REPORT ON MAYFLY CREEK WETLANDS

WITH RESPECT TO B.C. REG. 40/2016

Regarding

HYDROLOGICAL CONDITIONS

AND

POTENTIAL CATASTROPHIC DAM FAILURE

AND

DAM OWNERSHIP

Legal Property Description:
Lot 1, Plan VIP87399, Section 26,
Township 4; 028-078-161

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1.0 Introduction

The subject property comprises 20 acres, of which about 6 acres, covering seasonally flooded wetlands and a supporting system of dams, is protected by Covenant. The dam system was probably built in the early 20th Century to create a water retention pond by excavation and terracing across a gently sloping hillside. Soil from the excavation was used in an improvised dyke-like structure on its eastern flank, with outflow directed off a spillway at its northern extremity. The structure served to retain and redirect waters of Mayfly Creek, a seasonal stream that, in nature, flowed along a poorly defined fan of random channels, discharging to the ocean some 400m to the east. The initial depth of the pond is not known, and neither is the height to which the 'dyke' was build above native ground levels. The initial purpose was the year-long retention of water to service logging and related interests episodically active in the area prior to the 1950's. There is no evidence that an impervious membrane, clay liner or other hydrological barrier was installed at the time of construction. The pond is likely to have been actively maintained into the 1940's but was abandoned when logging operations came to an end.

At the initiative of a local special interest group, and with the support of several levels of senior government, a collapsed wooden spillway located at the north end of the system was replaced in 2007 by a rock-fill dam. Water levels due to this intervention are now significantly higher than they had been in the past, and the pond fills to within a few inches of the dyke crest. This has resulted in significant localized over-flows that, in places, mix with seeping and strong springs.

The escape of water from seeps, springs and possibly by piping, suggests that the structural integrity of the retaining dams/dyke has been compromised over time, and that the combination of this, and the raised water levels due to the current height of the spillway, increases the likelihood of a catastrophic dam failure. Should this happen, a mud and debris flow, possibly in excess of 1,000,000 metric tonnes, would threaten and endanger life and property down-slope. The threatened area includes homes located to the north and east, as well as traffic on Iron River Road, and the Island Highway beyond it.

The newly enacted *BC Reg. 40/2016*, the 'Water Sustainability Act' and 'Dam Safety Regulation' (Appendix 6) imposed by it, requires that the owner of a dam meeting criteria specified under 'Part 3, Division 1', is subject to obligations and responsibilities. The writer believes that the dam located on the drainage of Mayfly Creek immediately south of Iron River Road qualifies as being of 'HIGH RISK' under schedule 1 of the said act.

Further, the owner of the land on which the subject wetlands and dam-system are mainly situated (land owner) derives no benefit from the above, has no direct interest, financial or otherwise, that would motivate its preservation, and is obligated only to 'passive' compliance (to do nothing) under well established Covenant Law.

2.0 Location, Ownership And Access

The Mayfly dam system and most of the associated wetlands are contained within a property identified as Lot 1 of part of the remaining portion of the North East 1/4 of Section 26. It is situated a few miles south of Campbell River City limits. The property, located about 150m west of the Island Highway, is accessed from Iron River Road, and is registered to Andre and Karen Audet, both of Courtenay B.C.

3.0 Current Status

3.1 Mayfly Creek, Pond And Dams

The Mayfly wetlands result from the diversion of Mayfly Creek to an artificial pondage (Figure 1), now largely filled with loose silts and organic particulate matter. The course of Mayfly Creek follows an easterly direction along a gentle easterly slope that originally extended to the shores of Oyster Bay. At a point located about 400m west of the ocean, that corresponds closely with the west boundary of the subject property, the course of natural drainage was altered and constrained by a simple run-of-the pit style earthen dam extending northward across the natural fall-line for a distance of about 400m (Figure 1). This dyke-like construction follows a constant elevation, and serves to impound the seasonal discharge of Mayfly creek. A rock spillway recently built at the northern end of this structure replaced the original wooden dam. Outflow follows a man-made northerly course across the fall-line, and across Iron River Road, to a wetland that drains to the ocean a short distance east of it.

Anecdotal reports, all verbal, suggest that the original impoundment dates to the early 20th Century where it served the needs of small-scale rail-road logging activity. No record of the dam's construction is known to exist. Figure 1 shows the impoundment area, the approximate outline of the constructed dams, and the current drainage pattern of Mayfly Creek. Figure 2 shows the impoundment system in cross-section at the location indicated in Figure 1 (section A-A`)

Dam construction will have predated regulations and codes related to water impoundment, and it is not likely that an investigation of underlying strata was ever conducted Pre-disturbance topography is likely to have followed the gentle uniform slope common to the area, and is indicated by the red line in Figure 2. The writer speculates that soils excavated from the pond were used in constructing the lateral dam since excavation at the well-site (Figure 1) reveals a random mix of sands, gravels, clays and wood debris to a depth exceeding 4 metres. In accordance with this hypothesis, a depth estimate of the original pond is implied by the balance between volumes of soils contained in the dam and the most likely original surface profile (figure 2).

It is unlikely that an impervious clay liner or other membrane will have been installed, and the period of construction predates the science of designed grain-size filtering now standard in earth-fill dams. The probable absence of design considerations in dam construction is consistent with the extensive weeping seen at various points on its flanks, and that the observed water table in winter lies at or near surface along the entire length of its apron-like buttress.

Current peak water levels result from the height of the 'modern' rock spill way, that raises those levels to the top of the lateral dam at several locations, and that results in overflowing of unconstrained streams at its north limit. Estimated discharge of individual unconstrained flows ranges between 20 and 500 gallons per minute by visual estimate (Figure 1).

The perimeter of the impoundment does not appear to have been altered or disturbed in recent decades with the exception of the spillway as noted above. This spillway completes the dam system on Mayfly Creek, and was built to satisfy an agenda initiated and supported by a consortium of Ministries and Crown agencies.

3.2 Wetlands, Historical To Present

Following its abandonment by logging interests and the deterioration of the wooden spillway, a succession of beaver dams served to retain seasonal waters. These dams trapped sediments over the intervening decades, thus filling the original pond to within two metres of the spillway elevation with

the exception of relatively small local depressions. Subsequent to that, the area, now little more than a gentle depression, grew-in with sedges, grasses and scrub to form what are currently termed 'Mayfly Wetlands". These are filled with water from early fall to late spring, but are completely drained during the months of July, August and September. Flooding begins with the start of rains, usually in mid to late October, bringing water levels to a depth of 1 to 2 meters, with local areas slightly in excess of it.

3.3 Soil Porosity, Permeability And Potential For Liquefaction

Native soils in the area are derived from glacial out-wash and consist largely of gravels and minor sands, both with a very high clay and silt content. These transmit water poorly and tend to remain fully saturated even when near a drainage ditch or in areas of significant vertical gradient. A cursory examination of soils used in constructing the lateral dam shows poor water transmissibility, and are, as a consequence, fully saturated to ground surface over much of the year. This is supported by pump tests of a domestic well (figure 1) wherein a static draw-down of 12 ft was achieved with a steady pump rate of 4gpm. Excavation in the well area uncovered randomly juxtaposed lenses of gravels, sands and clays, such as might be expected in an area filled with randomly selected materials.

