project discussing location, previous phases, general scope of work and project objectives. Main challenges of the project were also discussed: length of the wall, coordinating the work with other projects happening nearby, need to complete the project before the start of the Centre Block major rehabilitation project and current challenges of procuring the stone needed for the wall. Project benefits from lessons learned from the previous two phases of the wall but has specific challenges. Construction to start spring of 2015 with completion by end of 2016 at the latest.	**Info**
3.3	**Stone procurement** OG gave a summary of issues with procuring high quality stone from St. Marc quarry and mitigation strategies employed - PWGSC and Consultant team visited St. Marc's and St. Constant quarry and undertaking a testing program in parallel.	**Info**
3.4	**Paving material** OG gave a summary of evolution of paving material guidance and discussions to date. An amendment for the Consultants' contract is underway to revise pathway material used in accordance with revised PHLPISG, and stakeholder comments from Schematic Design Phase.	**Info**
3.5	**Return of comments** OG asked stakeholders that comments be returned to him by Friday September 26, 2014	**All**
3.6	**Lookout shape** MQ asked for clarification on Lookout shape & why it is not parallel to path. CU clarified that the Lookout is currently a skewed trapezoid, the northern side of which is parallel with the top of the tunnel portal below. The capstones at the top of the portal are very close to the Lookout, making the north wall parallel with the path would make the Lookout visible skewed in relation to the portal.	**Info**

Item #	Description	Action by
3.7	**Summer Pavilion - paving pattern** JZ commented that the paving pattern at the Summer Pavilion does not seem to be suitably aligned to the Pavilion. KP clarified that what is shown on the plans is not the final pattern alignment, which will be further refined in Construction Documents.	**KP**
3.8	**Relocation of curb to the North of Centre Block** FW, LL and DH stated that the changes proposed to Library Drive, and the relocation of the parking lot at the north-east of Centre Block may not be feasible because of Centre Block staging area and construction traffic needs. CU & KP stated that the current layout allows at all times for a 6.5m roadway with a 1.2m sidewalk for pedestrians, based on the most recent information and guidelines given to Consultants. FW stated that the guidelines need to be updated based on latest experiences on the Hill. Consultants will required updated guidelines before revising design. The staging area for the Centre Block(CB) project was briefly discussed, which will likely take over part of the roadway. Any work that is performed now will likely have to be redone after the CB project; it would be good if that could be avoided. OG discussed that CB staging area will also be limited by the presence of the monuments and even if this is only a temporary measure there is a need to increase GC real-estate for the NPW project so the project can be completed in time. KP stated that the price to relocate the curb is not a significant one at the project scale. Consultants will await comments, revised guidelines if required and direction from PM before performing changes to the design of Library Drive and the relocation of the curb.	**FW, DH, OG**
3.9	**Slope Planting** JZ asked what inspired the planting list proposed and whether this was influenced by Lessons Learned from the West Slope project and Slope Vegetation Management Plan. KP stated that the main intent was to plant indigenous shrubs that would not grow too high in order to preserve the view. KP will review the studies and reports mentioned and revise the planting list as needed. It was discussed that the lilacs help stabilize the slope and if replaced this should be done incrementally. MQ asked why shrubs are planted and if a ground cover was considered to allow more transparency for the wall. JHu recommended varying the planting, perhaps combining a ground cover with shrubs. KP to look into this further. It was discussed that the lilacs add a very formal view to the escarpment now, as they need to be trimmed regularly to form an edge. It will be important to create a more naturalistic image for the escarpment side. JZ discussed that the tall character of the lilacs currently causes people to climb on the masonry wall in order to get a better view. It would be beneficial if the vegetation were to stop around mid-way of the wall height to ensure a better view.	**KP**
3.10	**Pre-purchase** LL asked whether stone is being pre-purchased. OG detailed the stone procurement and quality control process. Yes, stone is being pre-purchased for the wall, and	**Info**

