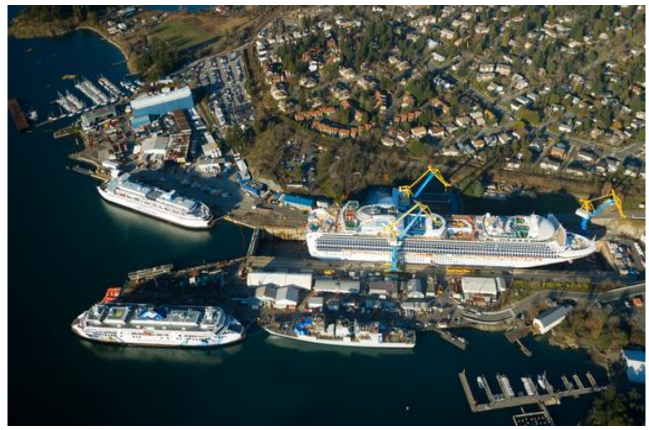
Esquimalt Graving Dock Climate Change Risk Assessment

Executive Summary



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EXECUTIVE SUMMARY

To ensure reliable and ongoing repair, maintenance and refit services, Public Service and Procurement Canada (PSPC) completed a Climate Change Risk Assessment following the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Engineering Protocol to identify infrastructure and operational vulnerabilities due to climate change and extreme weather events at Esquimalt Graving Dock.

PSPC owns and operates the Esquimalt Graving Dock (EGD) located at 825 Admirals Road in Esquimalt, British Columbia. EGD is one of only two West Coast dry docks and is the largest deep-sea ship refit and repair facility on Canada's Pacific Coast. The site and operations, including the cranes and berth facilities, can accommodate and service 92% of the world's bulk carrier ships and 100% of the world's general cargo ships. The facility also provides ship refit and repair services to a number of vessels including commercial vessels, the BC Ferry fleet, cruise ships and the federal fleet. The site is used by vessel owners such as the Royal Canadian Navy, the Canadian Coast Guard, BC Ferries, and foreign and private vessel owners.

PSPC is interested in knowing which infrastructure components may be vulnerable to climate and weather-related impacts; and to identify and prioritize risk and qualitative actions to improve resiliency and adaptability of the assets and operations to the changing climate.

Site assets that were reviewed in this project include:

1. Infrastructure: roadway, parking and laydown areas including asphalt and pavement structure, drainage systems, slope stability, dry dock walls and floors and cranes;
2. Electrical: electrical, generator and lighting systems; and
3. Mechanical: heating, cooling systems and ventilation, cranes (mechanical systems), dewatering pumps, plumbing systems, fire protection, compressed air systems, controls systems.

A detailed climate change projection report was prepared for Esquimalt Graving Dock projecting changes through the year 2070 for temperature, precipitation, wind, visibility, lightening, storms, sea level rise and extreme water levels. Cumulative climate change effects were also evaluated, such as cumulative impact of sea level rise, extreme high tides, and storm surge events (see Figure 1). The report also provided probability scores for each climate parameter to be used in the risk assessment exercise.

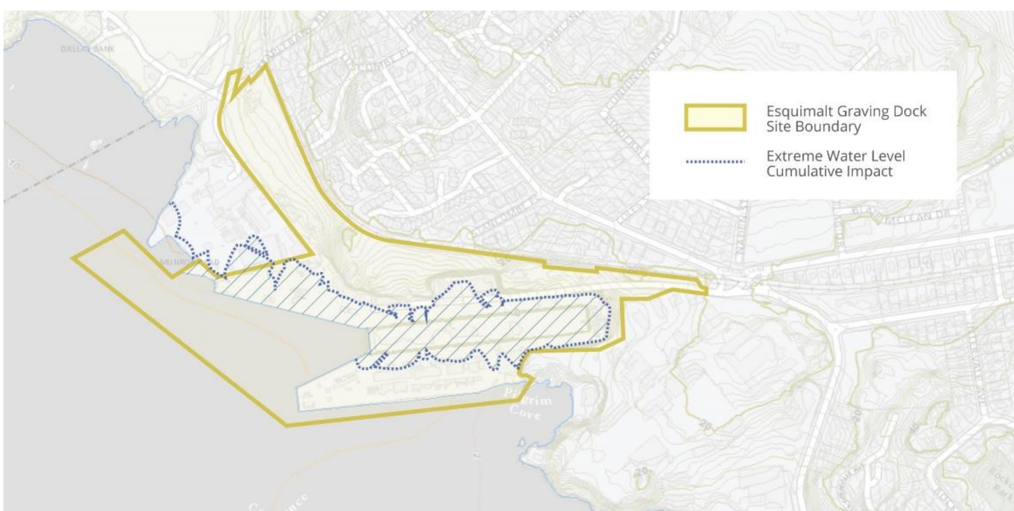

Figure 1: Potential Future Extreme Water Level Cumulative Impact at Esquimalt Graving Dock

Based on this analysis of the existing mechanical, electrical and infrastructure components and specific climate parameters, a total of 184 climate interaction pairs were identified and assigned a severity score. Risk scores were then calculated, ranging from 2 to 42, with 2 being low risk and 42 high risk. These risk scores were determined through group consensus during several Risk Assessment Workshop that were hosted virtually (due to COVID-19 pandemic) through Zoom meetings. Participants included various operational staff from the Esquimalt Graving Dock, Prism Engineering subject matter experts and PSPC, each of whom contributed unique knowledge, experiences and expertise of site systems, history and operations.

Of these interactions, 42 (23%) were defined as being low risk and require no further action. However, 123 (67%) were defined as medium risk requiring action or further engineering analysis and 19 (10%) received a high-risk score requiring action (see Figure 2).