Saturated gravels such as these can have a moderate-to-high liquefaction potential. (Appendixes 7; & Appendix 8 pages 1,2,3,4 and 5) As a consequence, the likelihood of shock generated liquefaction in the event of a strong seismic event can not be dismissed. In such an eventuality, there would also be potential for the simultaneous liquefaction of the underlying water-saturated native foundation soils, the disturbed material forming the lateral dam, and the semi-organic sediments impounded behind it. A catastrophically released debris flow, including contained water and all combined liquefied materials, would likely exceed 500,000 cubic metres (more than 1,000,000 metric tonnes).

3.4 General Observations Relating To Hydrological Stability

3.4.1 Lateral Dam And Sediment Infill

Water retention within the impoundment is poor, and the pond quickly dries in summer months. The rapid loss of retained waters is somewhat enigmatic since soil conductivity and permeability in both native soils and the lateral eastern dam appears to be low. However, minor springs and seeps are seen along the perimeter of impounding structure, and these likely account for most of the losses. The most prominent of these are seen along the lateral dam's north-east and southern segments. This not withstanding, the volume of inflow is sufficient to overwhelm such losses during wet months, and maintain a near-surface water table along the dam's flanks for as much as 80 to 100m down slope. The source of very strong unconstrained out-flows at the north end of the system may be in part attributed to piping, but that possibility can not be easily distinguished from surface seepage and overflow escaping beaver constructions. Maximum water depths within the impoundment are at no point greater than 2meters except for a relatively small section located directly south of the 'rock spillway'. However, the writer suspects that overall thickness of underlying saturated silt and organic matter is likely to exceed 6m over much of the excavated basin (supported by personal communications).

3.4.2 South springs, Surface Collapse And Thin Crust

The area situated immediately south of the impoundment and east of the property line, shows strong evidence of piping, thin surface crust and extensive surface collapse (Figures 9 and 12). Additionally, prior to the recent digging of a capture ditch, ground waters flowed uncontrolled from small vents and sheet-weeps along the hillside. The 'ditch' now intercepts the bulk of these waters though the water table remains very near surface even below gradient from the ditch (figure 7), which is itself greater than four feet in depth (Figures 6 and 8). This suggests an artesian-like hydraulic over-pressure that is not easily explained on the basis of what is currently known. At maximum flows experienced at the height of winter, the discharge of captured waters in the ditch exceeds 200 gpm (measured by weir, Figures 3, 5 and 6).

3.5 Dam Standards And Classification; Water Sustainability Act;

The measured difference in elevation between the crest of the dam (spillway) and its discharge at the bridge on Iron River Road is slightly greater than 5 meters (Appendix 9). The actual toe of the dam is obscured by a recent beaver construction and can not be measured directly. However, natural topographic trends suggest that the elevation of native soils on which the dam rests is likely to be near the point measured at the bridge. Alternately, any native soils on which the dam may rest should be considered as an element of the dam footing that is itself likely to liquefy under seismic shock (as was recognized in a review of conditions contributing to the Mount Polly tailing-dam collapse).

Accordingly, the writer considers that the Mayfly Creek Dam exceeds requirements for regulation under the terms of the 'Water Sustainability Act' for the following reasons:

1/ The dam is greater than 2.5m in height

2/ When filled, the impoundment contains more than 30,000 cubic meters of water and retains an addition loading of readily fluidized water saturated organic-rich silt likely to be well in excess of 100,000 cubic metres in volume.

3/ The soils comprising the lateral retaining dam and the native underlying soils, when saturated, are suspected to be readily fluidizable in event of seismic shock, and should be considered as such until shown to be otherwise.

4/ Under Schedule 1 of the Water Sustainability Act; Dam Safety Regulations (Act); The Mayfly Dam qualifies for a Classification of ***VERY HIGH RISK*** as per Paragraph 2, Table, of page page 34/37 of the 'Act'. (See Appendix 6) Specifically:

a/ Public roads and permanent residences in the threatened area, less than 100 people.

b/ Significant potential for deterioration to fish spawning habitat in lower Mayfly Creek.

c/ Two new homes and a children's play area in the threatened area. (Figures 4,10 and 11)

The writer considers that the Mayfly Dam significantly exceeds criteria for the designation of '**very high risk**' under the 'Act'.

3.6 Restrictions Under Covenant

The subject area is restricted by two covenants registered against the land parcel, namely registered instrument 'FB0144410 and FR0144412' (Appendix 5) and registered instrument 'EX026254 & EX026255' (Appendix 4). The terms of the covenants require that the 'landowner' be responsible for allowing the area to 'remain natural' and to remain 'as is'. However, the covenants either fail to recognize or are silent on the obvious fact that the protected wetlands are dependant on dams situated in the protected area, which are man-made structures designed as a 'management of nature' and that are subject to degradation and failure if not maintained. Since the Covenants makes no allowances for human intervention, and, can by long-standing Common Law, only charge the 'landowner' with 'passive' restrictions or obligations, the 'land owner' can have no obligations with respect to maintaining the area in a 'natural state' as specified in Item 6, section a, page 5 of 9, 'there should be no changes by the hand of man', (General Instrument Covenant; Registration EX026254 & EX026255; Dated March 11, 2005 in favour of the Crown). The overriding intent is expressed in 'Registered General Instrument Covenants FB0144410 and FB0144412, Dated February 8th 2008, in favour of the Comox Strathcona Regional District; which, under Section 2, Subsection 2.1, stipulates that: 'The Transferor and Transferee agree that this Agreement is intended: to forever protect, preserve, conserve, and maintain the Covenant Area in a natural state as set out in this agreement;

Since the ‘agreement’ does not define the term ‘natural state’, and since the only environmental assessment made was somewhat superficial in that it did not include ‘as-built’ parameters for the newly refurbished spillway, failed to recognize or identify that the supposedly ‘natural’ environment being protected was dependent on a man-made structure, that nothing in the ‘agreement’ identifies what was intended by the term ‘natural state’ or what is ‘set out in this agreement’ with respect to it, and that legal wording in covenants have historically been interpreted according to ‘common’ usage, the obvious ambiguities and contradictions, regarding what is intended by the terms ‘natural’ and ‘natural state’, or regarding specific responsibilities accruing to its signatories, are troubling.

The above conditions and restrictions not withstanding, FB0144410/FB0144412 accords the ‘Regional District’ certain rights under subsection 5.1, which includes the following under 5.1c:

> *to enter upon and protect, preserve, conserve, maintain, enhance, restore or rehabilitate in the Transferee’s sole discretion the Covenant Area to as near the condition described in the Report as is practicable if an act of nature or human agency other than as described in Section 5.1d, destroys, impairs, diminishes or negatively affects or alters the Covenant Area from the condition described in the Report*. (‘Report’ refers to Riparian Areas Regulation Assessment Report attached to the document)

3.7 Liabilities And Legal Issues

An adjacent property owner recently sought to resolve a problem caused by high volumes of water, discharged from the north end of the dam, that were inundating his property. He sought to have the height of the spill-way lowered in ‘hopes’ of resolving his problem by having this done His actions ranged from bullying tactics to legal threats (Appendix 11) and attempted ‘back-room’ dealings with government agencies (Appendix 3). Subsequent to that, a letter-report by the writer (Appendix 2), dated November 16, 2012, was addressed to Ms. Stacey Larsen, who at the time claimed to be some sort of agent for the DFO (unverified). Copies were sent to Margret Henigman, Ministry of Forests, Lands and Natural Resources and two other government agencies. The report identifying certain hazards and problems relating to the Wetlands and said ‘dam’, and was written in defence of the third-party initiatives and possible hidden agendas referenced in an E-mailed note received from Larsen (Appendix 3). *No response,* and no confirmation of reception, formal or otherwise, was received from any of the addressees. Further, no action was taken by the addressees on issues raised.