Item #	Description	Action by
	testing is being performed in parallel to determine compatible alternatives to St. Marc's. It is proposed that if limestone pavers are installed, procurement be part of the main contract.	
3.11	**Stone below grade** MQ asked whether additional courses of stone are still being proposed in option 3B as was the case for option 4 of schematic design. CU gave a summary of the discussion from the Schematic Design presentation. There is no need to provide additional courses of stone below grade as option 3B solves wall-path relationship in a more permanent way with minimal impact on landscape elements. Centre Block will no longer need to intervene to lower the grades to resolve this relationship and it is expected that any grade changes that are made during the Centre Block project will not have a significant impact on the path. CU & KP reaffirmed that option 4 - status quo reinstated the wall and path in a problematic relationship. RM discussed that investigations revealed a cinder layer which is believed to be the original pathway material. The location of this cinder layer is consistent with proposed distance between wall and path, approx 200mm below capstones.	**Info**
3.12	**Back of wall aspect** MQ asked if consideration was given to how the wall will look from the Gatineau side if lilacs are removed. CU clarified that the intent is to rebuild the Lookout as a full masonry wall, with face stones on both sides. The rest of the wall will be finished as in Phase 2 - with a light sandblast on the concrete.	**Info**
3.13	**Pathway Material** Pathway material options and challenges were discussed at length. It was observed that asphalt, as installed for the informal part of the Phase 1 pathway is an unacceptable material to stakeholders, particularly because it creates a precedent. Materials installed as temporary measures end up staying in place for a long time and open the door to installing the same elsewhere. KP discussed that during the Phase 1 pathway study certain criteria were established that the materials had to meet. Other alternatives to standard asphalt or limestone pavers exist, but not ones that meet all the criteria (e.g. concrete with exposed aggregates, pea-gravel asphalt, aggregate bound with a polymer). It was discussed that exposed aggregate concrete would have a construction joint every 4m, while polymer bound aggregate would have no joints. However, limestone pavers are easiest to repair; for all other materials any subsequent repairs would be visible. OG discussed that once the Centre Block project is underway the only area accessible to the public will be the perimeter pathway, and what is done now will likely be in place for a long time. JZ mentioned that the experience we are offering the users of the Hill needs to be taken into account as well. GP discussed that whatever material is used, it needs to create a dignified appearance. GP asked whether precedents in Northern Europe were explored. KP explained that there is a Landscape Plan in place which guides all interventions. Any research of precedents should have been implemented there; a piecemeal approach will not help create unity and a better result.	**Info** **Info** **Info** **Info**

Item #	Description	Action by
	RM discussed that the prominence of the site should warrant the use of different practices, materials and equipment. LL clarified that there is a zero snow policy on the Hill, and that O&M does have different practices in place for removing stone. However, LL stated that many users of the pathway and the Hill are not dressed for the weather therefore no snow is expected on the Hill.	**Info**
3.14	**Drawing clarity** JZ asked that additional info be provided on the proposed design at the Lookout and at the Baldwin-Lafontaine monument.	**RMA/KP**
3.15	**NCC installation** JHu advised that there is an NCC Canadian Heritage Installation that will soon be installed close to the Darcy McGee monument. JHu to forward drawings.	**JHu/OG**

*** END ***

Next meeting to be held: TBC.

Minutes prepared by:
Cristina Ureche-Trifu, Intern Architect
Robertson Martin Architects

Please advise the writer if there are any errors or omissions in regards to the above items. If no comments are received within three (3) days, these minutes will be considered final.

Appendix G:

Minutes from the Phase 2 Fall Protection Anchors Workshop

Titre du projet / Project Title : **North Perimeter Wall Rehabilitation: Piers 48 to 51: Anchorage**	N° de projet – Project N°: **R.011800.003**
Lieu du projet / Project Location : **Parliament Hill Grounds, Ottawa**	N° de dossier – File N°: **RMA : 12272**
Lieu de la réunion / Meeting Location : **NCR PPD Boardroom 315, 107 Sparks Street, Ottawa**	Date : **October 18, 2012, 10:00 hrs**
Prochaine réunion / Next Meeting:	N° de Réunion / Meeting N° : **01**

Présents / Attendees	Nom / Name		Titre /Title/	Représentant / Representing	N° Téléphone / Phone N°	Email
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√	**Doug Rancier**	**DR**		CIVITAS		drancier@civitas-inc.ca

These “Minutes” record only action items and are not intended to relay the full scope of discussions unless it is required for the full understanding of the work needed to advance the project. For the Team’s convenience, issues, which arose after the meeting, may be included and identified in [square brackets]. As well, items considered to be NOTES and resolved issues have been deleted from these minutes. Any errors or omissions should be reported to me or if not pressing, raised at the next meeting.

