File No.: 04-1000-20-2025-082

May 6, 2025

s.22(1)

Dear s.22(1)

Re: **Request for Access to Records under the Freedom of Information and Protection of Privacy Act (the "Act")**

I am responding to your request of February 5, 2025 under the ***Freedom of Information and Protection of Privacy Act*** for:

> **Regarding the February 4, 2025 announcement for closure of the Expo Deck south of Science World, record of:**
>
> 1. **The structural assessment report that informed the decision to close the deck; and**
> 2. **The report about deconstruction and options for replacement.**

All responsive records are attached*.

*Please note, there are no responsive records regarding part one of your request. For clarity, Streets Design staff advised our office that the attached report from 2023 speaks at high level about the expo deck structure, and was deemed responsive to point two of your request.

Under Part 5 of the Act, you may ask the Information & Privacy Commissioner to review any matter related to the City's response to your FOI request by writing to: Office of the Information & Privacy Commissioner, info@oipc.bc.ca or by phoning 250-387-5629.

If you request a review, please provide the Commissioner's office with: 1) the request number (2025-082); 2) a copy of this letter; 3) a copy of your original request; and 4) detailed reasons why you are seeking the review.

Yours truly,

Kevin Tuerlings, FOI Case Manager, for

[Signed by Kevin Tuerlings]

Cobi Falconer, MAS, MLIS, CIPP/C
Director, Access to Information & Privacy

If you have any questions, please email us at foi@vancouver.ca and we will respond to you as soon as possible. You may also contact 3-1-1 (604-873-7000) if you require accommodation or do not have access to email.

Encl. (Response Package)

:ma

Expo Deck Deconstruction - Scoping Study

City of Vancouver

30 May 2023

317071-00051

Advisian
Worley Group

advisian.com

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MAY 30, 2023

PROJECT: 317071-00051-EX-MA-REP-0001 : Expo Deck Deconstruction - Scoping Study

Rev	Description	Author	Review	Advisian approval	Revision date
A	Issued for Draft	R. Loseth		R. Loseth	7-Jul-22
B	Issued for Draft	R. Loseth	D. Dray	R. Loseth	24-Apr-23
0	Issued for Use	R. Loseth	D. Dray	R. Loseth	30-May-23

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1 Executive Summary

The Expo Deck is located at the east end of False Creek in Vancouver, BC. The facility was constructed for the 1986 World Exposition (Expo 86) and was designed, detailed, and constructed as a temporary structure in accordance with the Expo 86 building code with an intended service life of less than five years. Long-term durability considerations were intentionally not addressed in the design as the structure was not intended to be used beyond its short design service life. The structure has now been in service for 38 years and has undergone various rehabilitation programs to extend the service life where possible. Structural components of the deck are now reaching the end of their useful service life, reducing the reliability of the aging components. As a result, the City of Vancouver (CoV) are planning to deconstruct the Expo Deck by 2032 to address the increased risk associated with this aging structure. To support project planning and approvals for the deconstruction of the Expo Deck, the CoV has engaged Advisian to carry out a scoping study. This report presents the results of the study.

The scope of deconstruction is planned to include removal and disposal of the entire extent of the Expo Deck including top side surfacing, concrete deck panels, treated timber pile caps, and creosote treated timber piles. New works will be required to leave the shoreline in a stable state following deconstruction of the structure. Future Park development and reinstatement of the seawall will be completed as part of the future development plans for the area and is excluded from the scope of this study. The works are also expected to include remediation of sediments underlying the footprint of Expo Deck. Sediments are expected to be contaminated with creosote (localized to the pile locations) due to leaching of the existing timber piles. Remediation may consist of placement of a capping layer, or selective dredging of contaminated sediments that exceed allowable levels.

The works are expected to require permits from Transport Canada (TC) and Fisheries and Oceans Canada (DFO) through their Fish and Fish Habitat Protection Program (FFHPP). Engagement with the Ministry of Environment and Climate Change Strategy (Env) is expected to be required for any sediment remedial efforts associated with the deconstruction works.

Deconstruction of the deck can be split into three discrete areas: the section to the north of Science World, the section to the east of the Science World entrance, and the section to the south of Science World. The section to the east is currently under lease to the province, and per the lease agreement, the province is responsible for all inspection, maintenance, and repair of this portion of the structure. Deconstruction of each section of structure can be undertaken independently. Deconstruction of the North Section can be carried out entirely from the marine side using marine equipment if the CoV wish to minimize onshore impacts to the existing Creekside Park area. Deconstruction of the South Section is expected to require the use of both marine-based and land-based equipment and will result in impacts to existing facilities and neighbouring landowners. Parking Lot No. 610 will require closure, waterfront pedestrian and bicycle access will be permanently cut-off between Olympic Village and Science World as the edge of the deck is located along the southern property lines of the parcel for 1455 Quebec Street.

It is recommended that the project be implemented in three phases over a duration of approximately two years: nine months for preliminary design and permitting, six months for detailed design, tendering and award, and one year for deconstruction and shore stabilization works. The estimated order-of-magnitude cost to implement the project is $25.5 million. To maintain the Expo Deck in a serviceable condition until it can be deconstructed, repairs may be required to address any immediate concerns with structural integrity.

2 Introduction

To support project planning and approvals for the deconstruction of the Expo Deck, the CoV has requested Advisian to carry out a study to identify:

- The extent and scope of deconstruction.
- Stakeholders and the potential for impact to their operations/facilities resulting from deconstruction.
- Whether phasing should be considered given the condition of the existing structures.
- Any new works required to finish the shoreline following deconstruction of the structures.
- Construction/staging areas required to support deconstruction of the structures.
- Regulatory and environmental approvals required for deconstruction.
- Order-of-magnitude construction schedule and cost estimates.

As part of the study, Advisian's scope of services includes:

- Review of relevant background information.
- Preparation of a plan drawing identifying the extent of deconstruction in relation to its current use.
- Identification of a general scope and extent of deconstruction works.
- Identification of stakeholders and potential for impact to existing operations/facility.
- Identification of any new works necessary to leave the shoreline in a finished state following deconstruction of the structure.
- Identification of regulatory and environmental permits/approvals and timelines.
- Identification of construction area requirements to support deconstruction.
- Recommendations for phasing of the structure deconstruction and implementation of an ongoing inspection and maintenance program (based on the recent condition assessment).
- Recommendations for any additional investigations required to finalize a detailed scope of work for deconstruction.
- Preparation of an order-of-magnitude cost estimate and implementation schedule.

The following report presents the results of the study.

3 Description of Existing Facility

3.1 Description of Use

The Expo Deck structure provides support for a waterfront public park space and can be separated into three discrete areas:

- South Section structure consisting of precast concrete deck panels, supported on treated timber pile caps and piles. The structure provides support for the seawall bike path and pedestrian walkway, grass areas, a portion of Science World Parking Lot No. 610 off Quebec Street, and access to the Expo Deck Float.
- North Section structure consisting of precast concrete deck panels, supported on treated timber pile caps and piles. The structure provides support for the seawall bike path and pedestrian walkway, and grass areas of Creekside Park. There is a small observation platform located on the North Section of structure that consists of a cast-in-place concrete deck supported on steel pipe piles.
- East Section structure consisting of precast concrete deck panels, supported on reinforced concrete pile caps and steel pipe piles. This structure provides for access to Science World and is leased to the province under an existing agreement between the City and the province. Per the Agreement (Document No. DOC/2017/023482, Article 6), all inspections, maintenance, and repairs are the responsibility of the province and, subsequently, province's lessee (Science World). It is also important to note that the lease agreement goes beyond the extent of the East Section structure.

Figure 3-1 presents a plan view of the Expo Deck structure and lease boundary/area.

Design drawings providing details of the original as-built structure and previous rehabilitation programs are presented in Appendix 1.

Detailed descriptions of the structural components, landscape surfacing components, and utilities are presented in the following sections.

3.2 Description of Structural Components

A summary of the structural components of the Expo Deck structure is provided in the following sections.

3.2.1 North and South Sections

The North and South Sections of the structure consist of precast hollow core concrete deck panels, supported on ACA/CCA treated timber pile caps and creosote treated piles. Photo 3-1 presents a typical view of the supporting substructure.

Figure 3-1 Plan View of the Expo Deck Overlaid with Park Use

Photo 3-1 Typical View of Supporting Substructure - North and South Sections

The concrete deck panels are simply supported and secured to the pile caps with drift pins. Concrete panels are bonded to adjacent panels by means of grouted shear keys.

ACA/CCA treated timber corbels are located at pile cap splices. Pile caps are secured to the piles with drift pins.

Member geometries are summarized below:

- Precast Deck Units:
  - Type A Hollow Core: Six internal voids, 305 mm by 2,440 mm, spanning 6 m (maximum).
  - Type B Hollow Core: Six internal voids, 305 mm by 2,440 mm, spanning 9 m (maximum).
  - Replacement Panels: 305 mm by 2,400 mm, spanning 9 m.
- Timber Pile Caps (TPC):
  - TPC No. 1: 343 mm by 292 mm.
  - TPC No. 2: 343 mm by 394 mm.
  - TPC No. 3: 394 mm by 394 mm.
  - Supplement: 241 mm wide, depth to match existing pile cap, on both sides.
- Timber Corbels:
  - 343 mm deep, 1,220 mm long, width to match existing pile cap.
- Timber Piles:
  - 330 mm diameter and 360 mm diameter.

- Steel Piles:
  - 305 mm OD, 9.5 mm thickness (at observation and gangway platforms only).

At the South Section, there are four concrete beams (CB1, CB2, CB4, and CB5) and six concrete pile caps (two at CPC1, CPC2, CPC10, CPC11, and CPC12) that support the precast concrete deck. There are also eight concrete pile caps (CPC3, CPC4, CPC5, CPC6, CPC7, CPC8, CPC9, and CPC9a) which form part of the deck. There are another two beams (CB2 and CB6) and four pile caps (two at CPC1, CPC1A, and CPC2) which provide support the deck structure at the storm outfall. Photo 3-2 presents a typical view of the reinforced concrete supporting sub structure.

Photo 3-2 Typical View of Supporting Reinforced Concrete Substructure Located in Discrete Areas of the South Section of Substructure

There is a fender system along the offshore edge of the structure consisting of floating fender logs and creosote treated timber fender piles. Photo 3-3 presents a typical view.

Photo 3-3 Typical View of Fendering System

A backfilled slope, with sparse riprap, supports the transition between the inshore edge of the structure and land. Photo 3-4 presents a typical view.

Photo 3-4 Typical View of Foreshore Slope

3.2.2 East Section

The East Section of the structure consists of precast hollow core concrete deck panels, supported on reinforced concrete beams and pile caps, and steel pipe piles. This structure provides for access to Science World.

The concrete deck is continuous over the beam supports in this section of the structure and integral with the reinforced concrete beams and pile caps.

Member geometries of the major structural elements for the East Section are summarized below:

- Precast Deck Units:
  - Type A Hollow Core: Six internal voids, 305 mm by 2,440 mm, spanning 6 m (maximum) with cast-in-situ reinforced concrete infill along beam supports and panel ends.
- Concrete Beams:
  - CB 21: Precast concrete of 300 mm by 600 mm with cast-in-situ reinforced concrete infill at pile cap locations.
  - CB 22: Precast concrete of 300 mm by 700 mm with cast-in-situ reinforced concrete infill at pile cap locations.
- Concrete Pile Caps:
  - CPC 28: cast-in-situ reinforced concrete, 400 mm by 700 mm by 700 mm.
  - CPC 29: cast-in-situ reinforced concrete, 400 mm by 800 mm by 800 mm.
- Steel Piles: 273 mm outside diameter by 7.9 mm wall thickness.

3.3 Description of Topside Landscape Surfacing

The topside landscape items can be separated into the following primary components:

- Hardscape pathways typically surfaced with pavers or concrete.
- Parking area surfaced with asphalt.
- Turf areas.
- Horticulture beds (trees and plants).
- Miscellaneous landscape fixtures (benches, curbs, retaining walls, etc.).
- Handrail along offshore edge.

Figure 3-2, Figure 3-3, and Figure 3-4 present plan views of the landscape surfacing overlaid with the outline of supporting structure for the North, South and East Sections, respectively.

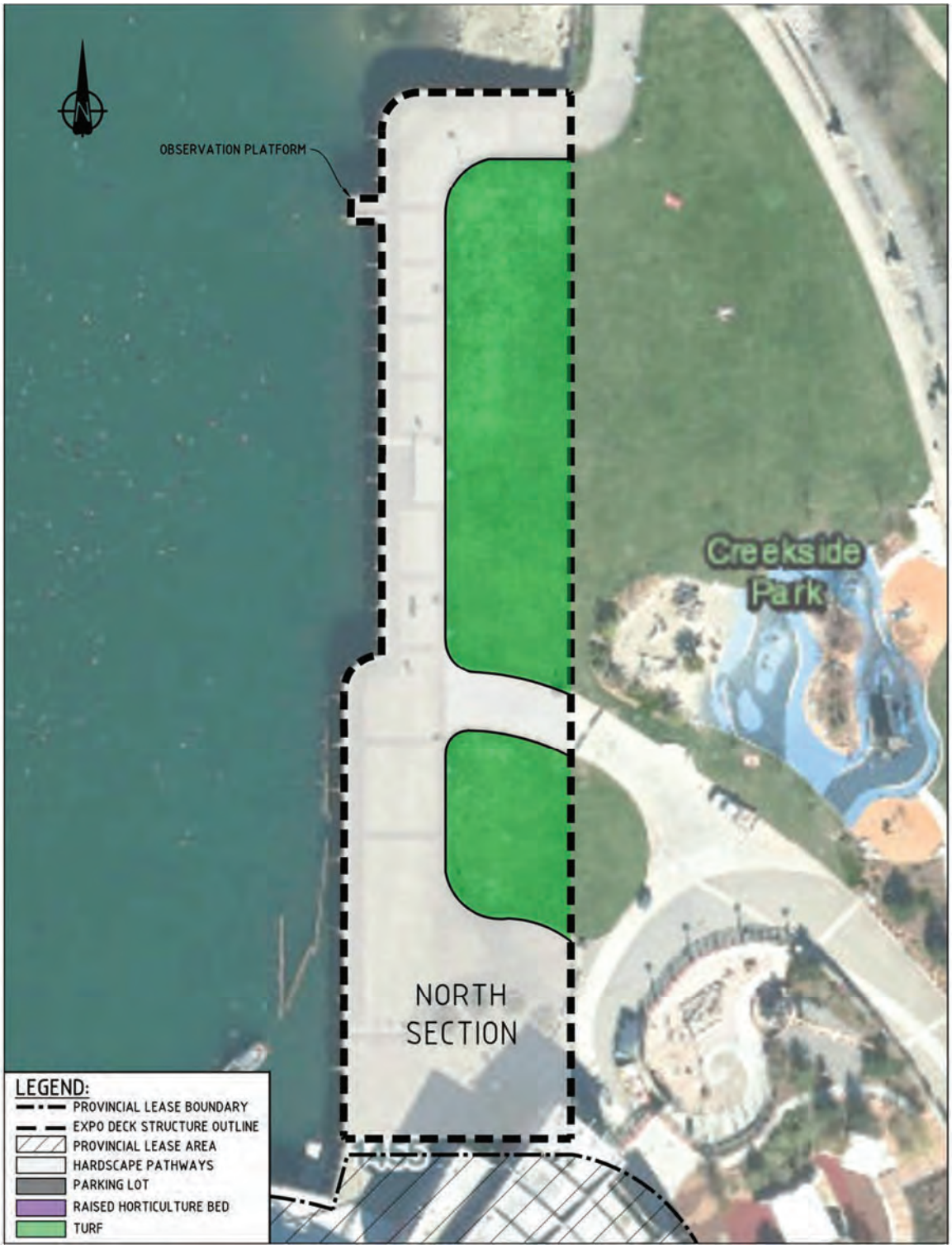


Figure 3-2 Plan View of Topside Landscape Surfacing, North Section

Figure 3-3 Plan View of Topside Landscape Surfacing, South Section

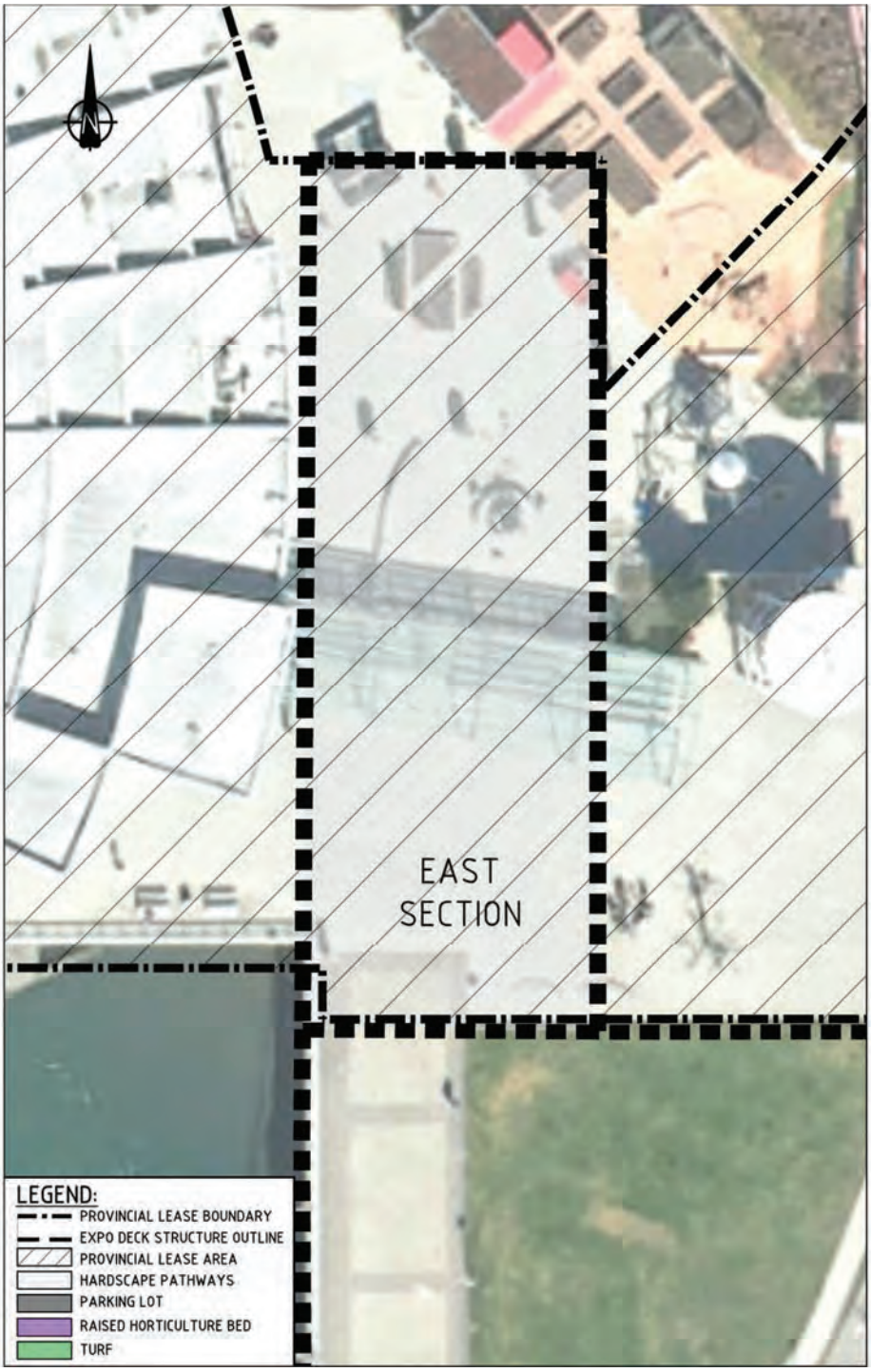


Figure 3-4 Plan View of Topside Landscape Surfacing, East Section

A steel handrail with 100 mm diameter posts, 200 mm diameter top rail, and 25 mm mid rails runs along the edge of the deck and is grouted onto a 300 mm wide reinforced concrete curb. Photo 3-5 presents a typical view of the handrail.