Liability with respect to escaping waters as implied by legal threats, and the possible liability for damages and loss of life that might result from a catastrophic dam failure, are a concern to the ‘land owner’. Though the ‘land owner’ holds that, responsibility for the dam, including, but not limited to, damages caused by escaping waters or its catastrophic failure, and all responsibilities and/or liabilities relating to statutory compliance, rests entirely with the Crown, the Crown appears reluctant to accept such responsibility. Additionally, no insurance company contacted by the ‘land owner’ is prepared to underwrite risks resulting from escaping waters.

4.0 Riparian Area Regulation Assessment Report Cynthia Hannah (Appendix 10)

A Riparian Area Regulation Assessment Report (Report) completed by Cynthia Hannah**,** dated September 2007, is attached to, and is incorporated in the registered instruments described and identified in Section 2.6 above. The document provides a detailed description of the Mayfly Wetlands area from an environmental perspective while identifying features believed to be of particular importance. In it, the author refers to the narrow rock-spillway, described in Section 3.1 above, as an ‘Artificial ‘Beaver Dam’, suggesting that the spillway is somehow a substitute for a ‘natural’ feature, thereby fostering the illusion of a ‘natural’ feature instead of the replacement for historic wooden structure needed to complete the man-made impoundment complex retaining the waters of Mayfly Creek.

The Hannah Report:

-fails to recognize that the wetlands are a consequence of retaining dams that make them possible, and are in fact 'man-made' and that the wetlands are in no respect the artefact of nature as implied by the report.

-fails to identify or address any ongoing need for maintenance and repairs as natural processes degrade impounding structures.

-fails to recognize that waters retained by the impoundment structures present a hazard to life and property in the event of a catastrophic failure.

Further, the 'Report' recognizes the saturated soil conditions without formally addressing their extent, or consequential issues related to them (paragraph 3 pages 22/35). In stating that 'any excavation on this property has the potential to divert water from existing watercourses', the author indirectly alludes to unstable hydrological conditions, and the potential for 'piping', though such conditions are NOT clearly in evidence during summer months. In paragraph 4 of page 22/35 the author describes the area as a 'sensitive hydrological system', but does not explain the expression, what it's understood to mean in context, or it's significance with respect to lands beyond the limits of the covenant, other than the terse and obtuse statement: '*there is a potential to divert water from the existing water course'*.

Ms, Hannah's narrative, given on Page 3/35, indicates that the primary objective for up-grading the dam system on Mayfly Creek stemmed from a 'stream keepers' desire to improve water retention during summer months, and thereby secure benefits for a salmon spawning area downstream. A summary of the 'Dam's' effects on habitat in the same narrative concludes that benefits realized were 'inadequate', thereby implying that the initiative had been a failure.

5.0 Dam Ownership

Dam ownership is an issue arising from the 2016 'Water Sustainability Act'; B.C. Reg. 40/2016 (Act), and responsibilities it imposes on the 'Owner'. The 'Act', under provisions stipulated in Part One; Pages 4 and 5; states that the owner of a dam might be:

- *(I) an owner, as defined in the ACT, of the land on which the dam is located*
- *(II) a person who had the dam constructed*

The 'rock spillway' that completes the dam complex on Mayfly Creek was built to accommodated an initiative by a local stream-keepers society in an attempt to improve fish habitat and salmon spawning conditions down stream (Section 4.0 above). A subsequent Covenant confers to the Crown certain benefits created by the resulting impoundment.

The 'Act' is silent on circumstance wherein a third party for whom the dam provides a benefit protected by Covenant might be considered a 'beneficial owner'. However, in the present case, given that the 'land owner' is precluded, by terms of Covenant, from making changes to the restricted area, and because under common law, a Covenantor's obligations under a negative covenant are held to be 'passive', and because benefits accruing to the Crown are the sole reason for having completed the rock spillway, and thus securing the future of the wetlands, the writer holds that the Crown assumes full responsibility for any and all non-passive action related to features protected by the Covenants, including, but not restricted to, infrastructure, supporting amenities and all responsibilities and/or liabilities such as may stem from them, without limitation, in perpetuity. Further, the Comox Strathcona Regional District (or its successor) has retained, by virtue of Priority Agreement FB0144410/FB0144412, the 'Right of Access' to 'maintain' the 'Covenant Area'; as per Section 3.6 above. Since the subject dam system is expressly an element covered and controlled by covenant, the securing of the right of access for the purpose of maintaining, is, by extension, an overt expression of ownership.

6.0 Discussion, Summary

6.1 Dam, Pond And Entrapped Sediments

Mayfly wetlands result from the diversion of Mayfly Creek from its natural course to an artificial pondage. A rock spillway, recently constructed at the northern end of this system replaced a decrepit wooden spillway that had collapsed decades earlier. This structure is described as an 'artificial beaver dam' in the Hanna Report (section 4.0 above) but is in no respect similar to a beaver dam in its construction or in its intended function other than that it serves to retain water. Outflow from the dam follows a man-made channel that traces northward across Iron River Road.

Anecdotal reports (verbal) suggest that the original impoundment could date to the turn of the 20th Century where it would have served the needs of early logging activity. Original depth and limits of excavation are not known, though one elderly resident, with whom the 'land owner' briefly spoke, recalled the pond as have been "a favourite 'swimming hole' of considerable depth". An exhaustive internet search finds no documentation giving design parameters, plans or descriptions of the impoundment, however a materials balance between volumes excavated and volumes likely contained in the lateral dam (see sectional profile, Appendix 2) suggests an excavation extending several meters below original ground surface.

It is unlikely that an impervious clay liner will have been installed in the pond and the period of construction predates designed grain-size filtering now standard in earth-fill dams. This is consistent with reports (Hanna 2008 etc.) that water levels were not sustained during summer months, that perennial seeps and springs are seen at various points along the base of the lateral dam, and with observations that, during winter months, the water table lies at or near surface along the latter and the buttressing in-fill adjacent to it, and that the water table drops quickly during seasonal dry periods.

The areal extent of pondage is estimated to exceed 40,000 square metres on the basis of ground features visible on Google Earth and a cursory examination of high-water limits with respect to them. Allowing a 1.5m average depth of retained water gives a total estimate of retained water as about 60,000 cubic metres, which is well beyond the threshold specified for a dam of its height. (page 9 of the 'Act'). Moreover, the writer considers that the undetermined volume of accumulated water-saturated sediments in retention must be considered as an additional liquefiable load, as it would likely behave in a way similar to those of the Mount Polly mine-tailings released catastrophically, and which triggered the enactment of Dam Safety Regulations addressed in this report.

Further, the potentially liquefiable and fully saturated lateral dam with its extensive buttressing, and the underlying fully saturated native soils, should be included when estimating the volume of fluidized debris that might be released in a catastrophic failure of this reservoir.