Item #	Description	Action by
1	**Mandate/Purpose of Anchors:** The intention of this project is to incorporate an anchor system in the redesign of the North Perimeter Wall. These anchors will serve as a permanent maintenance tool for the site - simple, robust, easy to inspect, and easy to maintain.	**INFO**
2	**Expected Activities on Slope:** AB broke down the activities by season and timeframe. Primary activities are for landscape personnel with small tools and chainsaws. In the winter, full size trees will be removed. In the spring, hand work (eg. cutting and planting) will be performed. In the long term, the anchors will facilitate landscape site maintenance, site inspections, geological and geotechnical inspections. RM observed that the anchors might also be used in the event of an emergency rescue	**INFO**
3	**Applicable Code Requirements:** After various code options were considered, CAN/CSA Z271 Safety Code for Suspended Platforms was selected as the loading requirements are well known in the industry and anchors are commonly available.	**INFO**
4	**Loading Requirements of Anchors:** It was discussed that rope work is typically performed while descending. Full weight will only be put on the anchors in the event of a worker falling. These anchors are intended for human use only and will not be designed to support the weight of heavy machinery. When large trees are eventually planted or removed, a crane will be used. The anchors will not be used during the construction/rehabilitation of the stairs.	**INFO**
5	**Spacing of Anchors:** The length of wall in question is approximately 40m. The piers are not evenly spaced, therefore the placement and spacing of anchors is to be determined without factoring them in. There was discussion about the optimal spacing of the anchors. Initially 10m spacing was proposed. It was observed that 5m spacing would allow 2 people to work on the same job without anchoring to the same anchor. MF noted that once the slope has been repopulated with large trees, flexibility will be even more important, meaning that anchors should be more closely spaced. EC raised the issue of the increased cost, however DR calculated that if the approx. cost per anchor is $500, then it would only cost an additional $2000 to use 5m rather than 10m spacing. 5m spacing will be the basis of design.	**INFO**
6	**Types of Anchors:** RM suggested using a standard, off-the-shelf product for the anchors. They ought to be galvanized or stainless steel (with stainless steel preferred). This will help prevent corrosion within the concrete. Furthermore, using a certified eyelet cast into the concrete would mean that yearly testing would not required. ML explained that if a cable system is used, the anchors at either end will need to be 10x stronger. The cable ought to be galvanized and rubberized. A similar design would be to link the anchors with a rigid rail which would act as a beam and lower the forces exerted on the individual anchors. However, if anchors are installed every 5m, the cable system would not be necessary.	**INFO**
7	**Anchor Installation into Wall:** MB described a system used to moor ships in the past. A removable solid plug would be slotted into an angled cavity. RM observed that this would essentially become a water pocket. The cavity could be capped, but idea was discarded.	

Item #	Description	Action by
	Consensus to proceed with cast-in place anchors. This is a preferable option to bolt-on or adhered as less stringent engineering testing will be required for maintenance. EC brought up the issue of ropes rubbing on lower retaining walls and the staircase that goes down the slope. Additional anchors could be incorporated into the lower retaining walls and the stairs. The anchors themselves should be kept as low as possible. RM observed that although the stone will go down to the ground on the front of the wall, there will be ±1" of exposed concrete on the back of the wall where the anchors should be cast in place. The anchors shall only be installed on the wall (otherwise expense will go up significantly). It was observed that for special circumstances, temporary anchors could be used. Concern about the potential for unauthorized use of the anchors was raised. It was suggested that the anchors could be recessed into the wall and covered with a lockable door. But this would make them unusable in emergency situations. RM pointed out that visibility is important; If you're going to be on the slope, use the anchors that were designed to protect you. It was decided to proceed with exposed anchors cast in place.	**INFO**
8	**Annual Inspection and Maintenance Requirements for Anchors:** The anchors will need to be inspected annually. An engineering inspection and load testing would be required for adhesive anchors every five years. For cast-in-place anchors, these inspections and testing would be at the discretion of the engineer. RM observed that following a known code such as CAN/CSA Z271 will facilitate the testing process. If a logbook is kept, anchors can be tagged with notices. It was decided not to use epoxy adhesive anchors but use cast-in-place to reduce inspections and testing requirements.	**INFO**
9	**Safety Protocols for Anchor Use:** It will be up to the contractor performing the work to ensure that their employees are properly trained and equipped. Tree workers will be used to the required equipment and process. With a climbing harness, workers will have their hands free. Two examples of certifications that could be required of workers: SPRAT (Safe Practices for Rope Access Technicians) or Aboriculture Canada (training and certification board).	**INFO**
10	**Additional Points:** EC asked whether any additional stakeholders should be involved in the discussion? RCMP might be a useful. EC will review and confirm.	**EC**

*** END ***

Next meeting to be held: TBD

Minutes prepared by:
Geoffrey Heintzman, Architectural Designer
Robertson Martin Architects

Please advise the writer if there are any errors or omissions in regards to the above items.