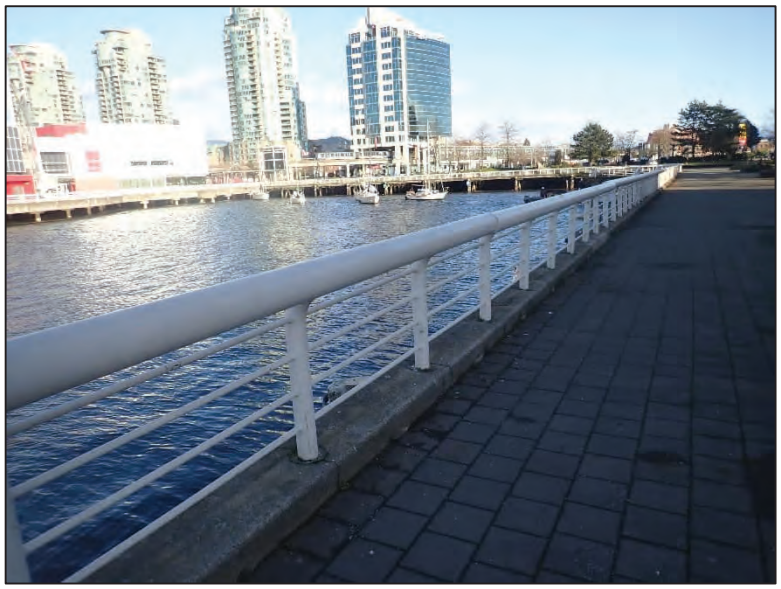


Photo 3-5 Typical View of Handrail

3.4 Description of Utilities

Pathway lighting and an outfall structure are located within the footprint of the Expo Deck. The outfall is located below deck of the South Section of the structure as shown in Figure 3-5.

Figure 3-5 Storm Outfall Location

Figure 3-6, Figure 3-7, and Figure 3-8 present plan views of the utilities overlaid with the Expo Deck structure.

Irrigation systems are also present in the turf areas.

Figure 3-6 North Section Utilities

Figure 3-7 East Section Utilities

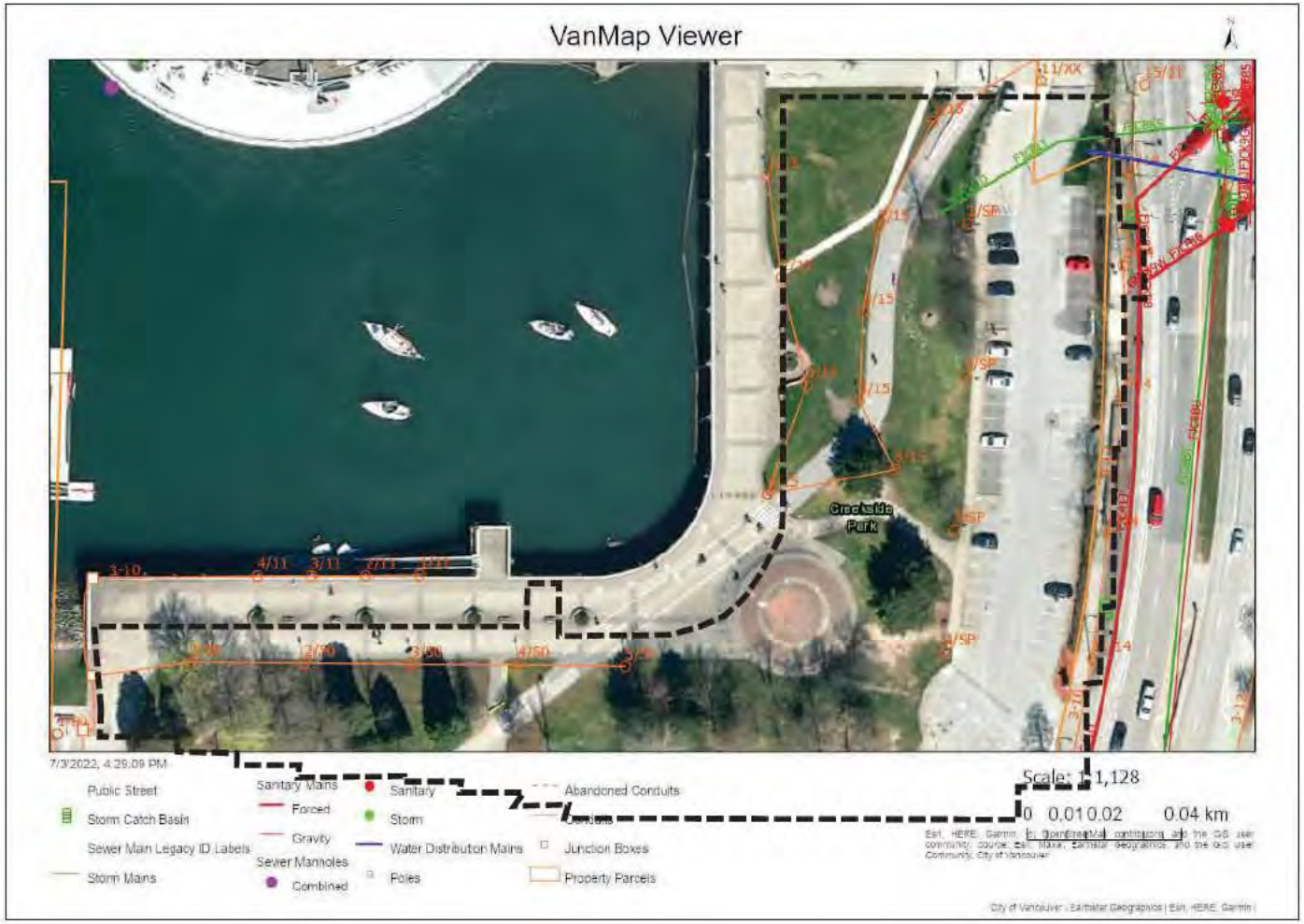


Figure 3-8 South Section Utilities

4 Scope of Deconstruction

The scope of deconstruction works includes:

- Removal and disposal of turf and underlying topsoil.
- Removal and disposal of plants, trees, and associated topsoil.
- Removal and disposal of hardscape surfacing including pavers and asphalt surfacing.
- Removal and disposal of steel handrail.
- Decommissioning, removal, and disposal of light poles and electrical services.
- Removal and disposal of miscellaneous landscape fixtures including benches, curb, garden walls, etc.
- Removal and disposal of reinforced concrete deck.
- Removal and disposal of CCA/ACA treated timber pile caps.
- Removal and disposal of creosote treated timber piles.
- Removal and disposal of reinforced concrete beams and pile caps.
- Removal and disposal of steel pipe piles.
- Sediment remediation.
- Supply and installation of erosion protection on existing slopes. This may need to be temporary in nature, subject to future park development plans.

The extent of deconstruction is indicated in Figure 3-2, Figure 3-3, and Figure 3-4 in the previous section.

The scope of work excludes reinstatement of landscaping, paths seawall, and associated utilities.

5 Construction Considerations

5.1 North Section

Deconstruction of the North Section of the wharf may be carried out with either land-based or marine-based equipment. Onshore construction area requirements will depend on the contractors proposed execution method. If land-based is considered an acceptable option by the CoV, it is recommended that Creek Side Park be closed and the area immediately to the west (outlined in red in Figure 5-1) be allocated for the contractor's temporary laydown and construction access to Quebec Street.

Figure 5-1 North Section Construction Area

To support stakeholder engagement, determine scope of upland deconstruction to support temporary laydown, and confirm scope associated with any temporary infrastructure needs to support seawall detours, it is recommended that a detailed study be carried out in the next phase of the project to:

- Confirm if deconstruction can be entirely carried out by marine-based equipment readily available in the existing market.
- If land-based deconstruction/access is considered:
  - Define the minimum temporary laydown requirements.
  - Develop layouts for temporary laydown and road accesses.
  - Confirm scope of work for deconstruction of upland areas to support construction.
  - Develop requirements for seawall traffic management.
  - Develop layouts and concepts for seawall detours.

5.2 South Section

Due to onshore access constraints, it is expected that deconstruction of the South Section of deck will require both marine-based and land-based equipment. There is very limited land onshore for use during construction as the edge of deck is close to the property lines. This may lead to marine-based deconstruction solutions from the market.

With reference to Figure 5-2, to support the deconstruction, it is recommended that all area to the east and south of the deck to the property lines be provided to the contractor for use during construction. It is also recommended that temporary access be provided at existing entrances along Quebec Street and from the roundabout at the corner of Athletes Way and Ontario Street.

Deconstruction using small crane equipment may be feasible from the deck topside in areas of the Type A deck panels (refer to Figure 5-3). The Type A deck areas are designed for a uniform live load of 12 kPa and HS 20 truck load. The feasibility of this is subject to load evaluation and the condition of the structure at the time deconstruction is to take place.

5.3 East Section

Deconstruction of the East Section may be done independently of the South Section of Expo Deck. If deconstruction of this section is to be considered, land-based access and laydown will be required to support the deconstruction as Science World inhibits marine access.

Figure 5-2 South and East Sections Construction Area

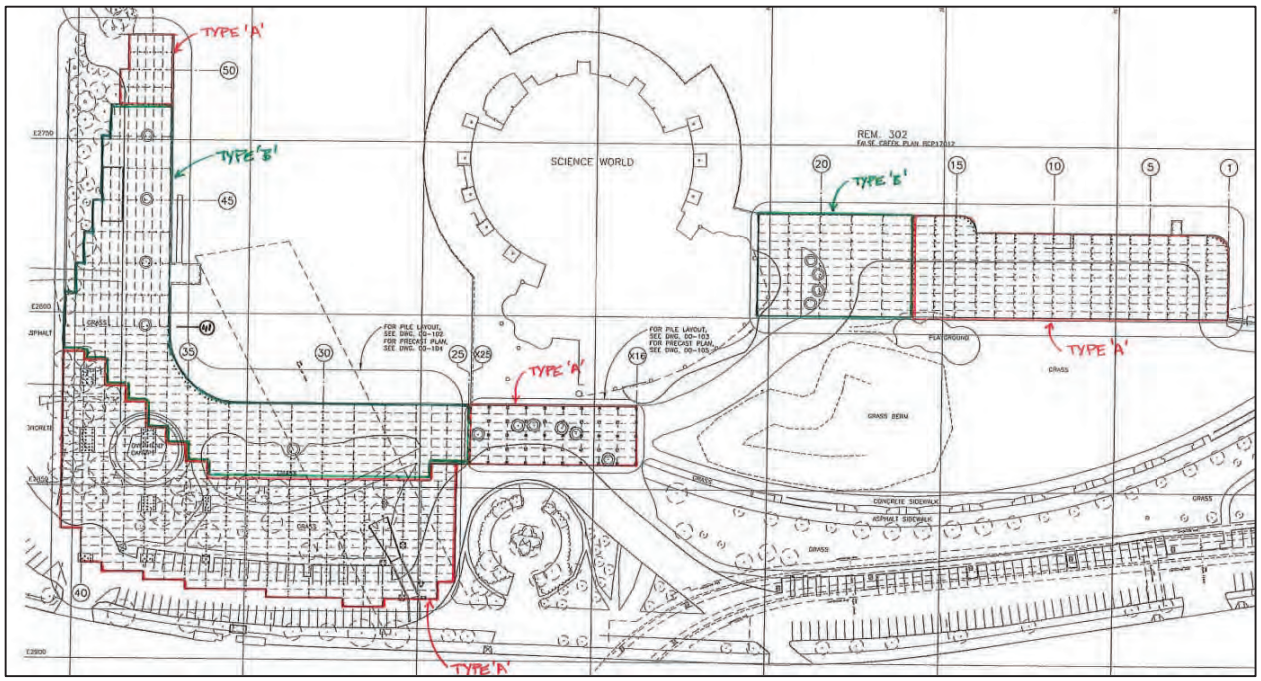


Figure 5-3 Deck Panel Type

6 Impact to Existing Facilities

Deconstruction of the Expo Deck structure is expected to impact the existing facilities as described in the following sections.

6.1 Science World

Deconstruction of the East Section and southern end of the North Section of the Expo Deck will limit access to Science World (refer to Figure 6-1). Existing areas fronting Science World will require reconfiguration to support access during and post deconstruction.

Figure 6-1 Science World Impacts Due to Deconstruction

6.2 Parking Lot No. 610

Deconstruction of the South Section of the Expo Deck will require deconstruction of part of the parking lot. Closure of the parking lot will be required during construction to support deconstruction and provide for roadway access to the South Section deconstruction work area. The parking lot will require reconfiguration post deconstruction.

6.3 Creekside Park and Seawall

Deconstruction of the South Section of the Expo Deck will permanently cut-off waterfront pedestrian and bike access between Olympic Village and Science World. The edge of the Expo Deck is located along the southern and eastern property lines of the parcel for 1455 Quebec Street (refer to Figure 6-2). If access must remain within this parcel, a marine structure or reclamation will be required to restore access following deconstruction.

Figure 6-2 Creekside Park and Seawall Impacts

To support deconstruction of the North Section of the Expo Deck, closure of the adjacent playground and Creekside Park area is recommended.

6.4 1601 Quebec Street

The landowner of 1601 Quebec Street and any future buildings on this property may be impacted by the deconstruction of the South Section of the Expo Deck, as the edge of the deck is located on or close to the property line. Foreshore works after deconstruction will be required to protect the existing slopes from erosion. The extent of this work has the potential to encroach onto 1601 Quebec Street.

6.5 Expo Float

Support and access to the float is currently provided by the Expo Deck. Deconstruction of this facility will be required as part of the Expo Deck deconstruction work. Photo 6-1 presents a view of the float.

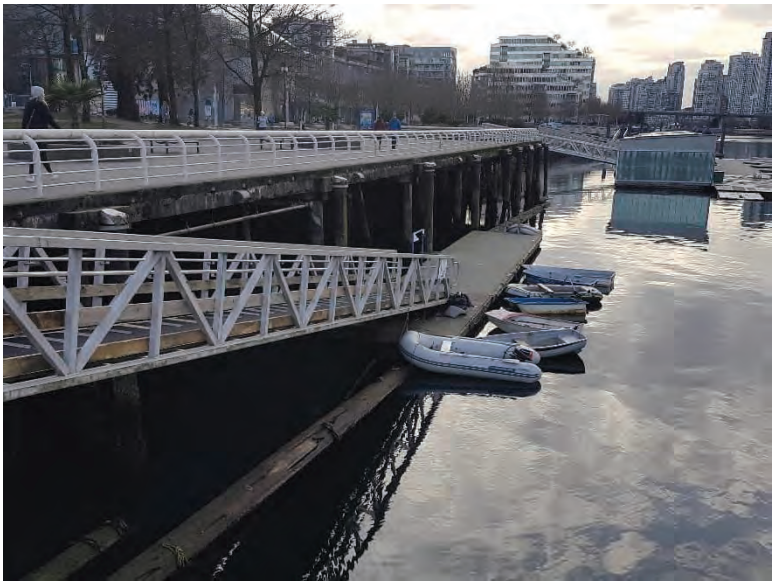


Photo 6-1 Expo Deck Float

7 Permits and Approvals

Based on a review of the proposed works and existing knowledge of the project location, the applicable federal, provincial, and municipal legislation that may apply to the deconstruction works are identified in Table 7-1.