Finally, the writer believes that the large volumes of water escaping the impoundment as seeps, weeps and springs, along with surface collapse at the north and south limits of the system, are evidence of piping that demonstrates an advanced state of deterioration.

6.2 Soil Porosity, Permeability And Potential For Liquefaction

Soils in the area are derived from glacial out-wash and consist largely of gravels and minor sands, both with a very high clay/silt content. These transmit water poorly and tend to remain fully saturated even where exposed to significant vertical gradients. Locally, these soils form a relatively thin blanket overlying glacially polished limey shale that appear to carry hydraulically over-pressured waters, from depth, to the soil interface. Evidence of the later can be seen on the nearby beach at low tide, and by direct observation of a vertical drill hole on Iron River Road, which bubbles with artesian water in mid-winter. The saturation of soils used in the Mayfly Dam System, and the underlying native soils on

which they rest, results directly from waters of the Mayfly impoundment, and waters introduced along vertical fracturing from underlying strata.

The writer considers that the situation at the Mayfly Creek Dam Complex, supported by assessment of similar soils (Appendix 7, 8) presents a significant potential for the catastrophic release of a fluidized debris flow that would endanger life and property along its path

6.3 Restrictions Under The Covenants

The Mayfly wetlands and adjacent area are restricted by Covenant in favour of the Crown. In accordance with these restrictions, the 'land owner' is precluded from undertaking any initiative with respect to the subject lands other than ensuring that they remain 'natural or as is' (whatever that may be determined to mean). This can only be interpreted as an obligation to allow degradation to progress with no authority or obligation to intervene, and is consistent with 'passive' obligations conferred by a Restrictive Covenant under common law.

6.4 Dam Status Under The Water Sustainability Act

As argued above, the writer finds that Mayfly Creek Dam system qualifies as a regulated 'Dam' under the "Dam Safety Act" , qualifies for a designation of '*Very High Risk*' for the stated reasons, and is therefore subject to all regulation prescribed under regulations.

6.5 Dam Ownership

Given that, the 'land owner' is formally relieved of any right to make use of the restricted lands, is further precluded from making any physical changes to the dam system or the lands affected by them, and that the Regional District of Strathcona has contracted to, and has retained for itself, the sole right of access for purpose of maintaining the Covenant Area, the Crown, though its various agencies, jointly or severally, is the de facto beneficial owner of the Mayfly Creek Wetland, and is by default, the only reasonable candidate for "Dam owner" under the 'Act'.

6.6 Spillway Lowering Initiative

The spillway lowering initiative sponsored by Ms. Larsen (section 2.7) is not expected to relieve problems relating to high water-levels within wet-land area because past and present beaver activity retains increasingly high water levels and, as a consequence, sediments carried to it by strong seasonal flows. It must be emphasized that the Mayfly pond and dam system is not now, and never has been, a natural environment sustainable without ongoing intervention by man. For these reasons, no initiative that fails to assume the comprehensive management of this long-term, poorly understood project, will lead to a successful resolution of the hazards it presents.

7.0 Conclusions

-The Mayfly Wetlands are supported by an extensive dyke-dam complex that clearly exceeds criteria for regulation under *BC Reg. 40/2016*, the Water Sustainability 'Act'.

-There is evidence that portions of the retaining dams, and their buttressed supports are in a state of progressive failure.

-There is a reasonable possibility that the dam complex, its retained sediments and the underpinning native soils are, when fully water saturated, in danger of failure by liquefaction if subjected to a strong seismic shock.

-A catastrophic failure of the dam system and contained sediments would release a highly fluid debris flow of up to 500,000 cubic metres (+/-1,000,000 tonnes), thereby threatening life and property down-slope from the structure.

-The said ‘Wetlands’, and by extension, the dam system with its retained sediments, are protected by Covenants in which stated objectives, and restrictions, are in conflict with physical realities readily evident on examination.

-The Crown is the only involved entity permitted to make physical alterations to the Covenant area, and, retains for itself the sole right of access for the purpose of rectifying deficiencies in the dam system and the wetland made possible by it,

-The Crown, through its extensive network of government entities and subordinate agencies, has by default assumed full and complete responsible for the maintenance of the dam system, and therefore tacitly assumes full responsible for any failure of said dam, including, but not limited to, property damage, loss of life and the cost of any litigation that might be borne by the ‘landowner’ as a result of it.

-The ‘land owner’, as a *passive* player, should not be, and can not be, charged with responsibilities associated with the wetlands, the retaining dams, or consequences relating to them.

-Based on what is currently known, a lowering of the spillway, as has been proposed by Ms. Larsen, will not resolve or alleviate the concerns and issues raised herein.

-If an initiative to alter physical features within the ‘Covenant’ were to be entertained, that initiative must be proposed, sanctioned, and conducted by the covenantee, who would do so for reasons stemming from the needs and objectives of the covenantee, and who would accordingly assume complete responsibility for it’s execution, any consequences resulting there-from, be they intended or otherwise, and would explicitly agree to indemnify, hold harmless and defend the ‘land owner’ from any action resulting from it.

-The writer holds that the ***Crown is the de facto dam ‘owner’ under the ‘ACT’.***

8.0 Recommendations

1/ It is recommended that the Crown complies fully with its obligations under *BC Reg. 40/2016*, the ‘Water Sustainability Act’.

2/ It is recommended that the Crown engage a qualified geotechnical engineer to immediately investigate safety issues at the Mayfly Creek dam complex identified in this report.

9.0 Disclaimer

The writer is a professional engineer registered in British Columbia, and holds a degree in Geological Engineering granted by the University of British Columbia. Further, the writer is familiar with mine tailing ponds, and the hazards they present, as a consequence of nearly 5 decades of experience in the mining sector, and has experience in the design and construction of small water retention systems. However, the writer’s experience in this area does not meet the standard of professional expertise required by the issues at play.

Consequently, nothing in this report should be relied upon for any reason other than that of providing information and motivation pursuant to further investigation and no action should be taken based on the merits of statements or conclusions contained herein without first consulting a qualified professional.

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Glossary

Grain Size Filtering: criteria for determining the grain-size distribution (gradation) of sand and gravel filters needed to prevent internal erosion or *piping* of soil in embankments or foundations of hydraulic structures.

Hydrologic system: A system of interrelated components, including the processes of precipitation, evaporation, transpiration, *infiltration*, *groundwater flow*, stream flow, etc., and *include those structures and devices used to manage them*. Hydrologic systems can be subject to different kinds of weather patterns, be spatial complexity, and randomly dynamic.

Liquefaction: is a phenomenon in which the strength and stiffness of a soil is reduced in its most general sense, by earthquake shaking or other rapid loading. *Liquefaction* and related phenomena *have been responsible for tremendous amounts of damage* in historical earthquakes around the world.

Mount Polley: An open pit copper and gold mine where a partial breach of its tailings pond dam released 10 million cubic metres of water and 4.5 million cubic metres of slurry into Polley Lake, located in the Cariboo region of British Columbia. The breach was widely described as a disaster by the media, though there was no loss of life, and no damage of consequence resulted. The event focused public attention on the dangers posed by small to medium size dams, and prompted government to enact regulations with respect to them.

Native Soil: Naturally occurring undisturbed deposit of unconsolidated soils of any composition.