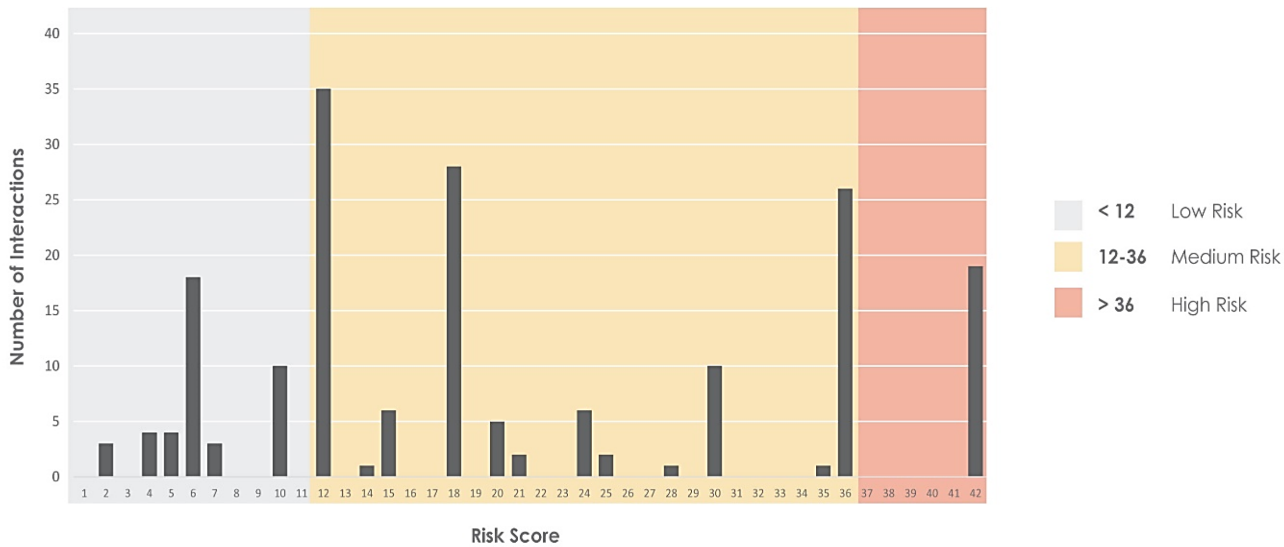

Figure 2: Risk Score Distribution Profile

Based on the data collected at various stages throughout the project and during the online workshops with operational staff, short, medium and long-term recommendations were developed for the infrastructure, electrical systems, and mechanical systems.

For the purposes of planning an implementation strategy of the recommendations that resulted from this Climate Change Risk Assessment, the following timeframes are suggested for PSPC's consideration:

- Short-Term: For immediate action or within **1 to 3 years**
- Medium-Term: Within **3 to 10 years**
- Long-Term: **10+ years**

A summary of these recommendations are presented in Table 1 below. These recommendations identify actions and potential upgrades to the systems or specific components to account for changes in climate and to address current engineering capacity and vulnerabilities.

Table 1: Short, Medium, and Long-Term Recommendations

TIMELINE	COMPONENT RECOMMENDATIONS		
	INFRASTRUCTURE	ELECTRICAL	MECHANICAL
SHORT-TERM (within 1-3 years)	Implement a monitoring program of the site drainage system, to identify potential capacity limitations related to the handling of extreme and intense precipitation events.	Replace enclosures for access card readers and security cameras which were noted as having indoor rated enclosures with NEMA 3 or greater outdoor rated enclosures to prevent equipment failure or malfunction.	Review site yard Operational Staff procedures for snow clearance surrounding critical Fire Protection access points.
		Install air conditioning in network rooms, to keep ambient temperatures below 30^{o}C	Perform an analysis on the design criteria used in the recent Pumphouse ventilation upgrades project as compared to expected future increases in outdoor air design temperatures.
		Replace all emergency lighting systems in the service tunnels with outdoor or weatherproof rated systems so that these systems are more resilient against water ingress to ensure they are operable in the event of an emergency.	
MEDIUM-TERM (3-10 years)	Conduct an assessment of Esquimalt, City of Victoria, CRD services (e.g. water main) at EGD site and consideration of future climate impact on those services' continuity.	Install housekeeping pads (raised concrete slab) for all transformers, substations, and distribution panels to improve resiliency against an increase in water levels by raising electrical equipment above the floor.	Perform an analysis on the current Substations ventilation-only cooling systems and their resiliency to upcoming expected future climate changes in outdoor air design temperatures.
		Replace all junction boxes, wire ducts, pull boxes, and any other similar electrical raceway components for the service tunnels and crane electrical feeds with watertight connections and enclosures to protect against water ingress in these areas.	Review the expected sea level and storm activity future increases as identified in this Report when designing the anticipated Service Tunnel water removal equipment (performance criteria and sizing considerations).

TIMELINE	COMPONENT RECOMMENDATIONS		
	INFRASTRUCTURE	ELECTRICAL	MECHANICAL
LONG-TERM (10+ years)	Consider designing and building additional protection options for the site to mitigate the impacts on critical or expensive infrastructure or transportation operations that are vital to the well being of an area.	Replace all enclosures and equipment for the electrical kiosks on and around the graving docks with NEMA 6 or greater rated enclosures which are suitable for occasional submersion.	
	Accommodate the impacts of sea level rise until it is no longer feasible.	In order to be able to quickly respond to any flooding or water ingress in substation buildings with critical electrical infrastructure, we recommend pumps or similar flood response systems be installed. Systems can be configured to be manually activated or automated with water sensors.	
	Consider the implications of retreating from current site long-term. This should be the last resort, as it would involve terminating the use of a facility. If retreating is exercised, replacement infrastructure could be built in a location that is less vulnerable.		