Table 7-1 Legislation, Agency, and Action Applicable to the Project

Legislation	Agency	Applicable Permit/Approval	Action
Federal			
Fisheries Act	DFO-FFHPP	Request for Project Review (RfR)	**Required**
Species at Risk Act (SARA)		*Fisheries Act Authorization* (FAA)	Not Anticipated
		SARA Permit	Not Anticipated
Canadian Navigable Waters Act	TC	Application for Approval	**Required**
		Minor Works Order	Not Anticipated
		Major Works Order	Not Applicable
		Public Notice	**Required**
Canada Marine Act	Vancouver Fraser Port Authority (VFPA)	Project and Environmental Review (PER) Permit	Not Applicable
Provincial			
Land Act	Ministry of Forests (MoF)	Water Lot Amendment	Not Applicable
Water Sustainability Act	MoF	Change Approval	Not Applicable
		Authorized Change	Not Applicable
Municipal			
Green Deconstruction By-Law	CoV	Deconstruction Permit	Not Anticipated
Noise Control Bylaw No. 6555	CoV	Bylaw Amendment	To be Confirmed by Contractor

7.1 Federal Permitting

The applicable federal permit/applications identified as action "Required" in Table 7-1, include the following considerations.

7.1.1 DFO-FFHPP

In accordance with the *Fisheries Act*, Advisian recommends that an RfR Application be prepared and submitted to DFO-FFHPP by a Qualified Environmental Professional (QEP) that describes the activities and mitigation measures to be implemented to prevent death to fish or the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat (DFO 2021). The RfR Application should be submitted to DFO-FFHPP, including a Construction Environmental Management Plan (CEMP). A Marine Habitat Baseline Study report will not be required as the project is deconstruction of an existing structure and is not anticipated to result in an increase to the existing footprint. It is expected that DFO will issue a Letter of Advice (LoA) that may contain additional mitigation or monitoring measures for the project. These measures can be incorporated into the CEMP for the contractor to implement during project activities. The requirement of a *Fisheries Act* Authorization is not anticipated.

The status of individual species is reviewed annually by the independent Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2019). Once a species has been reviewed by the COSEWIC, it is considered for legal protection under the SARA. DFO-FFHPP provides listing policy guidance for marine species under consideration (DFO 2016). Once listed, the SARA provides legal protection to Schedule-1 listed species. Section 79 of the SARA requires government agencies and the proponent to fully assess the potential effects and implement measures are taken to avoid or lessen the effects on a Species at Risk (SAR). A SARA permit is not anticipated for the location of the proposed activities.

7.1.2 Transport Canada

The Navigation Protection Program (NPP) administered by TC enforces the *Canadian Navigable Waters Act (*CNWA) and is responsible for administering and processing applications for approval. The *Minor Works Order* allows for specific works to be built, without review or approval by the Ministry of Transport under the CNWA, provided that conditions set out within the order are met during the project. Project works that fall within the criteria of the *Minor Works Order* are still required to submit a Notification of a Minor Work through the NPP to deposit information about the planned project activities. If a proponents' work does not meet the criteria established for the *Minor Works Order,* an application is still required if the work is located on a scheduled navigable water (TC 2021).

It is anticipated that the project will be required to submit an Application for Approval to the NPP considering that:

- The project is considered a recreational deck, and thus does not fall within a class of the *Minor Works Order*.
- The project is located on a scheduled navigable water.
- The project may interfere with navigation through construction/placement through deconstruction of an existing work. As access to the deck will need to be restricted during construction, the project is expected to require an approval.

Project activities will be submitted to the NPP and assessed to determine whether the planned project activities will interfere with navigation. Additionally, a public notice containing project details must be posted on the public registry. If deemed to interfere with navigation, an approval will have to be provided by TC, with conditions required to be adhered to during the project activities before works can proceed. There is potential that TC will deem that the project will not interfere with navigation, and the project could thus proceed with submission of a *no interference with navigation notification of work* through the NPP.

7.1.3 VFPA

The *Canada Marine Act* is administered through the Port Authority for shipping and port-related land and marine use in the Metro Vancouver Region. Any physical work that occurs within the Port Authority jurisdiction must be reviewed through the Project and Environmental Review (PER) process (VFPA 2021).

The project is outside of the Port Authority jurisdiction and therefore a PER review (or permit) is not required.

7.2 Provincial

Provincial permitting considerations include the following.

7.2.1 Ministry of Forests

Water lots in BC are under the jurisdiction of the Ministry of Forests (MoF). The construction, placement, and use of private moorage facilities on Crown land requires authorization from MoF. A Water lot amendment through MoF is not anticipated, as the project involves deconstruction of an existing structure; however, a review of the current water lot lease should be reviewed per the proposed activities.

7.2.2 Ministry of Environment and Climate Change Strategy (ENV)

Where a site is not firmly regulated within provincial or federal lands, jurisdiction for environmental issues may include both ENV and Environment and Climate Change Canada (ECCC). On other similar nearshore sites, our experience is that the provincial regulator, ENV, will typically take the lead on sediment contamination issues.

The *Environmental Management Act* (EMA 2023) is the primary element of the provincial legislative framework for protecting the environment and human health. The EMA sets out the requirements for investigation management, and remediation of contaminated sites within BC, and also prescribes requirements for waste disposal and discharge.

Under the EMA, a contaminated site is defined as an area of land in which the soil or any groundwater lying beneath it, or the water or the underlying sediment, contains a prescribed substance in quantities or concentrations exceeding prescribed risk-based or numerical criteria, standards, or conditions, as specified in the *Contaminated Sites Regulation* (CSR, ENV 2023a). The CSR is the enabling regulation under the EMA that includes procedures for the investigation and reporting of contaminated sites. The CSR prescribes numerical standards for soil, sediment, water, and vapour quality for specific land, sediment, and water uses.

ENV Protocol 11 (ENV 2023b) sets the Upper Cap Concentrations (UCCs) for substances with numerical standards in the CSR and which, when present in the exposure zone of soil, water, sediment or vapour, could potentially pose high risks to the environment or human health.

Under this Act and Regulation, the triggers to involve ENV are expected to be:

- If contaminants have migrated off the site to a neighbouring property. Remedial measures could be put in place to prevent off-site migration from occurring post-decommissioning.
- If UCCs are exceeded, an analysis of exposure pathways usually must be carried out to determine if a site is classified as high risk.
- If a building permit is required for deconstruction and/or pile installation, then a Site Disclosure Statement (SDS) may need to be submitted to the CoV. This would result in a building permit freeze until a Site Release can be obtained from ENV. Approval of a Site Release would typically involve site investigation work. CoV's policy indicates that deconstruction permits (if required for a project) would not trigger an SDS.

Investigation and sampling of the sediment and determination of municipal permit requirements would clarify what involvement ENV would have in the decommissioning work.

7.2.3 Water Sustainability Act

In BC, streams and aquifers are regulated under the *Water Sustainability Act* (WSA) to ensure proper management and maintenance of a sustainable water supply. The WSA regulates the authority to work around water and the requirements for making changes in and about streams (CIAS), where a "stream" is defined as any "natural source of water supply, including, without limitation, a lake, pond, river, creek, spring, ravine, gulch, wetland or glacier". Under the WSA, any proposed CIAS must have permission in the form of a legal instrument, through either an *authorized change, change approval*, *order*, or *authorization*. (BC ENV 2022). Upon review, it was determined that the project will not require notification or approval under the WSA as the activities are marine-based and not anticipated to impact freshwater sources or shoreline.

7.3 Municipal

Municipal permitting considerations include the following:

- Deconstruction of a building, including a house, multi-family home, or commercial/industrial building requires a deconstruction permit with requirements to reuse and recycle deconstruction materials under the CoV green deconstruction by-law (CoV 2022). It is not anticipated that a deconstruction permit will be required for the project, as the green deconstruction by-law does not contain scope for marine-based projects.
- Depending on the project schedule determined by the contractor, activities may be required to be completed outside of hours permitted (i.e., due to tides) by the CoV Noise Control Bylaw No. 655 (CoV 2021). If project activities are planned to be completed outside the hours outlined by the CoV, a noise by-law exception permit must be obtained through the CoV. Typically, it is the contractor's responsibility to obtain the Noise Bylaw exemption permit.

7.4 Documentation

It is expected that the following documents will be required to support permitting:

- Completed application form(s).
- Location figure for the proposed activities.
- Photographs of the structures and condition(s).
- Proposed project schedule, sequence of activities, methods, and equipment.
- Overview of aquatic environment and species in the form of an assessment and literature review, as appropriate.
- A CEMP that outlines proposed activities, potential environmental effects and mitigation and monitoring measures to manage and minimize environmental effects to the surrounding environment.
- Design drawings that indicate the extent of work.

8 Environmental Mitigations

8.1 Potential Impacts from Contaminated Sediments

Once pile structures are removed, the sediments in the area may be more susceptible to erosion and transport. Sediments immediately surrounding creosote-treated piles are expected to contain concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) and metals that will exceed the sediment standards set out on Schedule 3.4 of the Contaminated Sites Regulations (CSR).

Where these structures are removed and no longer have a beneficial use, the sediments should be investigated and assessed against the CSR standards to determine if concentrations pose a risk to ecological or human health. If concentrations exceed the standards, an assessment is recommended to determine the potential risks for the altered site conditions following decommissioning. If some type of remedial measure was warranted this would typically comprise either capping of the sediments to prevent erosion and contain them within the site boundary, or limited sediment removal depending on the degree, extent and depth of contaminated areas. The option selected should consider any resulting constraints to future redevelopment.

The requirements for remediation may be mitigated to some degree by the existence of elevated background contamination in the general area from other historical industrial uses and the current stormwater outfall. This could be assessed in more detail once a sediment investigation has been completed.

Where piles and other in-water structures remain in place as a means of stabilizing sediments, a beneficial use exemption (under Protocol 13 for Contaminated Sites, ENV 2021) will likely be applicable and investigation or remedial measures would not be required for sediments within a 3 m radius of such structures.

Tasks recommended include:

- Sediment sampling investigation in the vicinity of creosote-treated structures to be removed, screening of results against CSR sediment standards.
- Assess the risks of leaving any contaminated sediments in place.
- Determine remedial strategy (e.g., capping, risk management) if required.

8.2 Potential Impacts to Fish and Fish Habitat

To determine the mitigation and monitoring requirements for the deconstruction activities, the following guidelines and Best Management Practices (BMPs) will be referenced to provide operational procedures, including:

- A User's Guide for Changes In and About a Stream in BC (BC ENV 2022).
- DFO: Fish and Fish Habitat Protection Policy statement (DFO 2019a).
- DFO: Measures to Protect Fish and Fish Habitat (DFO 2019b).

- DFO: Projects Near Water: British Columbia Marine/Estuarine Timing Windows for the Protection of Fish and Fish Habitat (DFO 2014a).
- DFO: 2022 Management Measures to Protect Southern Resident Killer Whales (DFO 2022).
- Best Management Practices for Pile Driving and Related Operations (BC Marine and Pile Driving Contractors Association 2003).

High level environmental mitigation and monitoring measures that are expected to be required based on our previous project experience are provided in Table 8-1.

Table 8-1 Environmental Mitigations

Activity	Potential Environmental Effects	Proposed Mitigation and Monitoring Measures
Concrete Deck Deconstruction Vessels Use of Equipment	• Change in water quality due to release of deleterious substances (concrete fines). • Change in water quality due to structure removal. • Change in fish mortality risk.	• Follow BMPs for working in and around the marine environment to minimize the potential for deleterious substances entering the marine environment. A spill prevention and emergency response plan should be developed and implemented by the contractor. • Debris generated from deconstruction will be collected, contained, and disposed offsite at an approved facility. • A turbidity monitoring program based on visual observations should be developed and implemented. An EM should be on site to implement the turbidity monitoring program. • If there are concerns for effects to water quality based on visual monitoring, turbidity compliance monitoring will be conducted by the EM based on provincial (BC ENV 2021) and federal (CCME) (CCME 1999) water quality guidelines (WQG). • An erosion and sediment control plan should be developed and implemented for the project by the contractor. • Barges or other vessel used during the project are not permitted to ground on the foreshore or seabed, expecting only such disturbance as is reasonably required resulting from the use of barge spuds/anchors.
Timber Pile Cap and Pile Removal	• Change in fish and marine mammal mortality risk. • Change in water quality.	• Existing piles will be removed full length as practicable. • Pile removal activities should be scheduled to occur within the DFO least risk window (Area 28 - Burrard Inlet: August 16 to February 28) (DFO 2014b) if possible. • If pile removal is conducted with a vibratory hammer, mitigation and monitoring measures for pile removal will follow those outlined for vibratory pile driving, including: – Underwater acoustic monitoring by a qualified Marine Mammal Observer (MMO) to develop a Marine Mammal Exclusion Zone (MMEZ) based on a 160 dB re 1 uPa acoustic threshold.

Activity	Potential Environmental Effects	Proposed Mitigation and Monitoring Measures
		– Monitoring of the MMEZ by the MMO for marine mammal presence throughout pile removal activity. If a marine mammal is observed in the MMEZ, work will be stopped until the marine mammal has been observed leaving, or no observation has been made for 30 minutes. – Confirmatory acoustic monitoring of the MMEZ approximately every five days, depending on the project schedule. – A turbidity monitoring program based on visual observations should be developed and implemented. An EM should be on site to implement the turbidity monitoring program. – If there are concerns for effects to water quality based on visual monitoring, turbidity compliance monitoring will be conducted by the EM based on provincial (BC ENV 2021) and federal (CCME) (CCME 1999) WQG. • Debris generated from pile removal will be collected, contained, and disposed offsite at an approved facility. • Barges or other vessel used during the project are not permitted to ground on the foreshore or seabed, expecting only such disturbance as is reasonably required resulting from the use of barge spuds/anchors. • Existing piles to be removed may have invertebrates attached. Communication with DFO through submission of the RfR will confirm best course of action with consideration to either removal or re-location of these invertebrates.

9 Existing Condition and Remaining Service Life

9.1 Service Life

Service life is defined as the period of time over which a structure can safely support the design loads and serve its intended function requiring only scheduled inspection and maintenance. Significant replacement and/or rehabilitation of structure should not be required during the design service life.

The Expo Deck structure (North, South, and East Sections) was designed, detailed, and constructed as a temporary facility intended to have a service life of less than five years. Long-term durability considerations were intentionally not addressed as the facility was not intended to be used beyond its short design service life. However, the facility has now been in service for 38 years.

Since acquiring the asset, the CoV has continued to inspect and maintain the structure on a regular cycle. Presently, the CoV conducts annual inspections and performs rehabilitation work on as required basis. A rehabilitation program was carried out in 2008 and again in 2017 to repair the structure and address immediate structural integrity concerns. Following the implementation of the rehabilitation program in 2008, the remaining service life of the structure was estimated to be 10 to 15 years at that time.

Based on the extent of deterioration, durability concerns, design life expectancy, and duration that the deck has been in service, deconstruction of the Expo Deck is recommended.

9.2 Existing Condition - North and South Sections

Advisian recently carried out a detailed condition assessment of the North and South Sections of the deck. The results of the inspection are provided under Document No. 317071-00051-SB-MA-REP-2016, titled "Detailed Visual Inspection of the Expo Deck", included in Appendix 2. Based on the results of the inspection, estimated residual life estimates of each primary structural component are summarized in Table 9-1. For the purpose of the estimates, residual life represents the estimated period that will elapse between the inspection date and the time when a component in the condition observed will typically require significant rehabilitation or replacement.

Table 9-1 Summary of Residual Life Estimates

Element	Estimated Residual Life
Deck Panels at North and South Sides	4 to 8 years, following completion of recommended repairs.
Pile Caps at North and South Sides	4 to 6 years, following completion of recommended repairs.
Timber Piles at North and South Sides	10+ years, following completion of recommended repairs.
Steel Piles (Observation and Gangway Platform)	4 to 8 years, following completion of recommended repairs.
Fender Logs at North and South Sides	4 to 8 years, following completion of recommended repairs.

Element	Estimated Residual Life
Topside - Steel Handrails at North and South Sides	10+ years, following completion of recommended repairs.
Topside - Concrete Edge Beam at North and South Sides	4 to 8 years, following completion of recommended repairs.

Regardless of the deconstruction schedule, an interim repair program may be required to address localized areas of damage and deterioration to ensure the facility remains in a safe and serviceable condition. A summary of the estimated costs for recommended repairs, categorized by urgency, are summarized in Table 9-2. Refer to Document No. 317071-00051-SB-MA-REP-2016 titled "Detailed Visual Inspection of the Expo Deck", included in Appendix 2 for a description of the urgency ranking system and a complete summary of recommended repairs.

Table 9-2 Order-of-Magnitude Cost Estimates for Repairs

Location	Estimated Repair Cost		
	Urgency U=4 (Repair Immediately)	Urgency U=3 (Repair by 2 Years)	Urgency U=2 (Repair by 3 Years)
North Section	---	$47,000	$111,000
South Section	---	$42,000	$45,000

An inspection program is recommended to ensure the facility remains in a safe and serviceable condition until such time that it is deconstructed. Based on the age and condition of the structure, detailed condition assessments are recommended to be carried out on a three-year inspection frequency in 2023, 2026, and 2029.

9.3 Existing Condition - East Section

The condition of the East Section was assessed in 2019 by Westmar Advisors and the results are provided in Document No. 1190076_00_MEM_001_RA attached in Appendix 2. Based on the results of the inspection, the condition of the East Section of deck is similar to that seen in the North and South Sections.

10 Estimated Cost

Order-of-magnitude cost estimates for deconstruction of the Expo Deck are presented in Table 10-1.