Outwash: Deposit of sand and gravel carried by running water from the melting ice of a glacier and laid down in *stratified* deposits.

Piping: Piping is defined as the progressive development of internal erosion by seepage, appearing down-gradient as a hole discharging water. Piping is induced by regressive erosion of particles from downstream and along the upstream line towards an outside environment until *a continuous pipe is formed*.

Pond liner: An impermeable geomembrane used for retention of liquids, including the lining of reservoirs, retention basins, hazardous and nonhazardous surface impoundments.

Pump Test: is a field experiment in which a well is pumped at a controlled rate and water-level response (drawdown) is measured in one or more surrounding observation wells and optionally in the pumped well (control well) itself; response data from pumping tests are used to estimate the *hydraulic properties of aquifers*, evaluate well performance and identify aquifer boundaries. *Aquifer test* and **a***quifer performance test* (APT) are alternate designations for a pumping test. In petroleum engineering, a pumping test is referred to as a **drawdown test**.

Seeping: (also sheet weep): Water percolating through porous soil, and released to surface over a broad area without major vents or springs.

Seismic Event: The word earthquake is used to describe any *seismic event*—whether natural or caused by humans

Spillway: A structure used to provide the controlled release of flows from a dam or levee into a downstream area,

Spring: Water overflowing onto the land surface as the result of an aquifer being filled to the point of saturation; from rock fissures, through highly permeable gravels, as a result of ***piping*** in soils, etc.

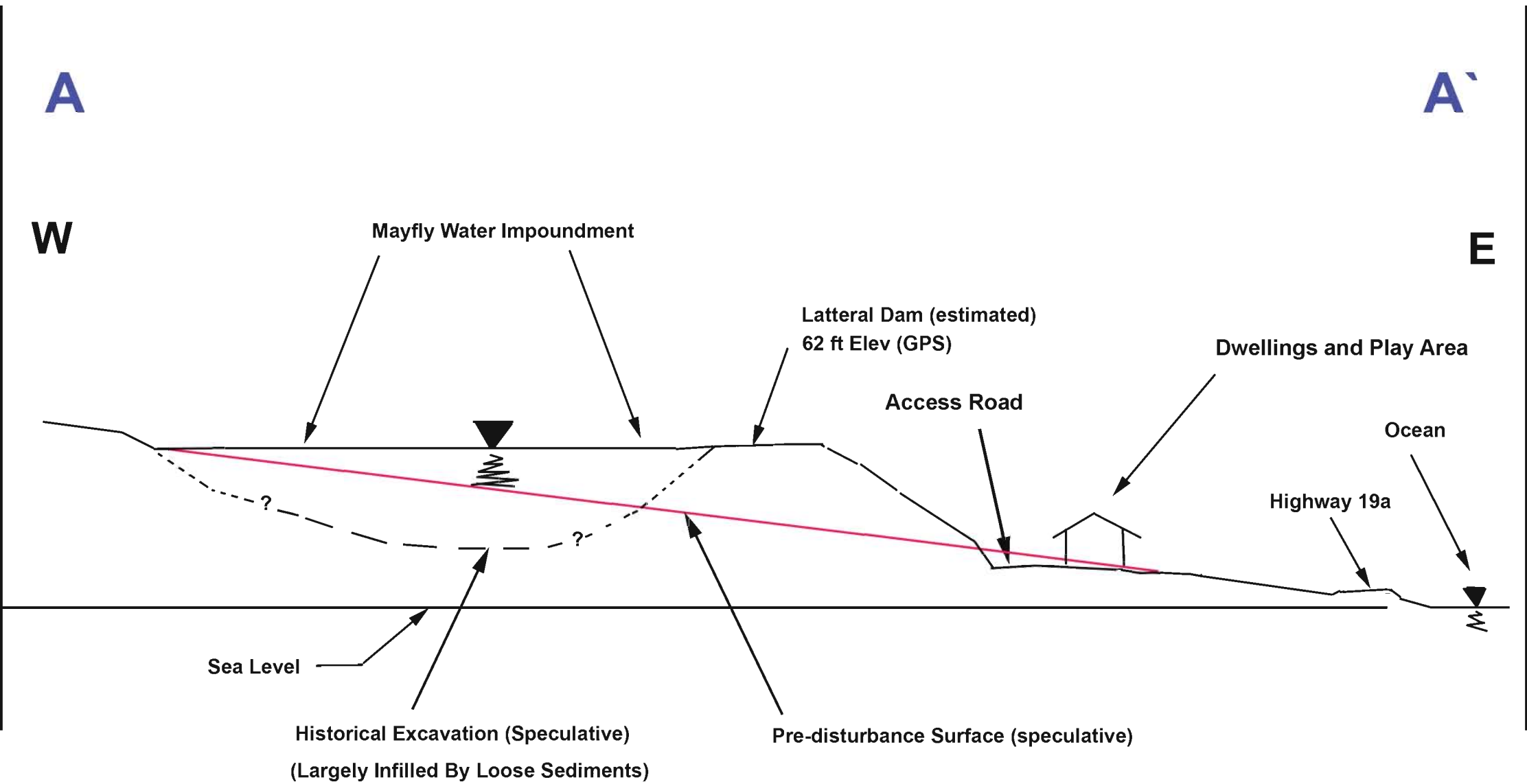
Static Draw-down: A measure of maximum well output while maintaining a constant maximum draw-down.

Streamkeeper: Generally, a lay person that takes an active interest in preserving and enhancing local waterways. Streamkeeper Programs generally respond to community concerns, typically promoted by special interest groups that rely on volunteer workers for stream enhancement projects.

Appendix 1

Figures 1 to 12


Mayfly Dam and Area
Oyster Bay, B.C.
Prepared By: A.J Audet P.Eng April 2018
Extensive Unconstrained Flows
Latteral Dam or Berm
Iron River Rd
Rock Spillway
Dwelling #1
A
Well Site
0
Children's Play Area
Thin Crust
Dwelling #2
19A
S Island Hwy
Flooded Area
(Approx)
2
Area of Thin Crust and Surface Collapse
2
A'
Point of Water Influx
Property Line (Approx)
Drainage Ditch
Google Earth
Image © 2018 DigitalGlobe
Legend
Fig 1
0 Water Table
Ditch
Lateral Dam
Flooded Reservoir
N
200 m



Mayfly Creek Lower Drainage and Area, Oyster Bay

Cross-Section Sketch Showing Relative Positions of Retention Pond, Roads and Dwellings