Table 10-1 Order-of-Magnitude Cost of Deconstruction

Description	Estimated Cost		
	North	East	South
Mobilization/demobilization.	$300,000	$200,000	$500,00
Allowance for traffic control.	120,000	90,000	210,000
Allowance to prepare the site in support of Expo Deck deconstruction works to including deconstruction of existing onshore area and preparation of temporary laydowns and accesses outside of the Expo Deck footprint. *Works to modify access to science world is not included. *Permanent works to re-instate the seawall and park is not included.	210,000	140,000	160,000
Removal and disposal of topside softscape, hardscape, utilities, and handrails.	290,000	110,000	540,000
Removal and disposal of deck structure (deck panels, timber pile caps, and piles).	3,020,000	740,000	7,530,000
Allowance for soil remediation and shore stabilization (installation of a 0.5 m thick 6 in. minus scour layer over seabed within wharf extents and top up of 1 m thick riprap on slopes above zero chart datum).	930,000	360,000	2,090,000
Subtotal Deconstruction Costs	**$4,870,000**	**$1,640,000**	**$11,030,000**
Surveys and investigations.	100,000	50,000	150,000
Engineering (6%).	300,000	100,000	670,000
Permitting and approvals (4%).	200,000	70,000	450,000
Subtotal Deconstruction and Engineering Costs	**$5,470,000**	**$1,860,000**	**$12,300,000**
Contingency (30%).	1,650,000	560,000	3,690,000
Total Estimated Cost	**$7,120,000**	**$2,420,000**	**$15,990,000**

In reviewing the above estimated costs, note the following:

- Detailed estimates are provided in Appendix 3. Estimates above have been rounded to the nearest $1,000.
- The estimate is in Canadian dollars and is based on Q1 2023 prices.
- The estimate is based on in-house experience and budget price quotations from local contractors and suppliers for similar projects.
- The estimate does not include:
  - Any applicable taxes.
  - Escalation.
- A contingency allowance of 30% of the total estimated cost is included. The contingency is not a reflection of the accuracy of the estimate but covers undefined items of work which will have to be performed, and elements of cost which will be incurred, but which are not explicitly detailed or described due to the level of engineering and estimating which has been completed to date.
- The total estimated cost, including contingency, is considered accurate to ±50%.
- Subtotals and totals are rounded to be reflective of the level of accuracy of the cost estimate.
- Thickness of soft scaped grass areas assumed to be 300 mm.
- Thickness of hard scaped paver areas assumed to be 75 mm.
- A temporary laydown area of 1,400 sq. m has been assumed for deconstruction of the North Section. Site preparation allowances include placement of 200 mm thick gravel surface within the temporary onshore laydown.
- Disposal costs are based on landfilling treated timber and crushing and recycling reinforced concrete.
- Works to modify the access to Science World, or re-instate a pile supported dock structure are excluded.
- Permanent works to re-instate a seawall access, landscaping, and associated utilities are excluded.
- Allowance for soil remediation and shore stabilization is based on installation of a 0.5 m thick 6 in. minus scour layer over the seabed within wharf extents and top up of 1 m thick riprap on slopes above zero chart datum. Costs to dredge and dispose of contaminated sediments is not considered in the estimate.

11 Implementation Strategy and Timelines

For planning purposes, the following project phases and associated timelines are recommended:

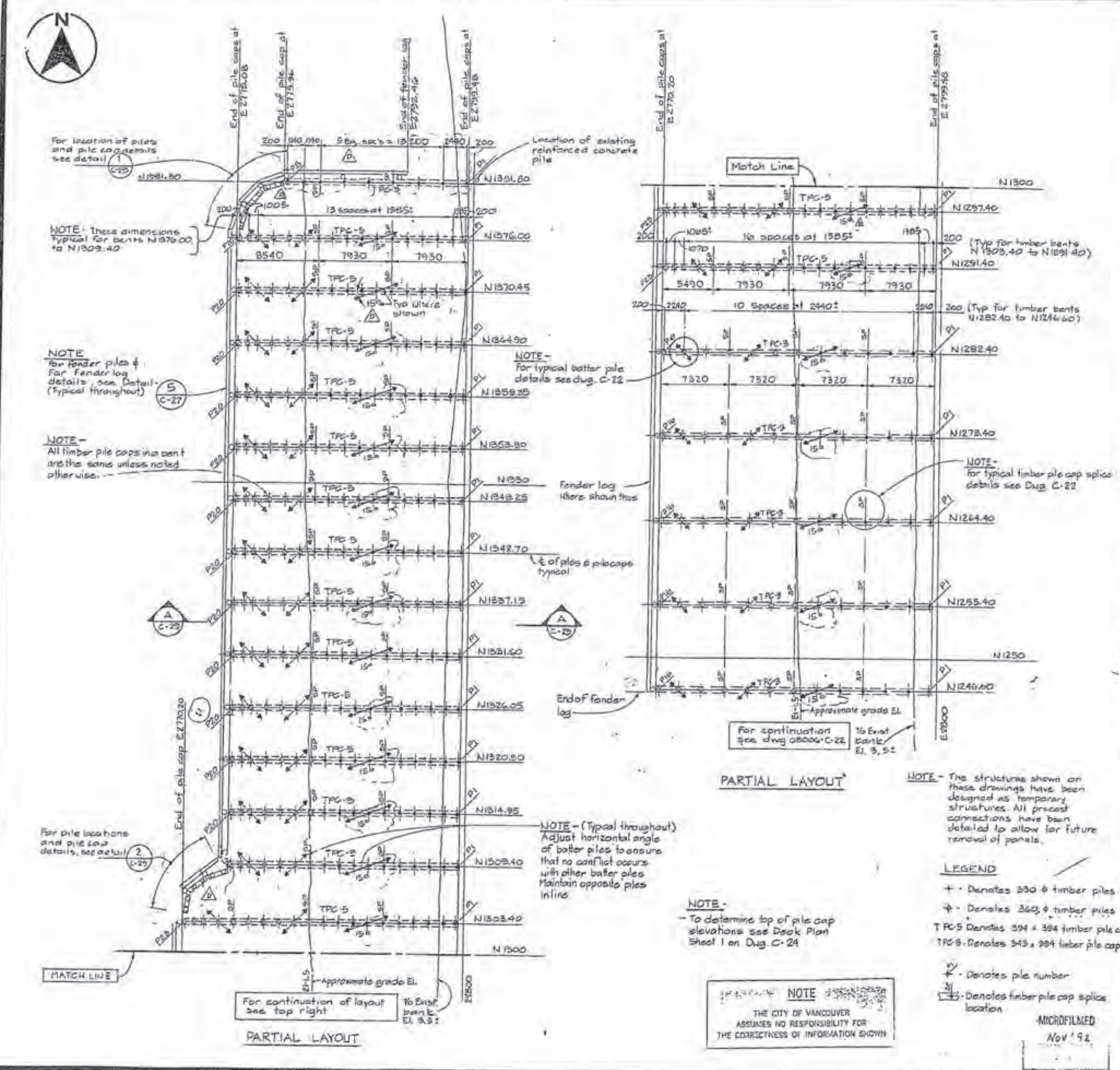
- **Phase 1: Site Investigations, Permitting, and Preliminary Design**. Approximate duration of nine months. Recommended scope to include:
  - Site investigations, including:
    - Topographic survey to confirm the extent of the deck deconstruction, scope of the topside landscape components, above and underground utilities, and potential for encroachment onto neighbouring properties.
    - Sediment sampling in areas expected to be impacted by creosote-treated piles, followed by an assessment of risks to human and ecological health.
    - Visual assessment of the existing shoreline (below the deck structure) to scope the extent of shore stabilization required following removal of the existing deck structure.
  - Assess the risks to human and ecological health associated with leaving any potential contaminated sediments in place.
  - Develop a remedial strategy for contaminated sediments (if required).
  - Develop a permitting plan and stakeholder engagement strategy.
  - Scope improvements required to the foreshore area following deck deconstruction with consideration incorporating into future park development plans.
  - Carry out a deconstruction study to:
    - Assess the existing market capacity/equipment to complete the deconstruction entirely from the water side.
    - If land-based deconstruction is considered:
      - Define the minimum onshore temporary laydown and access requirements.
      - Develop layouts for temporary laydown and road accesses.
      - Confirm scope of work for deconstruction of upland areas to support construction.
      - Develop requirements for seawall traffic management.
      - Develop layouts and concepts for seawall detours.
    - Assess opportunities/impacts associated with phasing of the deconstruction works (deconstruction of north with the south, versus separating north from south).
    - Assess contracting options and strategies.
  - Prepare preliminary (30%) deconstruction drawings and specifications to support permit submissions, development of capital cost estimates for project funding, stakeholder engagement and pre-qualification of contractors. Preliminary drawings to include:
    - Plan drawings indicating the extent of deck deconstruction.
    - Details of the existing hard and softscape surfacing to be deconstructed.

    - Plan drawings indicating location and extent of existing utilities to be deconstructed.
    - Plan, sections, and details of final slope treatment following deconstruction.
    - Plan, sections, and details of sediment remediation.
    - Plan drawings indicating temporary construction areas and accesses, including scope for construction of temporary fencing, deconstruction of onshore infrastructure, and temporary surfacing requirements.
  - Plan, sections, and details of temporary seawall routing (if required).
  - Pre-qualify implementation contractors.
  - Prepare and submit permit applications based on 30% designs.
  - Prepare capital cost estimates and an implementation schedule.
- **Phase 2: Detailed Design and Tender.** Approximate duration of six months to one year (subject to permitting). Recommended scope to include:
  - Prepare 60%, 90%, and issued for tender deconstruction drawings and specifications.
  - Tender and award the deconstruction works.
- **Phase 3: Deconstruction.** Approximate duration of 10 months for the South Section, six months for the north section, and four months for the East Section.

In review of above schedule duration estimates, please note that the following is excluded:

- Timelines for CoV internal procurement processes.
- Stakeholder engagement and coordination.

Appendix 1
Reference Drawings



NOTE
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Nov '92

NOTES

Design Code:

Expo 86 Building Code

Design Loads

Live loads – see dwg 08006-C 24
Ground snow load – 1.9 kN/m²
Superimposed dead load: piping etc. 0.25 kN/m²
Wind load – q^{10} = 0.45 kN/m²
q^{30} = 0.55 kN/m²

Timber Piles

Timber piles shall conform to CSA CAN 3-056-M79 and shall be of the size shown on the dwgs. All piles shall be pressure treated with creosote to a retention of 192 kg/m³ by the full cell process. Piles shall be driven so that the tips penetrate into the dense till or till-like layer to the approval of Expo 86.

Allowable Pile Capacity

Ground El	Pile capacity
> El. –4.0	220 kN
El. –5.0 to El. –4.0	180 kN

Timber Pile Caps

Timber pile caps shall be Douglas Fir No. 1 grade structural posts & timber conforming to NLGA standard grading rules and shall be pressure treated with ACA or CCA to a retention of 6.4 kg/m³

Concrete Reinforcing Steel

Reinforcing bars shall be deformed bars conforming to CSA G30.12-M77 and shall be grade 400

Cast-in-place Concrete

1. All concrete shall conform to CSA CAN 3-A23.1-M77.

2. All concrete shall have a minimum 30 MPa ultimate compressive strength at 28 days

3. Maximum aggregate size to be 20 mm. Maximum water/cement ratio to be 0.50.

4. Minimum concrete cover to reinforcing steel shall be 75 mm except 65 mm for cast in place deck slab

5. All corners and edges of concrete beams to be chamfered 25 mm

All pile bents supporting Type A units except those marked * are designed for column loads of 45 kN unfactored at any location. Min. spacing of columns 1 x pile spacing

KEY PLAN

EXPO 86

The 1986 World Exposition
Vancouver, British Columbia
Canada

May 2 - October 13, 1986

Rev.	Date	By	Chk.	Revision
B	7 Dec 83	RH	CTS	Re-issued for tender contract No C 006
A	16 Nov 83			Issued, addendum No 1, Contract No C 006
	7 Nov 83	JvL		Issued for tender contract No C-006
C	Jan 84	RH		Area B issued for construction
D	17 Jan 84	RH		piles & pilecaps revised at curves. Batter horiz. angle changed. Bent at N1312.8 revised.

PBK Phillips Barratt Kaiser

Approved 4-1-84

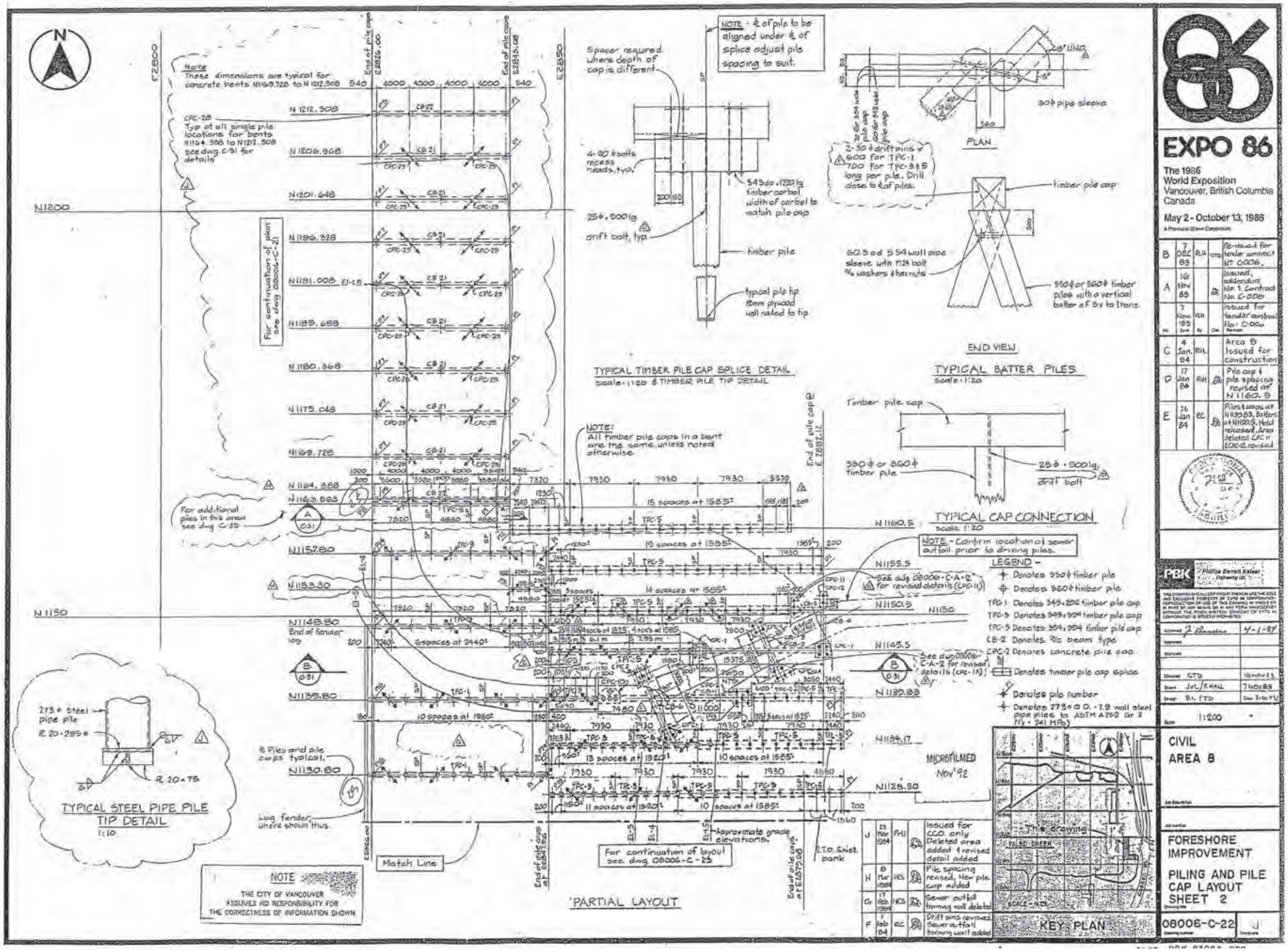
Drawn	CTD / R.L.H.	4 NOV 83
Date	JvL / R.HALL	7 NOV 83
Design	BL / JB	
Scale	1:200	

CIVIL
AREA B

FORESHORE IMPROVEMENT

PILING AND PILE CAP LAYOUT SHEET 1

08006-C-21 | D


EXPO 86
The 1986 World Exposition
Vancouver, British Columbia
Canada
May 2 - October 13, 1986
TYPICAL TIMBER PILE CAP SPLICE DETAIL
TYPICAL BATTER PILES
END VIEW
PLAN
TYPICAL CAP CONNECTION
TYPICAL STEEL PIPE PILE TIP DETAIL
PARTIAL LAYOUT
KEY PLAN
NOTE - Confirm location of sewer outfall prior to driving piles.
NOTE: All timber pile caps in a bent are the same unless noted otherwise.
LEGEND -
Denotes 330ϕ timber pile
Denotes 360ϕ timber pile
TPC-1 Denotes 343×292 timber pile cap
TPC-3 Denotes 343×394 timber pile cap
TPC-5 Denotes 394×394 timber pile cap
CB-2 Denotes R/c beam type
CPC-2 Denotes concrete pile cap
Denotes timber pile cap splice
Denotes pile number
NOTE
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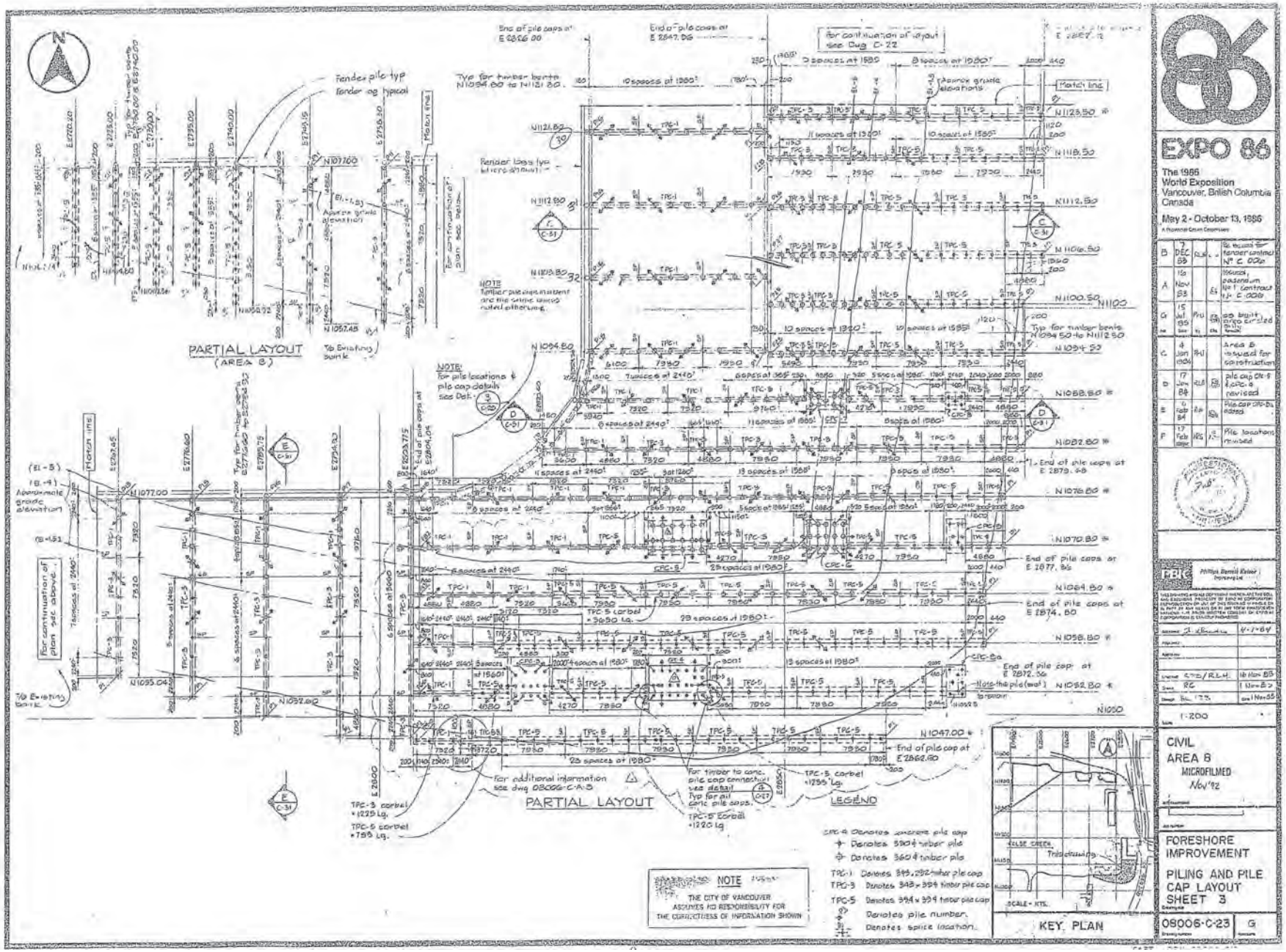
MICROFILMED Nov '92
For continuation of layout see dwg 08006-C-23
Match Line
Log fender where shown thus.
CIVIL
AREA 8
1:200
FORESHORE IMPROVEMENT
PILING AND PILE CAP LAYOUT SHEET 2
08006-C-22
J


PARTIAL LAYOUT
(AREA B)
PARTIAL LAYOUT
NOTE
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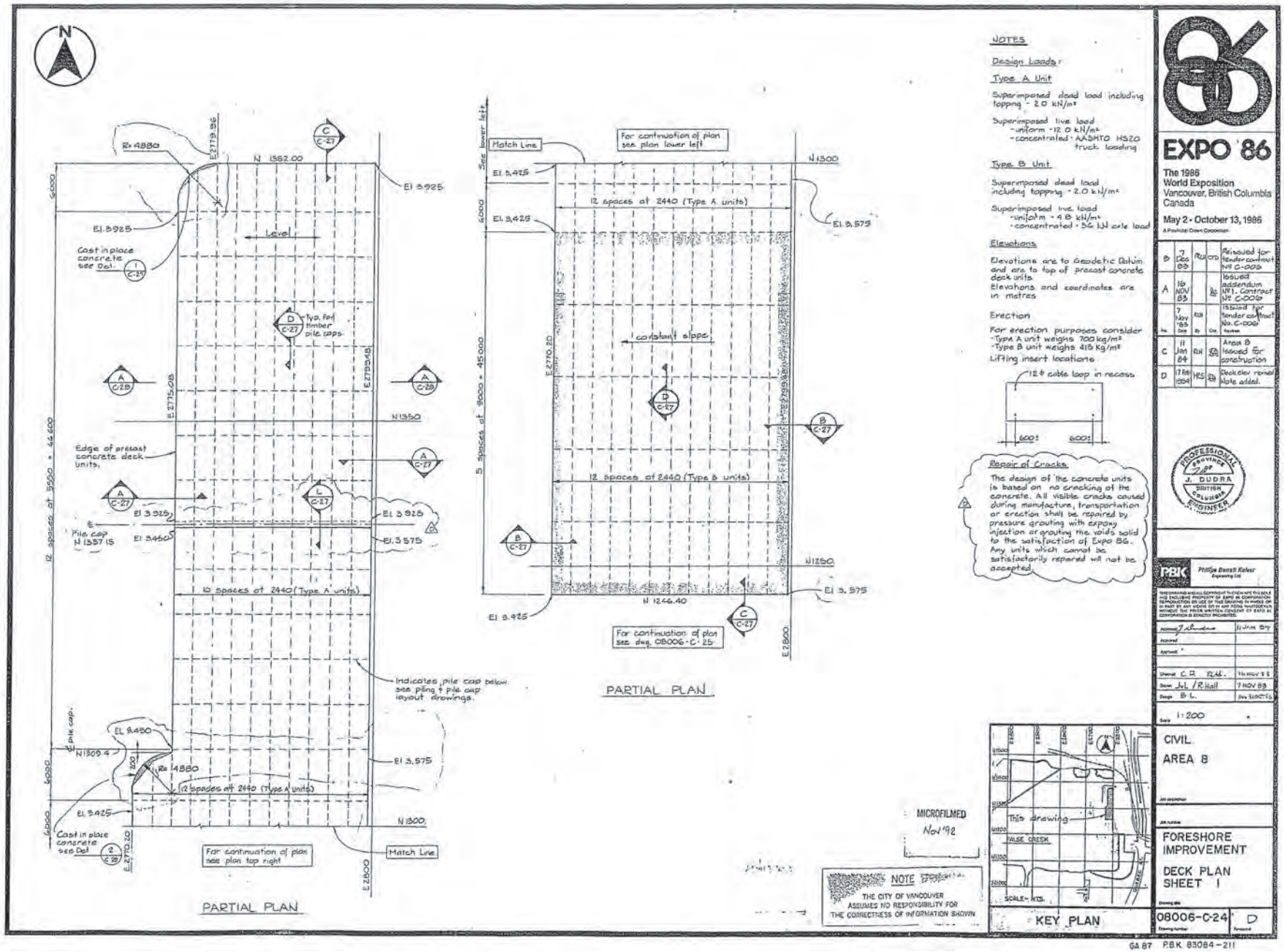
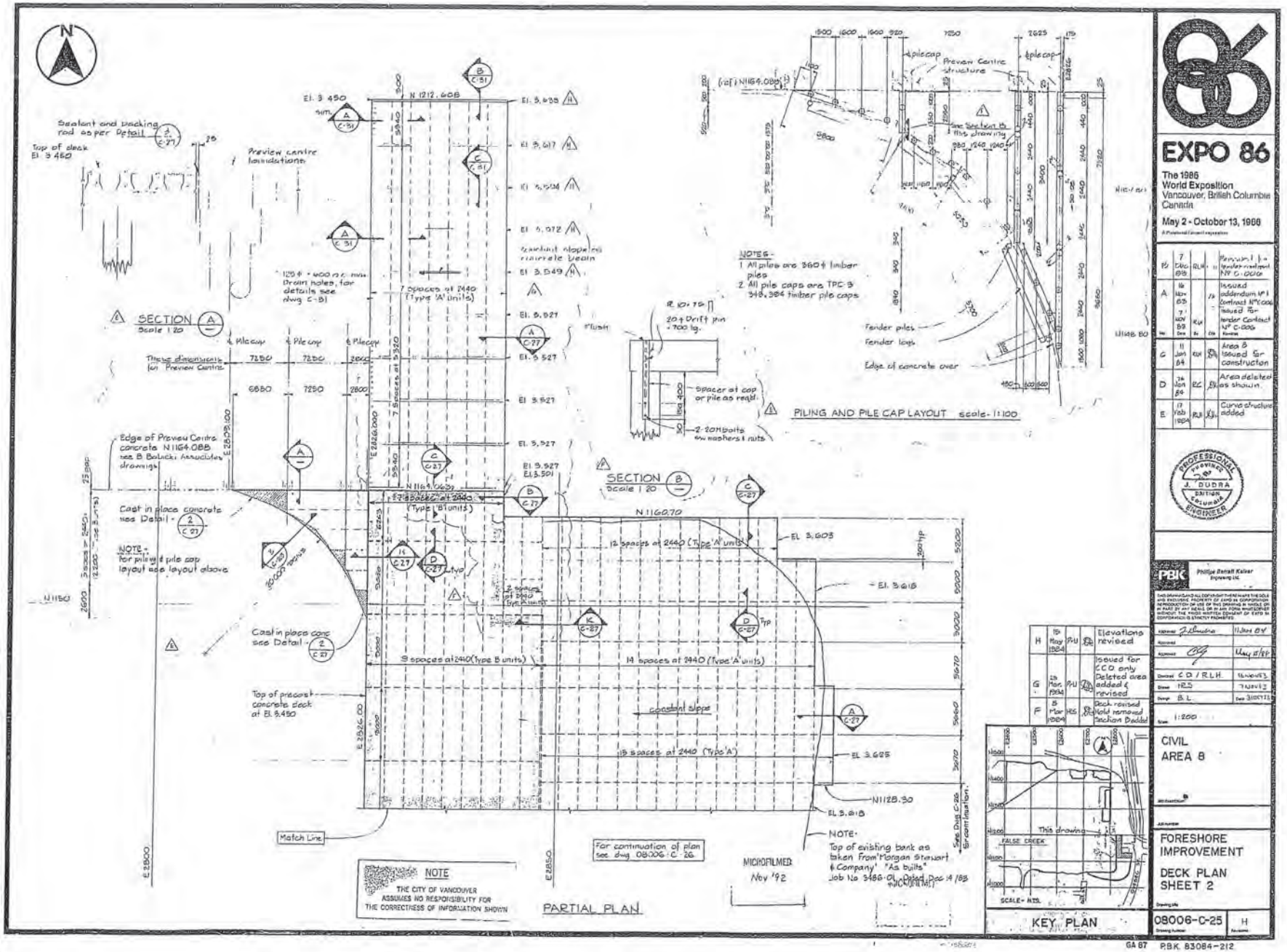
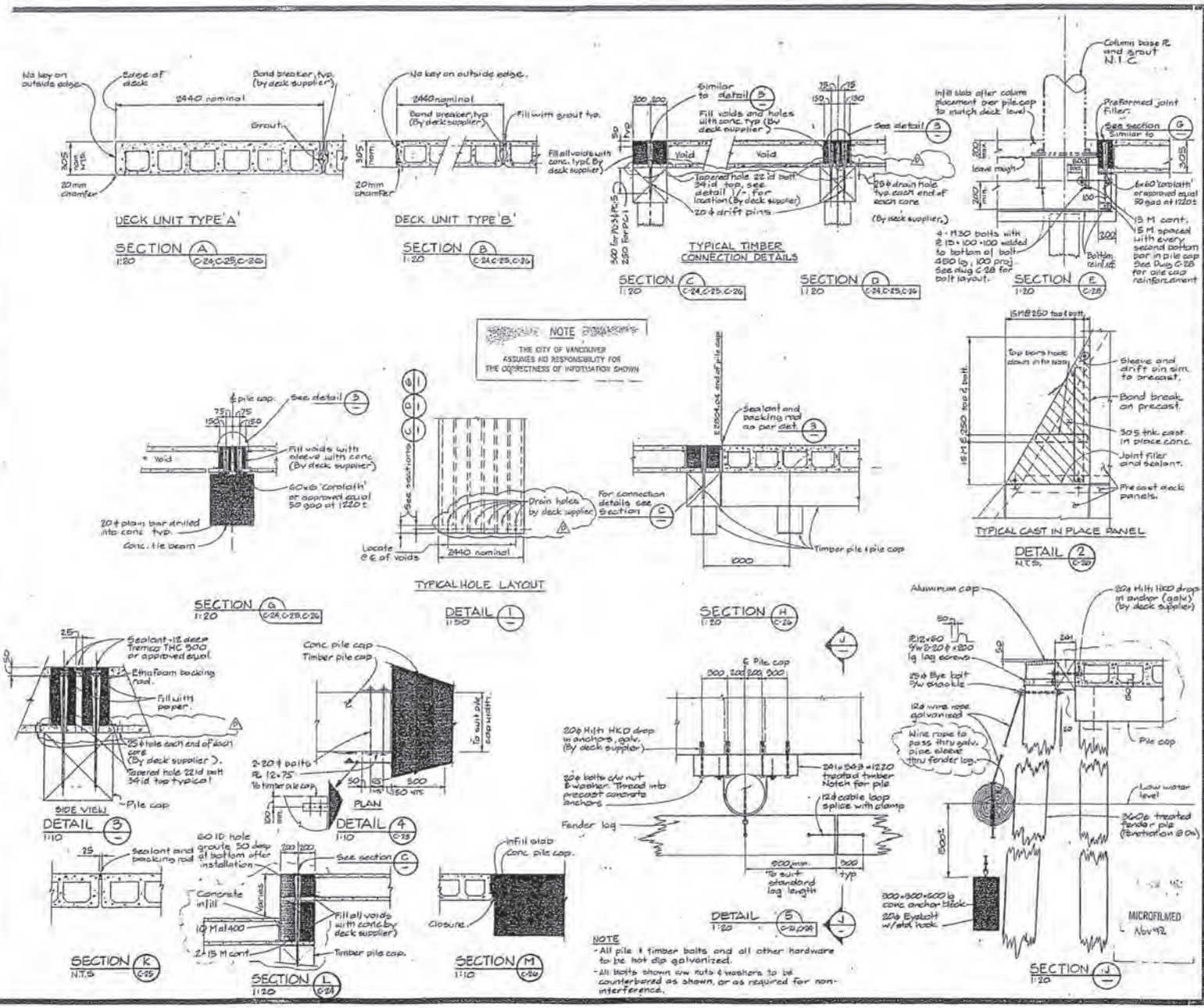
LEGEND
KEY PLAN
EXPO 86
The 1986 World Exposition
Vancouver, British Columbia
Canada
May 2 - October 13, 1986
CIVIL
AREA B
MICROFILMED
Nov '92
FORESHORE IMPROVEMENT
PILING AND PILE CAP LAYOUT SHEET 3
08006-C-23
G



GA 87 P.B.K. 83084-211





EXPO 86

The 1986 World Exposition
Vancouver, British Columbia
Canada

May 2 - October 13, 1986

No.	Date	By	Chk	Description
B	7 DEC 85	RLH		Reissued for tender control No C-006
A	16 Nov 83		RLH	Issued for addendum No 1, Contract No C-006
	7 Nov 1983	RLH		Issued for tender control No C-006
C	11 Jan 84	RLH	RLH	Area B issued for construction
D	17 Feb 1984	RLH	RLH	Drain holes added, Coriolath pads removed

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA J. DUDRA

PBK Philip Barratt Kaiser Engineering Ltd

Approved	J. Dudra	11 JAN 84
Approved		
Approved		
Checked	C.T.D / R.L.H	16 NOV 83
Drawn	P.U	1 OCT 83
Design	B.L.	1 OCT 83