Note: Vertical Scale is Exagerated

April 2018 A.J. Audet P.Eng

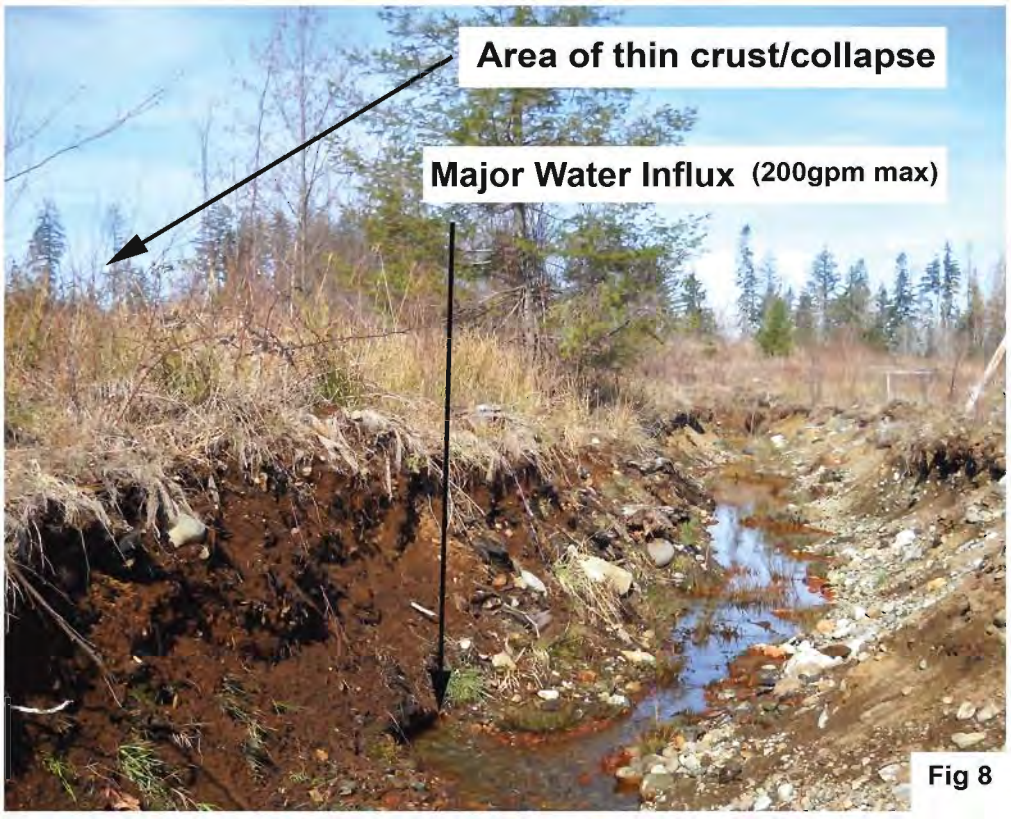
0 200m

Horizontal Scale

Figure 3 Ditch Draining Water Escaping by Piping at South End

flGURE 4; Dwelling #2 Located to the East and Below Mayfly Pondage

Hole 40m Down-Slope From Ditch, Showing Water Table (Dec 2018)



Drainage Ditch Showing Main Water Influx March 2018

Figure 5

Wier on Drainage Ditch; Top of Brown stain Marks 6.125 inches

Figue 6

Wier Discharge of 190gpm; February 8, 2019

Fig 9

Detailed View of Surface Collapse Above Zone of Piping

Family Infrastructure Below Mayfly Dam System, and Highway in Background

Fig 11

Dwelling #1; Located East and Below the Mayfly Pondage

Fig 12

Large Area of Dangerously Thin Crust; South End of Mayfly System

Appendix 2

Memo to Stacy Larsen DFO

Copy to file.

Andre J. Audet P.Eng
2580 Crystal Drive
Courtenay, BC
Canada, V9N 9K1

Email: andre@audet.ws
Tel: 1 250 338 8809

November 16, 2012

Memo To: Stacey Larsen, DFO
Cc Margret Henigman, Ministry of Forests, Lands and Natural Resource; Craig Anderson, Regional District; Mike Stalberg, BC Fish and Wildlife Branch
From: A. Audet
Subject: Mayfly Creek Issue/Modification of Covenant

Reasons for Initiative

Water, from a property owned by Andre and Karen Audet (Audet), which is escaping along a constructed corridor, is the subject of concern to an adjacent land owner, and possibly to certain unspecified special interest groups.

The contents of an email received from Stacy Larsen, consultant to the DFO and dated November 13, 2012, are attached hereto.

Historical Context and Background

Mayfly Creek, a seasonal stream draining a large undeveloped region of low, undulating terrain formed primarily by out-wash from retreating glaciation, currently follows a 'man-made' course across the NW corner of the subject holding. This stream presents on early topographic maps as terminating at Oyster Bay with a poorly defined dendritic delta, of which none of the members follow a well defined course. In the early 20th Century, logging interests established a booming ground in the sheltered waters of Oyster Bay to accommodate logging operations inland. Specialized steam locomotives used in transporting logs needed a reliable source of fresh water, which prompted operators to excavate a shallow 'mill-pond' enhanced by a small dyke on the east flank and a wood dam to the north (personal communication). Outflow was directed northward via an artificial channel, and then onto low-ground that drained to the ocean. Over time, sedimentation all but completely filled the impoundment, and though the dam eventually deteriorated, several generations of beaver have maintained dams at that and various nearby locations that continued to retain water for seven to eight months of the year. The impoundment was usually dry from late June to early November in a typical year.

In recent years, special interest groups, dedication to fish habitat enhancement, focused on the drainage system and undertook to improve spawning conditions down-stream by increasing water retention through the construction of a permanent earth-fill dam designed to maximize the height to which the artificial impoundment would allow. A diversion 'ditch' was constructed below the east bank to capture and redirect overflow expected during periods of high water and to accommodated any additional diversion caused by natural forces such as beaver activity. It appears as though Provincial and Federal Fisheries and Environmental agencies supported the initiative and may have funded the project to some degree.

Subsequently, cooperation between various ministries and the Regional District of Strathcona (Regional District) established a Covenant designed to protect the resulting wet-lands and the earth-fill dam. This Covenant is written in favour of the 'Regional District' and imposes certain conditions on the land-owner (Audet) and states in part that the dam "will remain natural or as is" and that the lands within the covenant

will remain "natural and untouched by the hand of man". It is further stipulated that Audet is charged with insuring that the above stated conditions will be respected and upheld.

As things stand, the subject lands remain as natural as the man-made supporting infrastructures permit. The diversion channel, discussed above, captures over-flow waters escaping the impoundment as foreseen and appears to function as designed.

Current Situation

The impoundment is not retaining water as long as had been hoped and consequently is not contributing to improved fish-habitat downstream during summer and early fall. Moreover, hydraulic 'piping' through ad hoc dykes built nearly 100 years ago is promoting the erosion of cavities below vegetation, which in places creates a thin-crust that collapses underfoot. The risk of serious injury is high and the overall potential for life-threatening consequences is not negligible.

If left to 'natural' processes, as conditions of the Covenant demand, Mayfly Creek will likely carve-out a new channel, diverting waters eastward from the current dam to an interception by the diversion channel and hence to an alternate channel that will cross the private lands currently being flooded. Beaver activity, which by definition is natural and fully protected under terms of the Covenant, will continue to influence water-levels within the system.

Suggested Intervention

Casual telephone discussions with Ms. Larsen have centered on intervening by either lowering or completely removing the man-made dam. While acting on either of these suggestions would lower water levels in the short term, and would redirect waters to the intended channel, neither provides a 'sustainable' natural solution since beaver are certain to reconstruct the dam as they have recently done a short distance up stream. Moreover, unless the dam were to be removed completely, piping and consequential deterioration of retaining dykes will continue. Accordingly, a proposal for removing the dam completely, or altering it somewhat, without provision for an ongoing management plan, does not present a sustainable solution going forward. Audet has not been formally consulted regarding benefits, consequences or sustainability of the proposals, which appear to be attempts at a 'band-aid' solution dealing with immediate needs without concern for longer term objectives. None of the above mentioned activities are permitted under the terms of the Covenant now in force.