Scale AS NOTED

CIVIL
AREA B

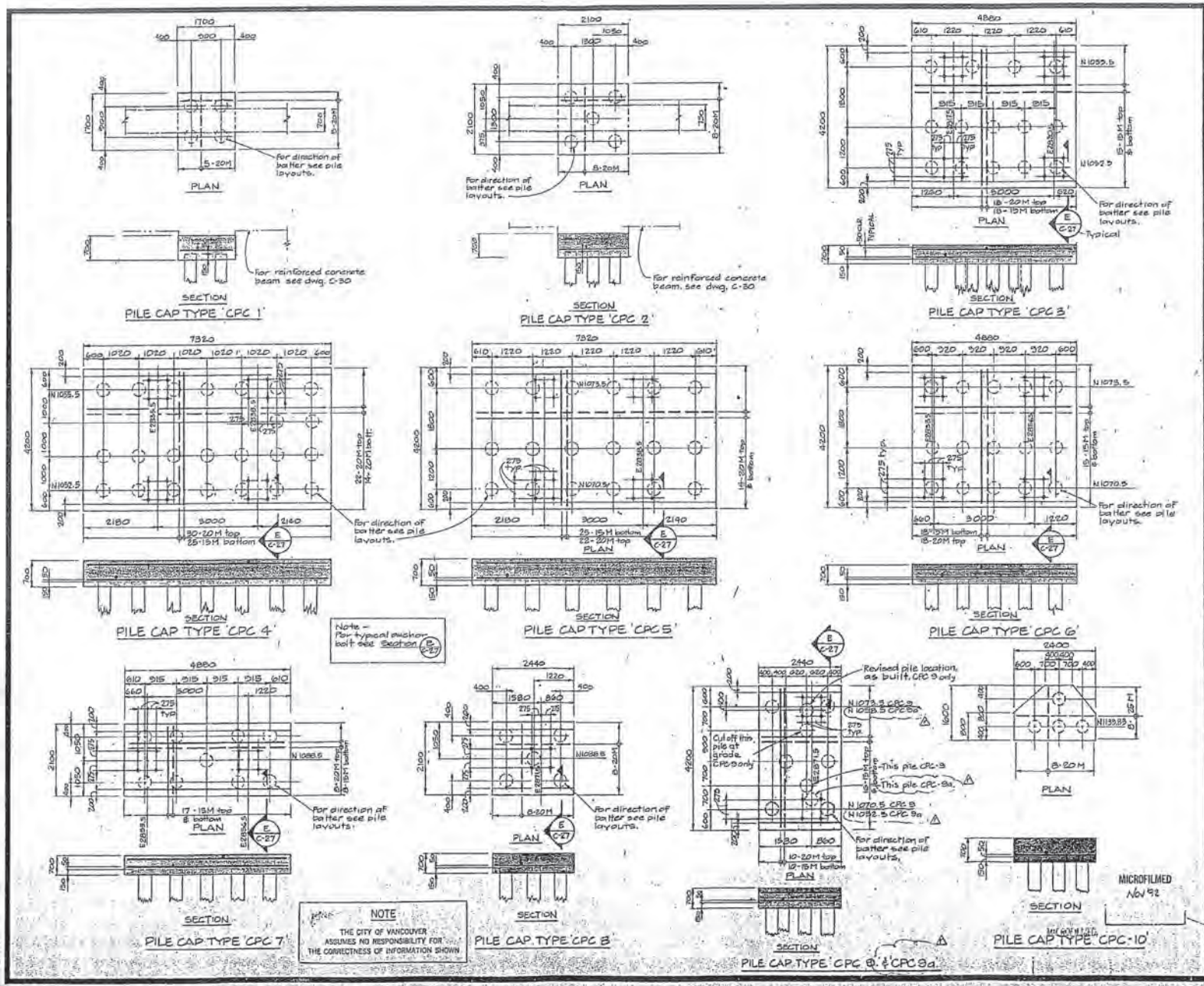
FORESHORE IMPROVEMENT

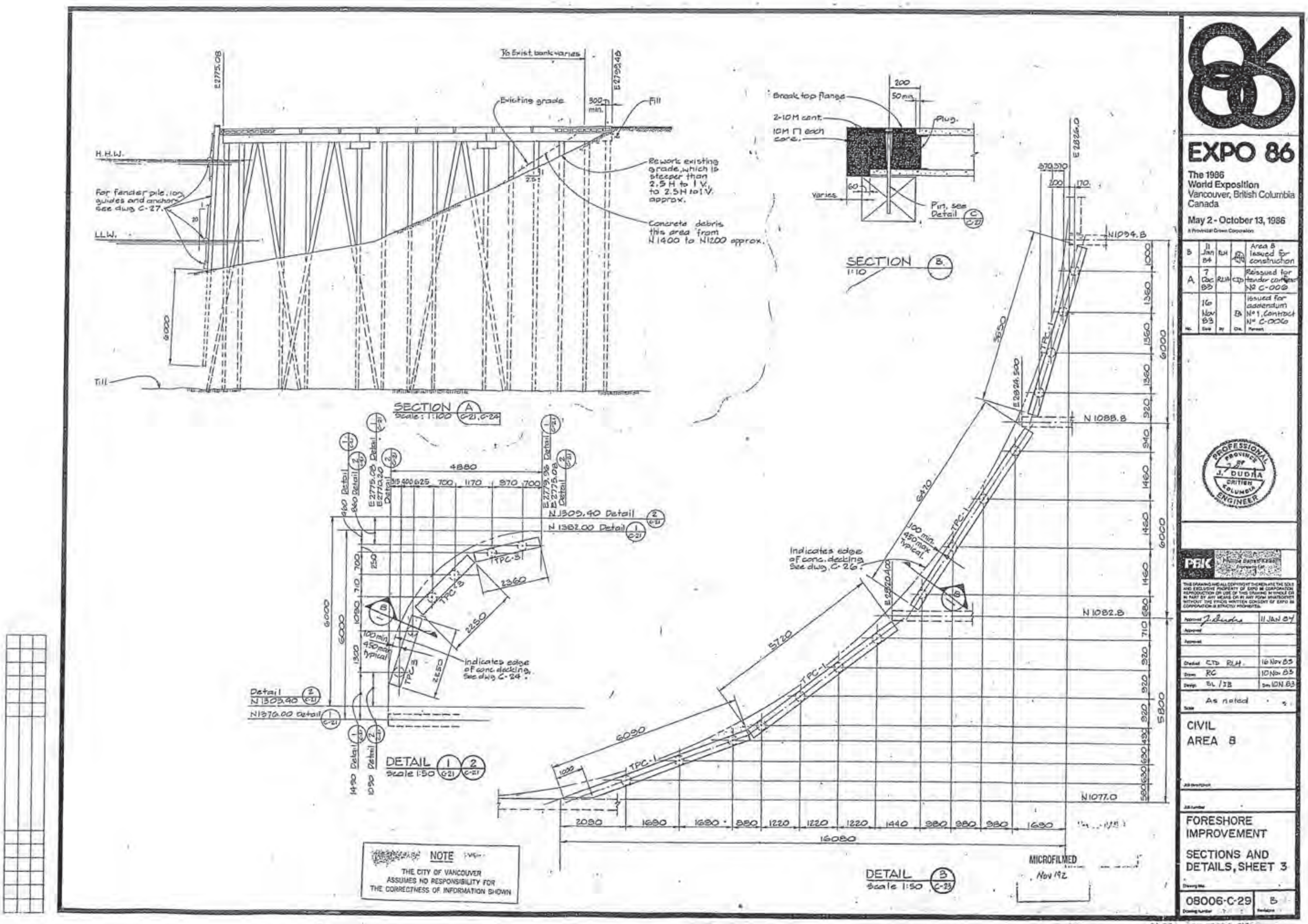
SECTIONS AND DETAILS, SHEET 1

08006-C-27 D

MICROFILMED Nov 92

GA 87 P.B.K. 83084-214




SECTION A
Scale: 1:100
Existing grade
Fill
To Exist. bank varies
H.H.W.
L.L.W.
Till
For fender pile, log guides and anchors See dwg. C-27.
Rework existing grade, which is steeper than 2.5 H to 1 V, to 2.5 H to 1 V approx.
Concrete debris this area from N 1400 to N1200 approx.
SECTION B
1:10
Break top flange
2-10M cont.
10M each core.
Plug.
Varies
Pin, see Detail C
DETAIL 1 2
Scale 1:50
Indicates edge of conc. decking, See dwg. C-24.
100 min. 450 max typical
DETAIL B
Scale 1:50
Indicates edge of conc. decking See dwg. C-26.
N1094.8
N 1088.8
N 1082.8
N1077.0
16080
EXPO 86
The 1986 World Exposition Vancouver, British Columbia Canada
May 2 - October 13, 1986
B 11 Jan 84 Area B Issued for construction
A 7 Dec 83 Reissued for tender contract Nº C-006
16 Nov 83 Issued for addendum Nº 1, Contract Nº C-006
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA J. DUDRA
PBK
As noted
CIVIL
AREA B
FORESHORE IMPROVEMENT
SECTIONS AND DETAILS, SHEET 3
08006-C-29 B
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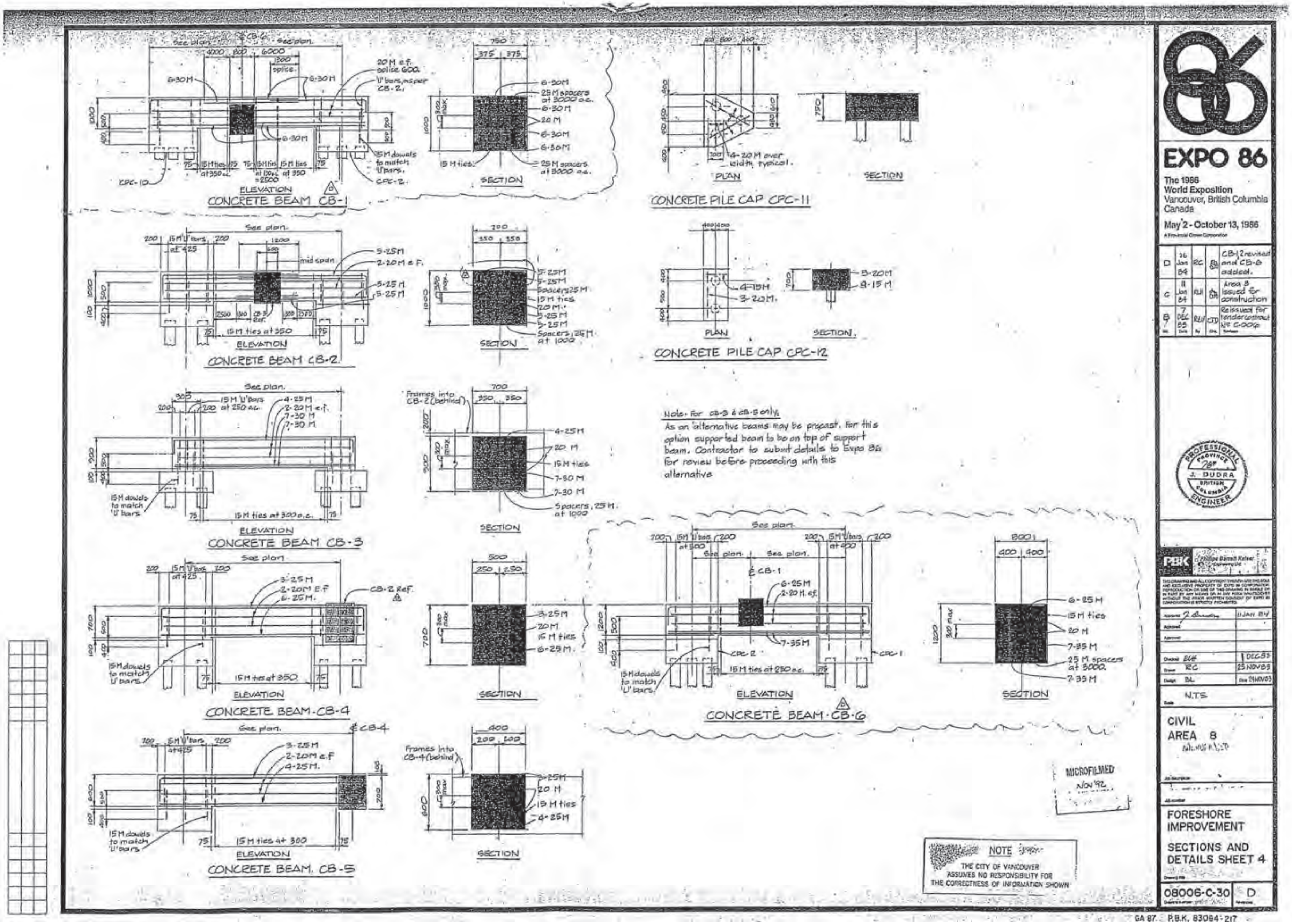
PBK 83084-216



CONCRETE BEAM CB-1
ELEVATION
SECTION
CONCRETE PILE CAP CPC-11
PLAN
SECTION
CONCRETE BEAM CB-2
CONCRETE PILE CAP CPC-12
CONCRETE BEAM CB-3
Note - For CB-3 & CB-5 only.
As an alternative beams may be precast. For this option supported beam to be on top of support beam. Contractor to submit details to Expo 86 for review before proceeding with this alternative
CONCRETE BEAM-CB-4
CONCRETE BEAM · CB-6
CONCRETE BEAM. CB-5
EXPO 86
The 1986 World Exposition
Vancouver, British Columbia
Canada
May 2 - October 13, 1986
PROFESSIONAL ENGINEER
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N.T.S.
CIVIL
AREA 8
FORESHORE IMPROVEMENT
SECTIONS AND DETAILS SHEET 4
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NOTE
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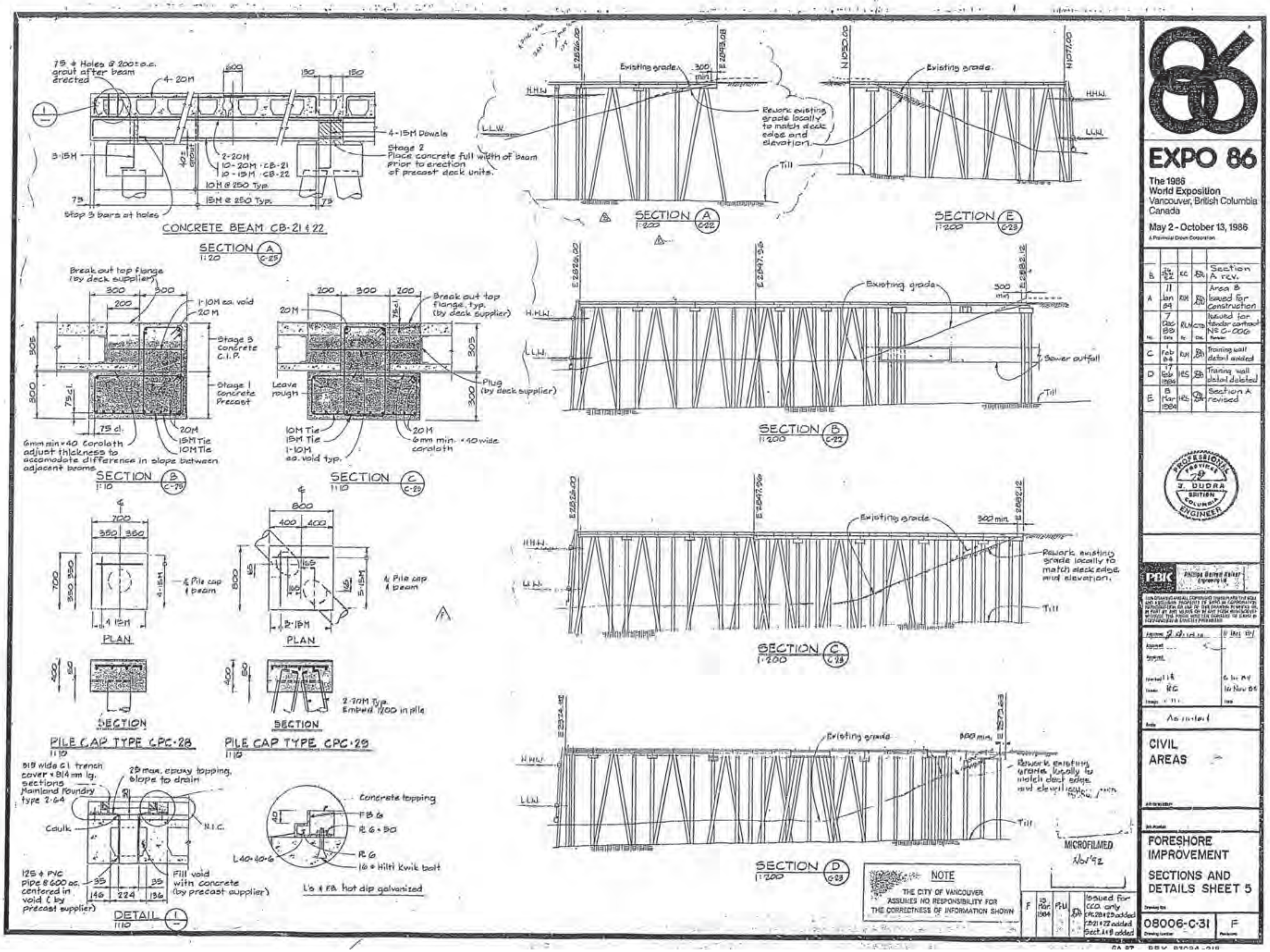
CONCRETE BEAM CB-21 & 22
SECTION A 1:20
SECTION B 1:10
SECTION C 1:10
PLAN
SECTION
PILE CAP TYPE CPC-28
PILE CAP TYPE CPC-29
DETAIL 1 1:10
Concrete topping
L's & FB hot dip galvanized
SECTION A 1:200
SECTION E 1:200
SECTION B 1:200
SECTION C 1:200
SECTION D 1:200
Existing grade
Rework existing grade locally to match deck edge and elevation.
Sewer outfall
Till
H.H.W.
L.L.W.
NOTE
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EXPO 86
The 1986 World Exposition
Vancouver, British Columbia Canada
May 2 - October 13, 1986
CIVIL
AREAS
FORESHORE IMPROVEMENT
SECTIONS AND DETAILS SHEET 5
08006-C-31
F

Appendix 2
Condition Assessment Reports

WESTMAR ADVISORS

December 12, 2019

Science World
c/o Bush Bohlman and Partners LLP,
Suite 1550 – 1500 West Georgia St.
Vancouver, B.C V6G 2Z6

Project No.: 1190076
Document No: 1190076_00_MEM_001_RA

Attention: Hugh Swan, Facilities Director, Science World
c/o Tim White, Ph.D., PEng, Partner, Bush, Bohlman & Partners LLP

Reference: Science World – City Heavy Deck – Condition Assessment and Options for Rehabilitation

1 Introduction

To plan for future construction and expansion, Science World would like to understand the load carrying capacity of two sections of the Expo Deck (referred to as the City Heavy Deck in this Report) as they relate to live loads and vehicle loads. Westmar Advisors Inc. (Westmar) has been retained by Science World and Bush, Bohlman & Partners LLP (BBP) to perform an engineering review of the two sections of deck, provide comment on permissible live loads at this location and provide recommendations for rehabilitation. As part of the engineering review, a condition assessment of the two sections of deck was carried out on November 29, 2019. Results from the condition assessment are presented in this memorandum.

Facility: Science World – City Heavy Deck Sections

Inspected by: Westmar Advisors Inc. - Vignesh Ramadhas, P.Eng.
Foreshore Technologies Inc. – Alex Sevensma
Foreshore Technologies Inc. – Sarah Frioult

Time: November 29, 2019 0900 hr to 1230 hrs

1.1 Scope of Work

The scope of work is as outlined in Westmar's proposal dated November 9, 2019 and summarized below:

- Review of previous condition assessments and load ratings for the area of study.
- A visual, non-destructive condition assessment above and below the deck surface. The structure will be access by boat and no diving will be completed unless there is any reason to suspect that the structures have deteriorated below water since the last underwater condition assessment.
- Preparation of a report summarizing findings from the condition assessment, including estimated remaining service life.