An additional concern that requires consideration is that removal of the dam will negatively affect Audet. The dam provides foot access to the western end of the property (as permitted under terms of the Covenant), and that access would be lost should the dam, or parts of it, be removed.

Legal Considerations

The Covenant is a legally binding contract to which Audet is a signatory. As such, there is no provision whereby any government agency or official may grant exception and nothing short of a court order would relieve Audet of the obligations therein. While the attached email states that 'Mike Stalberg, the Fish and Wildlife Section Head, has agreed to sign-off' on the matter, that decision does not alter or abrogate any of the responsibility owed by Audet.

Further, Audet may *not* grant others the right to undertake activities that Audet is not permitted to undertake and for which Audet would risk severe financial consequences, that at a minimum would include restoration of the site to existing conditions, but which might also result in litigation and the need to defend against third-party civil action.

Ms. Larsen states that the covenant transferee is listed as the Ministry of Water land and Air Protection, but my read of the Covenant document clearly shows that conditions of it are in favour of the Regional District.

Considering that environmental issues are exceedingly sensitive, that government departments often conflict in their interpretations and application of statute, that numerous NGOs and First Nations groups have a stake in natural habitats in this region and that the matter impinges on both Provincial and Federal jurisdictions, Audet believe they are obligated to refrain from engaging in or appearing to sanction any activity that might be seen as contrary to the terms of the Covenant and will therefore aggressively oppose any initiative that does not meet conditions stipulated in it.

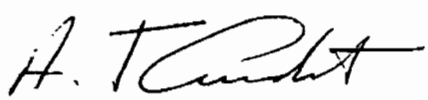
Conclusions

-The portion of Mayfly Creek crossing the Audet property, and the dam located thereon, is causing flooding problems on an adjacent property and the owners of that property seek a resolution.
-Current conditions are consistent with objectives of long-standing and established infrastructure now in place, and as such do not present an 'emergency' situation.
-Audet is bound by severely restrictive conditions of an overriding covenant that specifically forbids any alteration within the Covenant area.
-Informal discussions imply that various government agencies are in favour of either modifying or removing a dam protected by an overriding covenant.
-Access between portions of the Audet 'property' will be curtailed if the existing dam is altered or removed.
-The Covenant is drawn in favour of the Regional District, which is itself bound by the terms of it.
-Terms of a covenant may be altered only with the formal agreement of all signatories to it.
-Since the Covenant forbids all activity within its boundaries, changes in its terms are necessary if any physical change to conditions are to be effected.
-Audet has not been formally consulted with regards to the proposed intervention.
-Audet will support an initiative to alter the terms of the Covenant provide that it incorporates negotiated changes that reflect the need for long-term sustainable management, make allowances for such, and that Audet's objectives for the 'Quiet Enjoyment' of its holdings be considered and respected.
-Audet will not agree to support any costs, direct or indirect, relating to this initiative.

Recommendations

It is recommended that parties desiring a change in conditions in the Mayfly drainage system should petition the Regional District to re-open negotiations on the terms of the Covenant, since it is to the Regional District that obligations depend.

Andre J. Audet P.Eng



November 14, 2012

Appendix 3

E-mail From Stacy Larsen to Audet

Hello Andre,

Good to talk with you just now.

Here is the information that is the background to the recommended actions for the excess water flooding situation on Mayfly Creek.

The issue was brought to my attention by a landowner in the area with a different plan of action (trenching and installing a pipe to drain the overflow from the trench out of the wetland on your property).

A different solution was recommended once the full scope of the water runoff and beaver dam on the weir was observed, and after talking with the Oyster Bay Streamkeepers. The DFO (Fisheries & Oceans Canada), the stream keeper group & the provincial government (Ministry of Forests, Lands & Natural Resource Operations & Ministry of Transportation) agreed that this was the best course of action.

This plan was reviewed and discussed with Maggie Henigman, MA, CCEP (Ecosystems Biologist of Ministry of Forests, Lands and Natural Resource Operations) who is the Habitat Officer that reviewed the Section 9 submitted by the property owner whose land is being flooded. Maggie & I have discussed the matter and have agreed on a plan of action which will lower the level of the beaver dam significantly which will then lower the level of water in the wetland which will in turn both reduce or end the flooding to the other property owners land and also keep the water in Mayfly Creek itself.

After discussing the plan with you I then talked to Maggie about the convenant. I found out that the covenant transferee is listed as the Ministry of Water land and Air Protection, which is basically FLNRO (Ministry of Forests, Lands and Natural Resource Operations) now. We have Mike Stalberg, the Fish and Wildlife Section Head agreeing to sign off permission to have the dam lowered. I can also talk to the Strathcona Regional District and have their cooperation more than likely.

Let me know if you would like further information at this time about the background or proposed plan.

Thank you,
Stacey

Stacey Larsen, Dip.T., B.Sc.F, RPF
Acting Community Advisor
Fisheries and Oceans Canada
150-1260 Shoppers Row, Campbell River, BC V9W-2C8
off: 250-286-5823
cell: 250-204-0083

Appendix 4

General Instrument Covenant; Registration EX026254 & EX026255; Dated March 11, 2005 in favour of the Crown

11 MAR 2005 13 08 EX026254

wetlands (Covenant)

LAND TITLE ACT
Form 11(a) (Section 99(1)(e), (j) and (k)

$4½
1P

APPLICATION FOR DEPOSIT OF REFERENCE OR EXPLANATORY PLAN(CHARGE)

I, Kerry A Polmer Registry Co. Ltd agent for Richard D. Wright BCLS 552 Trunk Road, Duncan, BC V9L 2R1
(full name, address, and occupation)
owner of a registered charge,
(or agent of Oyster Bay Investments Ltd (inc No BC 681619) 8811 4th St. Richmond BC. V8Y 3B4
(full name, address and occupation)
the owner of a registered charge) apply to deposit reference/explanatory plan of covenant over part of the NW¼ of Section 26; Part of NE¼ of Section 26 except part in plans VIP 68872; Part of SE¼ of Section 26; Part of SW¼ of Section 26, all within Township 4, Comox District, Plan 552C

I enclose:
1. The reference/explanatory plan.
2. The reproductions of the plan required by section 67(s) (see below).
3. Fees of $ 34.00

02 05/03/11 13:09:33 02 VI 622324
PLANS $34.00

DATED this 11th day of March, 2005

VIP78497

SIGNATURE via: Kerry A. Polmer Registry Co. Ltd. 10108

NOTE: (i) Under section 67(s) the following reproductions of the plan must accompany this application:
(a) one blue linen original (alternatively white linen or original transparencies)
(b) one duplicate transparency.
(c) one whiteprint is required as a worksheet for the land title office.

(ii) The following further requirements may be necessary:
(a) If the parent property is in an Agricultural Land Reserve, a release is required unless the parent property is less than 2.0 acres (app. .8094 hectares) or where, for permitted uses, an approving officer has signed the plan under section 3(1)(a) and (b) of the Subdivision and Land Use Regulation (B.C. Reg. 7/81) under the *Agricultural Land Commission Act*.
(b) Where a notice respecting a grant under the *Home Purchase Assistance Act* is endorsed on title, an extra white print must accompany the application, unless the *Ministry of Lands, Parks and Housing* agrees otherwise in writing. This extra print must contain the following endorsement:

"The eligible residence as defined by the *Home Purchase Assistance Act* is located on lot *[number]* created by this plan.