- Provide recommendations on rehabilitation options

1.2 Evaluation of Results

The inspection, related findings, and recommendations are based on the following:

- The scope of the inspection provided in Section 1.1.
- Published recommendations and standards relating to structures of this type have been used as a guide to develop the scope of work for this inspection.
- The inspection, findings, and recommendations are based on our engineering judgment and familiarity with the design, construction, and maintenance requirements of similar structures.
- The inspection findings and recommendations are based on Westmar's field data.
- The findings and recommendations are for the use of Science World and BBP only.
- The findings and recommendations are Westmar's assessment of the condition of the structure at the time of the inspection.
- The inspection is based on examining and reporting only on the condition of the structure. It is not intended as a check of the original design.
- As the inspection is based on visual observations, there is a possibility that hidden or latent defects have not been detected during the course of the inspection. Users of the facility should always report any unusual conditions so that they can be evaluated.
- The inspection carried out at the facility does not replace regular scheduled maintenance inspections. It is therefore essential that operating and maintenance personnel continuously monitor the dock's appearance and operation and report any unusual conditions so that they can be evaluated. Maintenance personnel should be trained to observe critical components during the routine maintenance activities.

1.3 Reference Material

The following reference material were made available prior to the inspection:

- WorleyParsons Letter. 09204 – Review of Loading on Science World Foundation Structure dated January 21, 2010.
- BBP Project No 6919 – SR01: Science World Facility Renewal Project - Entry Level Overall floor - Allowable Loads.

2 Description of the Structure

2.1 Description

The City heavy deck sections are located to the north and southeast of Science World in False Creek, Vancouver, BC. The deck sections were constructed in 1986 as temporary structures for Expo 86. The structure consists of prestressed hollow-core concrete deck panels supported on treated timber pile caps and piles along the north end of the site. At the southeast end, the concrete deck panels are supported on steel pipe piles and concrete pilecaps.

Battery limits of Westmar's condition assessment are shown schematically in Figure A.

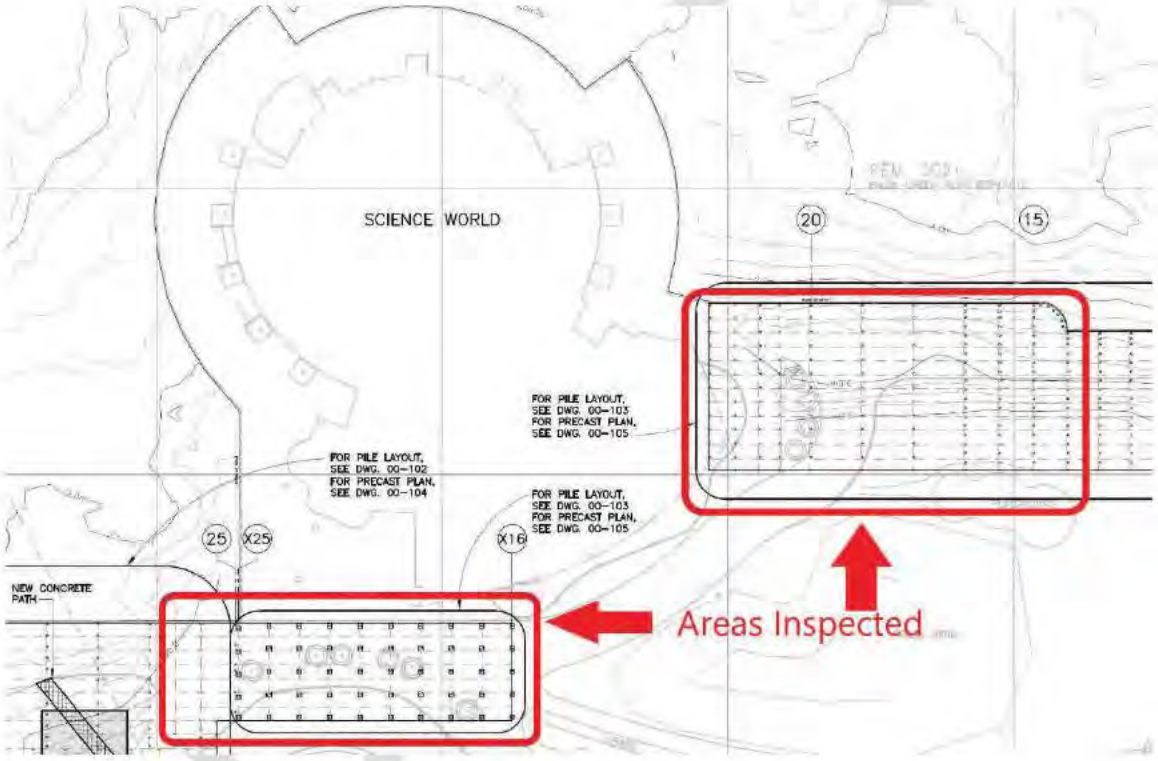


Figure A – General Arrangement of Areas Inspected during Westmar's condition assessment

2.2 Reference System

The reference system used to identify damage and/or deterioration is presented in Appendix 1.

3 Inspection Results

General observations from the inspection are presented in this section. In reviewing results of the inspection, please note the following:

- The term "serviceable condition" is used to describe a structure, or a specific element of a structure, which is considered to still function in the manner in which it was originally intended.
- The term "monitor for further deterioration" is used to describe an element with damage and/or deterioration but does not require immediate remedial action. It is anticipated that repairs will be required in the future.

Photographs are located in Appendix 2.

3.1 Piles

The piles supporting the City heavy deck are in a serviceable condition with generally minimal damage/deterioration. The section of the City heavy deck located to the north of Science World is supported on timber piling. At this location, there are localized areas with weathering damage and pile splitting.

The section of the City Heavy Deck located to the southeast of Science world is supported on steel pipe piles. At this location, there is widespread damage to the pipe coating (Photograph No. 1) with water ingress between the coating and the steel pipe (Photograph No. 2). An impressed current system has been installed to protect the steel pipe piles from corrosion (Photograph No. 3).

3.2 Pile Caps

The pile caps supporting the City heavy deck are in a serviceable condition with localized damage and/or deterioration due to improperly sized or installed drift pins and damage due to water ingress.

Specific locations with damage and/or deterioration are listed below:

- There is mechanical damage to the pile cap at Bent No. 22 at panel 2 due to the use of drift pins with length longer than the depth of pile cap (Photograph No. 4). Repair or replacement of this section of pile cap is recommended.
- There are multiple bored holes on the side face of the pile cap at Bent No. 22 (Photograph No. 5). If left unchecked, decay of timber at these locations will occur. Repair or replacement of pile cap is recommended.
- There are wet fibres on the top 25 to 50 mm of the pile cap at Bent No. 22 with a 25 mm split along the soffit (Photograph No. 6). Repair or replacement of pile cap is recommended.
- There are multiple notches to the pile cap at Bent No. 21 resulting in a reduced member cross section (Photograph No. 7). Monitoring for further deterioration is recommended.

- There is mechanical damage to the pile cap at Bent No. 22 at panel 11 due to the use of drift pins with length longer than the depth of pile cap (Photograph No. 8). Repair or replacement of this section of pile cap is recommended.
- There is water ingress, vegetation growth (Photograph No. 9) and onset of fungal decay on the Pile Cap at Bent No. 18. Monitoring for further deterioration is recommended.

3.3 Deck

There is widespread deterioration of the concrete hollow core deck slabs. Typical deterioration identified during the condition assessment includes:

- Longitudinal cracking with efflorescence and areas of delamination along the soffits of the precast panels of varying severity.
- Localized spalling resulting in reduced cross section of the deck.
- Cracking and spalling at the supports of the deck panels.

Specific inspection findings from Westmar's condition assessment are presented in Table 1.

Table 1 - Inspection Findings – Deck Panels

Bent No.	Panel No.	Description of Finding
23 to 24	1	Full length longitudinal crack and multiple spalls along the slab soffit, with one spall close to panel support (Photograph No. 10).
	1 to 2	Efflorescence between Panel Nos 1 and 2.
	3	Previous grout repairs at Southeast corner of deck panel (Photograph No. 11). Repair is effective.
	4	Previously implemented grout/patch repair is failing (Photograph No. 12). Exposed metal hanger has punched through the slab.
	5	Old timber formwork has been left in place and is failing (Photograph No. 13). Five spalls along slab soffit with dimensions 100 mm to 150 mm and up to 25 mm deep. Longitudinal cracking also present.
	6	Spalling of deck soffit with cores in deck to support utilities (Photograph No. 14)
	10 to 11	Efflorescence between Panel Nos 10 and 11.
	11	300 mm x 150 mm x 25 mm spall close to south end (Photograph No. 15)

Bent No.	Panel No.	Description of Finding
22 to 23	1	Two spalls along soffit of panel
	4	Spalling of deck soffit at South end
	5	Spalling of deck soffit at North end (Photograph No. 16)
	7	Longitudinal cracking with efflorescence
	10	Spalling of soffit with longitudinal cracking and efflorescence.
	11	Spalling of soffit with longitudinal cracking and efflorescence.
	12	Cracking with efflorescence at south end of panel.
21 to 22	1	Longitudinal cracking with efflorescence.
	5 and 6	Spalled soffit at interface between Panel Nos 5 and 6 (Photograph No. 17)
	8	Spalled soffit at South end of Panel No. 8
	9	Spalled soffit at north end of with exposed drift pin (Photograph No. 18)
20 to 21	1	Longitudinal cracking with efflorescence and spalling
	4	Multiple locations with spalling to soffit of deck and full-length longitudinal cracking with efflorescence (Photograph No. 19)
	5	New deck panel at this location (Photograph No. 20)
	7	Spalling of soffit with longitudinal cracking and efflorescence (Photograph No. 21).
	9	Spalling of soffit with longitudinal cracking and efflorescence.
	10	Spalling of Soffit
	11	Longitudinal cracking of soffit
19 to 20	2	Spalling of soffit
	5	Longitudinal cracking with efflorescence and spalling
	6	Longitudinal cracking with efflorescence
	7	Longitudinal cracking with efflorescence and spalling
	9	Longitudinal cracking with efflorescence and spalling

Bent No.	Panel No.	Description of Finding
X16 to X25	--	Most panels have longitudinal cracking with efflorescence. Spalling of concrete was observed at multiple locations. In general, the condition of the precast deck panels appeared to be better than that of the panels at the North City Heavy Deck.

4 Permissible Loads

4.1 Piles

Both the timber piles supporting the City heavy deck section located to the north of Science World and the steel pipe piles supporting the City heavy deck section to the south east of Science World are in a serviceable condition. Localized damage/deterioration such as mechanical damage, pile splitting, and coating loss and corrosion was observed. Widespread damage and/or deterioration that would compromise pile capacity was not observed. It is noted that repairs to localized areas of damage and/or deterioration that may limit transfer of loads between structural elements may be required. In general, pile deterioration is similar or has marginally increased in comparison with previous condition assessments and is not expected to reduce the permissible loads beyond values recommended by previous studies.

4.2 Pile Caps

As with the piles, there is no evidence of widespread damage or deterioration to the pile caps. Localized areas with mechanical damage from improperly sized or installed drift pins, damage due to water ingress and the onset of decay were observed. Repairs to these localized areas will be required. Provided that these repairs are implemented, it is Westmar's opinion that the pile caps have adequate capacity to support the permissible loads recommended by previous studies.

4.3 Deck

There is widespread deterioration of the concrete deck panels with longitudinal cracking of the panels, and spalling of deck soffit.

Previous studies have concluded that longitudinal cracking and delamination of the soffit does not have a significant impact on the longitudinal flexural capacity of the deck panels. The exception to this being the case where delamination has propagated through the interface between the soffit and the web resulting in loss of bond between concrete and prestressing strands resulting in significantly reduced capacity of the panel.

The deck panel's ability to support point loads is a function of its ability to distribute loads transversely to the webs. Since the panels contain no transverse reinforcement, load distribution is entirely dependent on the capacity of the un-reinforced concrete between the webs. Due to the presence of longitudinal cracks between the webs and/or delamination or spalling of concrete along the bottom flange, the strength of the section and consequently its ability to distribute point loads is greatly compromised. In its current damaged state, the bottom flange does not contribute to section capacity between the webs and load distribution is entirely through the top flange.

Based on a comparison of Westmar's current inspection findings and previous condition assessments and the extent of repairs recommended in the City of Vancouver's 2017 remediation package, there is

a marginal increase in deterioration to the deck panels. However, in calculating permissible wheel loads, previous studies have assumed no contribution from the bottom flange and as such, the observed deterioration to the deck is not expected to reduce the permissible loads beyond previously recommended values.

Permissible loads recommended by previous studies are summarized below:

Type A Panels (City Heavy Deck Southeast Side):

- Uniform Live Load: 12.0 kPa (250 psf)
- Wheel Load: 1,350 kg (3,000 lbs)
- Axle Load: 2,700 kg (6,000 lbs)

Type B Panels (City Light Deck North Side):

- Uniform Live Load: 4.8 kPa (100 psf)
- Wheel Load: 1,150 kg (2,500 lbs)
- Axle Load: 2,300 kg (5,000 lbs)

The loads noted above assume no contribution from the bottom flange but consider full contribution from the prestressing strands. Hence, these recommendations are not applicable to locations where delamination has propagated through the interface between the soffit and the web resulting in loss of bond between concrete and prestressing strands. At locations where prestressing strands have been compromised, the deck panels have significantly reduced capacity and should be replaced. Locations with compromised prestressed strands can only be determined by a Level II condition assessment of the facility and Non-Destructive Testing at suspect locations.

It is Westmar's understanding that Science World would like to use the City heavy deck for construction access during planned renovations to the facility in the coming months. It is noted that the permissible axle loads recommended by previous studies do not assume vehicle access at frequencies as high as that would be required during construction activities and therefore, use of the City heavy deck for construction access is not recommended.

5 Service Life

Service life is defined as the period of time over which a structure can safely support the design loads and serve its intended function requiring only scheduled inspection and maintenance. Significant replacement and/or rehabilitation of structure should not be required during the design service life.

The Expo deck structure was designed, detailed and constructed as a temporary facility intended to have a service life of less than 5 years. Long-term durability considerations were intentionally not addressed as the facility was not intended to be used beyond its short design service life. However, the facility has now been in service for over 30 years, with only minimal repairs and rehabilitation.

Based on the extent of deterioration to the deck panels and their inability to support the original design loads, it can be argued that the structure has reached the end of its service life. Replacement of a significant number of deck panels would be required for the structure to support the original design loads. Reducing the load limit on the deck will temporarily alleviate concerns with respect to the overall safety of the structure; however, deterioration of the deck panels is expected to continue until replacement is necessary. The point at which this will occur is difficult to predict. However, it has been Westmar's experience that deterioration becomes exponential as a structure nears the end of its service life.

6 Replacement/Rehabilitation Options

The precast concrete hollow core deck panels limit the live loads, particularly the vehicle loads, that can be applied on the City heavy deck. Repairs to longitudinal cracking and spalling of the deck soffit may be possible. However, the effectiveness of such repairs to restore bond strength between cracked sections requires further analysis, particularly since the cracks have been left exposed for a prolonged period of time. Even if it is demonstrated that the repairs can be effective, the service life of the deck cannot be prolonged by any appreciable amount.

The timber piles and pile caps are in a serviceable condition with no evidence of widespread damage. Localized deterioration due to weathering, water ingress and mechanical damage was observed, and repairs to areas which compromise pile capacity are required. Provided these repairs are completed, the substructure of the City Heavy Deck will have an expected remaining service life of no more than 10 years with continuing inspection and repairs. This is longer than the remaining service life of the concrete deck panels. It is noted that because of the continued water ingress through the deck, it is likely that the piles and pile caps will not dry out. This constantly wet condition has the potential to accelerate deterioration.

Considering the remaining duration of Science World's tenancy agreement with the City, planned construction activities at Science World and the inherent risks associated with operating on a structure that is well past its service life, it is Westmar's recommendation that Science World pursue options to replace the existing structure.

Assuming that Science World's operations can be limited to the City Heavy Deck Section to the North of Science World, one of the following replacement/rehabilitation options may be pursued:

- **Option 1 - Replacement of Deck Panels only:** This option includes replacement of only the concrete deck panels over a 30 m by 18 m plan area. As noted previously, the substructure of the City Heavy Deck continues to be in a serviceable state and provided regular inspection and maintenance repairs are implemented, the service life of the substructure could be prolonged for approximately 10 years. The existing deck panels are doweled into the pile caps and during removal, some damage to the pile caps should be anticipated. Accordingly, some allowance for replacement of damaged pile caps should be made. Any localized repairs required to the timber piles should also be undertaken when the deck panels are replaced to allow easy access during construction.
- **Option 2 – Replacement of Deck Panels and Substructure:** As an alternate to replacing the deck panels alone, replacement of the entire structure could be considered. To avoid conflict with existing piles, new piles could be installed in between existing pile bents. The existing timber piles could be used to aid with ground improvement. Since this option involves replacement of both the deck panels and the substructure, design of the structure can adopt a service life that is in line with the remaining duration of Science World's tenancy agreement.

If vehicle travel can be strictly restricted to certain sections of the City heavy deck, Option 1 or 2 can be implemented to only those areas where vehicles will traverse the deck. In such a case, barricades or other means will have to be implemented to prevent accidental vehicle travel over sections of deck that are not replaced.

Other options for replacement of the City heavy deck using retaining structures such as sheet pile walls or building a revetment is also feasible. However, these options have a larger footprint in comparison with the two proposed options and will require more involved permitting processes.

7 Recommendations and Conclusion

The Expo deck structure was designed as a temporary facility with a limited service life. The structure has now reached the end of its service life and is no longer able to support the original design loads. In 2008, it was recommended that the permissible loads on the deck be reduced to reflect the deterioration of the concrete deck panels and their reduced ability to support wheel loads from vehicles. The recommendation assumed that the prestressing strands were still uncompromised but noted the exponential nature in which deterioration could spread and affect structures towards the end of their service life.

It is now being proposed that the City heavy deck be used as access for construction vehicles during planned additions/renovations to Science World. Given the expected increase in usage of the deck during the proposed construction and the marginal increase in deterioration observed during Westmar's current condition assessment, the use of the City heavy deck for construction access is not recommended. Instead, it is recommended that Science World pursue options to replace the City heavy deck.

Two options for replacement of the City heavy deck have been proposed:

- Option 1 - Replacement of the deck panels alone.
- Option 2 - Replacement of the deck panels and substructure.

Both options can be scaled to match the footprint over which construction access is required. The service life of Option 1 will be limited to the remaining service life of the existing substructure while Option 2 can be designed to match the duration of Science World's tenancy agreement.

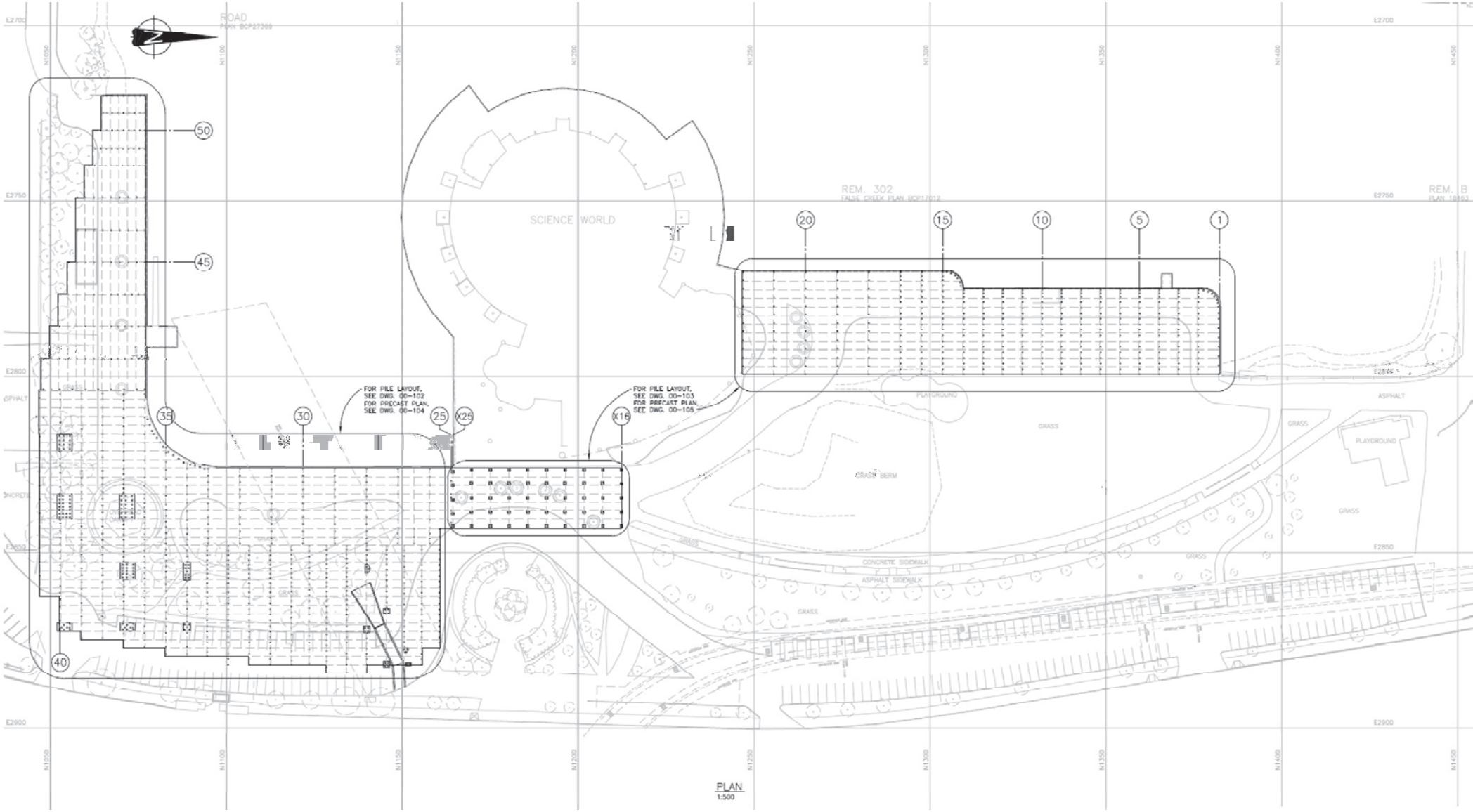
We trust the above meets your immediate needs. Please do not hesitate to contact us at 604-729-8125 or via email at vramadhas@westmaradvisors.com should you have any questions or require additional information or clarification.

Sincerely,

Vignesh Ramadhas, P.Eng.
Practice Lead - Infrastructure
Westmar Advisors Inc.

cc: Daniel Leonard, Westmar Advisors Inc.

Appendix 1 – Reference System


ROAD
PLAN BCP27369
REM. 302
FALSE CREEK PLAN BCP17612
SCIENCE WORLD
REM. B
PLAN 18863
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45
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X25
X16
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1
FOR PILE LAYOUT,
SEE DWG. 00-102
FOR PRECAST PLAN,
SEE DWG. 00-104
FOR PILE LAYOUT,
SEE DWG. 00-103
FOR PRECAST PLAN,
SEE DWG. 00-105
PLAYGROUND
GRASS
GRASS BERM
CONCRETE SIDEWALK
ASPHALT SIDEWALK
ASPHALT
E2700
E2750
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N1050
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PLAN
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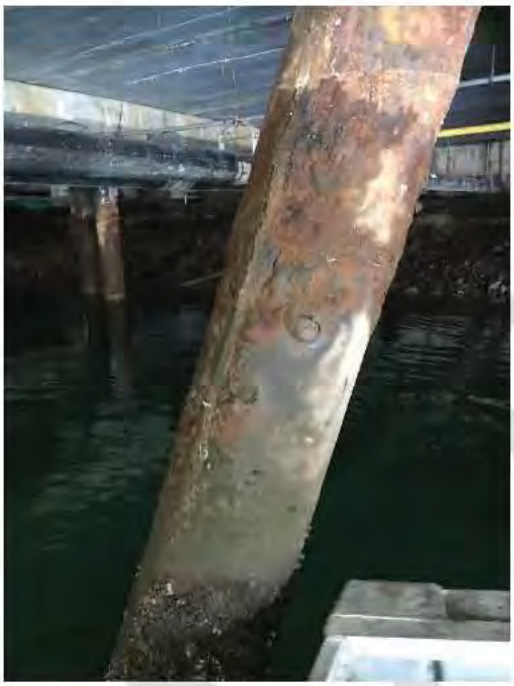
Appendix 2 – Photos

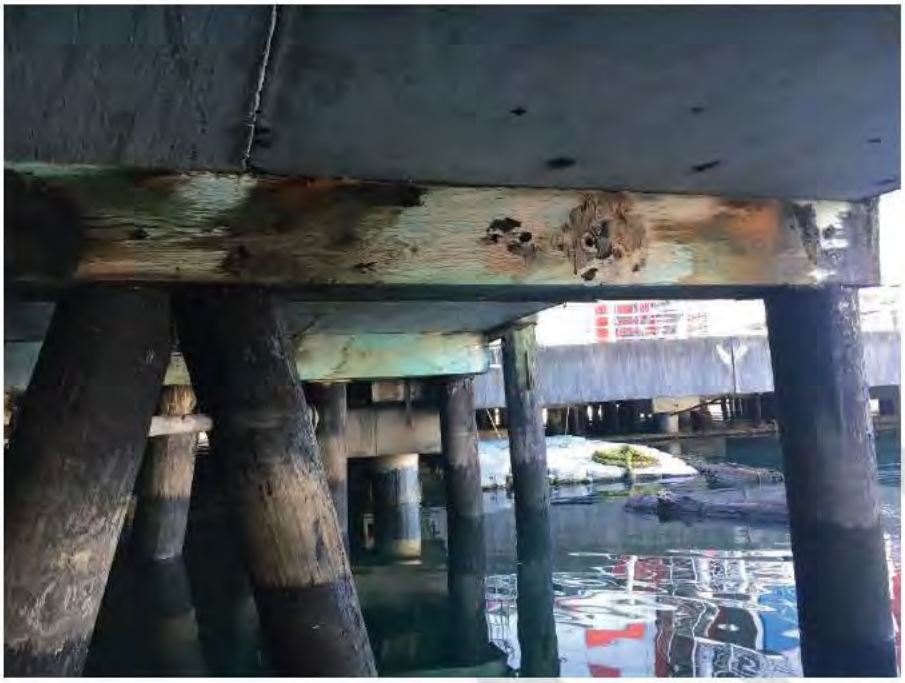


Photograph No. 1: Widespread coating failure with corrosion on steel pipe piles at the City heavy deck to the southeast of Science World

Photograph No. 2: Water ingress between pipe coating and steel pipe piles at the City heavy deck to the southeast of Science World

Photograph No. 3: Impressed current system installed on steel pipe piles at the City heavy deck to the southeast of Science World

Photograph No. 4: Mechanical damage to pile cap at Bent No. 22.



Photograph No 5: Multiple holes on side face of pile cap at Bent No. 22

Photograph No 6: Wet internal fibres with 25 mm split at soffit of pile cap at Bent No. 22

Photograph No 7: Multiple notches on pile cap at Bent No. 21

Photograph No. 8: Mechanical damage to pile cap at Bent No. 22 at location of Panel 11.

Photograph No. 9: Water ingress and vegetation growth on Pile Cap at Bent No. 18.

Photograph No. 10: Full length longitudinal crack and multiple spalls along the slab soffit at Panel No. 1 between Bent Nos 23 and 24.

Photograph No.11: Previous grout repairs to Southeast corner of Panel No. 3 between Bent Nos 23 and 24.

Photograph No.12: Previously installed repair at Southeast corner of Panel No. 4 between Bent Nos 23 and 24 failing.

Photograph No.13: Previously installed formwork failing at Panel No. 5 between Bent Nos 23 and 24.

Photograph No.14: Soffit spalling at Panel No. 6 between Bent Nos 23 and 24.

Photograph No.15: Spalling of soffit at Panel No. 11 between Bent Nos 23 and 24.

Photograph No.16: Soffit spalling at North end of Panel No. 5 between Bent Nos 22 and 23.

Photograph No.17: Spalling of deck soffit at interface of Panel Nos. 5 and 6 between Bent Nos 21 and 22.

Photograph No.18: Spalled concrete at North end with exposed drift pin at Panel No. 9 between Bent Nos 21 and 22

Photograph No.19: Spalling of deck soffit and cracking with efflorescence at Panel No. 4 between Bent Nos 20 and 21.

Photograph No.20: Panel No. 5 between Bent Nos 20 and 21 replaced.

Photograph No.21: Spalling of deck soffit and cracking with efflorescence at Panel No. 7 between Bent Nos 20 and 21.

Appendix 3
Detailed Cost Estimate

	North Section				East Section				South Section			
	Quantity	Unit	Rate	Total	Quantity	Unit	Rate	Total	Quantity	Unit	Rate	Total
Mob/Demob				***$ 420,000.00***				***$ 290,000.00***				***$ 710,000.00***
Mob/Demob	1	LS	$ 300,000.00	$ 300,000.00	1	LS	$200,000.00	$ 200,000.00	1	LS	$500,000.00	$ 500,000.00
Allowance for traffic control	120	days	$ 1,000.00	$ 120,000.00	90	days	$ 1,000.00	$ 90,000.00	210	days	$ 1,000.00	$ 210,000.00
Site Preparation of Temporary Construction Areas				***$ 201,325.00***				***$ 131,275.00***				***$ 157,737.50***
Supply and Install temporary Fencing	300	lin.m	$ 200.00	$ 60,000.00	250	lin.m	$ 200.00	$ 50,000.00	450	lin.m	$ 200.00	$ 90,000.00
Removal of softscape surfacing	700	sq.m	$ 5.00	$ 3,500.00		sq.m	$ 5.00	$ -	650	sq.m	$ 5.00	$ 3,250.00
Removal of harscape surfacing	700	sq.m	$ 10.00	$ 7,000.00	900	sq.m	$ 10.00	$ 9,000.00	50	sq.m	$ 10.00	$ 500.00
Removal of existing utilities	1	LS	$ 5,000.00	$ 5,000.00	1	LS	$ 5,000.00	$ 5,000.00	1	LS	$ 10,000.00	$ 10,000.00
Disposal of soil	210	cu.m	$ 150.00	$ 31,500.00	0	cu.m	$ 150.00	$ -	195	cu.m	$ 150.00	$ 29,250.00
Disposal of pavers	105	tonne	$ 500.00	$ 52,325.00	135	tonne	$ 500.00	$ 67,275.00	7	tonne	$ 500.00	$ 3,737.50
Supply and install 200mm thick gravel surfacing	1400	Sq.m	$ 30.00	$ 42,000.00	0	Sq.m	$ 30.00	$ -	700	Sq.m	$ 30.00	$ 21,000.00
Removal and Disposal of Topside				***$ 284,705.00***				***$ 106,275.00***				***$ 538,575.00***
Removal of hardscape surfacing	2180	sq.m	$ 10.00	$ 21,800.00	900	sq.m	$ 10.00	$ 9,000.00	3700	sq.m	$ 10.00	$ 37,000.00
Removal of softscape surfacing	1629	sq.m	$ 5.00	$ 8,145.00	0	sq.m	$ 5.00	$ -	3900	sq.m	$ 5.00	$ 19,500.00
Removal & disposal of existing utilities	1	LS	$ 10,000.00	$ 10,000.00	1	LS	$ 10,000.00	$ 10,000.00	1	LS	$ 20,000.00	$ 20,000.00
Removal and disposal of handrail	170	lin.m	$ 50.00	$ 8,500.00	0	lin.m	$ 50.00	$ -	200	lin.m	$ 50.00	$ 10,000.00
Removal and disposal of steel structures	0	LS	$ -	$ -	1	LS	$ 20,000.00	$ 20,000.00	0	LS	$ -	$ -
Disposal of soil	489	cu.m	$ 150.00	$ 73,305.00	0	cu.m	$ 150.00	$ -	1170	cu.m	$ 150.00	$ 175,500.00
Disposal of pavers	326	tonne	$ 500.00	$ 162,955.00	135	tonne	$ 500.00	$ 67,275.00	553	tonne	$ 500.00	$ 276,575.00
Removal and Disposal of Deck Structure				***$ 3,019,431.83***				***$ 736,030.28***				***$ 7,528,645.90***
Sawcut deck	1912	lin.m	$ 200.00	$ 382,444.00	432	lin.m	$ 200.00	$ 86,304.00	4628	lin.m	$ 200.00	$ 925,520.20
Remove deck panels	226	each	$ 750.00	$ 169,500.00	63	each	$ 750.00	$ 47,250.00	538	each	$ 750.00	$ 403,500.00
Remove timber pile caps	570	lin.m	$ 150.00	$ 85,473.00	0	lin.m	$ 150.00	$ -	69	lin.m	$ 150.00	$ 10,350.00
Remove concrete beams	0	lin.m	$ 300.00	$ -	144	lin.m	$ 300.00	$ 43,200.00	72	lin.m	$ 300.00	$ 21,694.50
Remove timber piles	361	each	$ 1,000.00	$ 361,000.00	0	each	$ 1,000.00	$ -	886	each	$ 1,000.00	$ 886,000.00
Remove concrete pile caps	0	each	$ 1,500.00	$ -	45	each	$ 1,500.00	$ 67,500.00	16	each	$ 1,500.00	$ 24,000.00
Remove Steel pipes	0	each	$ 1,000.00	$ -	45	each	$ 1,000.00	$ 45,000.00	0	each	$ 1,000.00	$ -
Disposal of concrete	1431	tonne	$ 1,000.00	$ 1,431,269.85	447	tonne	$ 1,000.00	$ 446,776.28	3811	tonne	$ 1,000.00	$ 3,810,696.95
Disposal of treated timber	590	tonne	$ 1,000.00	$ 589,744.98	0	tonne	$ 1,000.00	$ -	1447	tonne	$ 1,000.00	$ 1,446,884.25
Shore stabilization & Remediation				***$ 923,042.88***				***$ 354,367.73***				***$ 2,084,539.73***
1 m thick rip rap	2177	cu.m	$ 300.00	$ 653,042.88	806	cu.m	$ 300.00	$ 241,867.73	4837	cu.m	$ 300.00	$ 1,451,206.39
0.5m thick scour layer	1080	cu.m	$ 250.00	$ 270,000.00	450	cu.m	$ 250.00	$ 112,500.00	2533	cu.m	$ 250.00	$ 633,333.33
Subtotal Deconstruction Costs				**$ 4,848,504.71**				**$ 1,617,948.01**				**$ 11,019,498.13**
Surveys and Investigations				$ 100,000.00				$ 50,000.00				$ 150,000.00
Engineering (6%)				$ 290,910.28				$ 97,076.88				$ 661,169.89
Permitting and Approvals (4%)				$ 193,940.19				$ 64,717.92				$ 440,779.93
Subtotal Deconstruction and Engineering Costs				**$ 5,433,355.18**				**$ 1,829,742.81**				**$ 12,271,447.94**
Contingency (30%)				$ 1,630,006.56				$ 548,922.84				$ 3,681,434.38
Total Estimated Costs				**$ 7,063,361.74**				**$ 2,378,665.66**				**$ 15,952,882.32**