B.C.L.S. or solicitor for the owner"

(c) Controlled access approval must be evident on the plan where parent property adjoins a highway that is designated as a controlled access highway.
(d) Where the plan refers to a restrictive covenant to be made under section 219, the instrument containing the covenant must be tendered with the plan.

EX026255 11 MAR 2005 13 09 EX026254

2/6

2C

LAND TITLE ACT
FORM C
(Section 233)
Province of British Columbia
GENERAL INSTRUMENT - PART 1

Reference No.: 011052-60conser2.cov.doc
1. APPLICATION:
Richard D. Wright, BCLS, CLS, Notary Public
552 Trunk Road, Duncan, BC V9L 2R1
Phone 748-5883

via: Kerry A. Pollner
Registry Co. Ltd. 10108

Signature of applicant's agent

2. PARCEL IDENTIFIER(S) AND LEGAL DESCRIPTION OF LANDS:

008-865-043	THE NORTH WEST ¼ OF SECTION 26, TOWNSHIP 4, COMOX DISTRICT, PLAN 552C
008-866-371	THE NORTH EAST ¼ OF SECTION 26, TOWNSHIP 4, COMOX DISTRICT, PLAN 552C, EXCEPT PART IN PLAN VIP68872
008-866-273	THE SOUTH EAST ¼ OF SECTION 26, TOWNSHIP 4, COMOX DISTRICT, PLAN 552C
008-866-079	THE SOUTH WEST ¼ OF SECTION 26, TOWNSHIP 4, COMOX DISTRICT, PLAN 552C

3. NATURE OF INTEREST:*

Description	Document Reference	Person Entitled to Interest
COVENANT Over Part in Plan VIP 78497	ENTIRE DOCUMENT	TRANSFEREES
PRIORITY AGREEMENT Granting Covenant No. EX026254 priority over Mortgage Nos. EW81133, EV154497, and EX19142	pages 5 and 6 paragraphs 21 and 22	

02 05/03/11 13:10:11 02 VI CHARGE 672324 $129.50

4. TERMS: Part 2 of this instrument consists of (select one only)
(a) Filed Standard Charge Terms ___ D.F. No.
(b) Express Charge Terms X Annexed as Part 2
(c) Release ___ There is no Part 2 of this instrument
A selection of (a) includes any additional or modified terms referred to in Item 7 or in a schedule annexed to this instrument. If (c) is selected, the charge described in Item 3 is released or discharged as a charge on the land described in Item 2.

5. TRANSFERORS:
OYSTER BAY INVESTMENTS LTD., INC. NO. 681619 (covenant)
WEYERHAEUSER COMPANY LIMITED, INC. NO. A-51955 (priority)
~~**KOKANEE MORTGAGE MIC LTD., INC. NO. 280349 (priority)**~~
THE CANADA TRUST COMPANY (priority)

6. TRANSFEREES:
HER MAJESTY THE QUEEN, in the Right of the Province of British Columbia, as represented by the **MINISTRY OF WATER, LAND AND AIR PROTECTION**, having its offices at 2080-A Labieux Road, Nanaimo, BC V9T 6J9

7. ADDITIONAL OR MODIFIED TERMS:
N/A

5. EXECUTIONS: This instrument creates, assigns, modifies, enlarges, discharges or governs the priority of the interest(s) described in Item 3 and the Transferor(s) and every other signatory agree to be bound by this instrument, and acknowledge(s) receipt of a true copy of the filed standard charge terms, if any.

OFFICER SIGNATURES	EXECUTION DATE	PARTIES SIGNATURES
As to signature BRIAN R PURCELL BARRISTER & SOLICITOR SUITE 500 NORTH TOWER 5811 COONEY ROAD RICHMOND, B.C. V6X 3M1 TELEPHONE 604-276-2765	2005 / 03 / 08	OYSTER BAY INVESTMENTS LTD., INC. NO. 601619 by its authorized signatory: Mike Riesterer As Transferors and Transferees

OFFICER CERTIFICATION:
Your signature constitutes a representation that you are a solicitor, notary public or other person authorized by the Evidence Act, R.S.B.C. 1979, c.116, to take affidavits for use in British Columbia and certifies the matters set out in Part 5 of the Land Title Act as they pertain to the execution of this instrument.

OFFICER SIGNATURES	EXECUTION DATE	PARTIES SIGNATURES
As to both signatures SEAN ESTABROOK NOTARY PUBLIC 77 BLOOR ST TORONTO ON M4Y 2T1	2005/ 04 / 26	THE CANADA TRUST COMPANY by its authorized signatories: Print Name: Shawna Venturin Print Name: Rhonna Gaagle As Priority

OFFICER CERTIFICATION:
Your signature constitutes a representation that you are a solicitor, notary public or other person authorized by the Evidence Act, R.S.B.C. 1979, c.116, to take affidavits for use in British Columbia and certifies the matters set out in Part 5 of the Land Title Act as they pertain to the execution of this instrument.

LAND TITLE ACT

FORM D

EXECUTIONS CONTINUED

OFFICER SIGNATURES	**EXECUTION DATE** Y	M	D	**WEYERHAEUSER COMPANY LIMITED INC. NO. A-51935** by its authorized signatory(ies):
Anne Giardini Barrister & Solicitor Weyerhaeuser Company Limited 925 West Georgia Street Vancouver, BC, V6C 3L2	2005	03	09	Print Name: Alex A. Shorten Print Name: As Priority Paul Perkins

(as to both signatures)

OFFICER CERTIFICATION: Your signature constitutes a representation that you are a solicitor, notary public or other person authorized by the *Evidence Act*, R.S.B.C. 1996, c. 124, to take affidavits for use in British Columbia and certifies the matters set out in Part 5 of the *Land Title Act* as they pertain to the execution of this instrument.

LAND TITLE ACT

FORM D

EXECUTIONS CONTINUED

OFFICER SIGNATURES	EXECUTION DATE Y	M	D	KOKANEE MORTGAGE MIC LTD. INC. NO. 260348 by its authorized signatory(ies):
DONALD T. KNAPP BARRISTER & SOLICITOR 246 - 2ND AVENUE KAMLOOPS, BC V2C 2C8 Phone (250) 372-5542	2005	07	04	Print Name: Mark Ross Print Name: As Priority

(as to both signatures)

OFFICER CERTIFICATION: Your signature constitutes a representation that you are a solicitor, notary public or other person authorized by the *Evidence Act*, R.S.B.C. 1996, c. 124, to take affidavits for use in British Columbia and certifies the matters set out in Part 5 of the *Land Title Act* as they pertain to the execution of this instrument.

TERMS OF INSTRUMENT - PART 2
COVENANT

WHEREAS:

1. The "**Transferors**" mean the Transferors as set out in Item 5 on Page 1 (Form C) of the attached General Instrument - Part 1.

2. The "**Transferees**" mean the Transferees as set out in Item 6 on Page 1 (Form C) of the attached General Instrument - Part 1.

3. The "**Lands**" mean the Lands as set out in Item 2 on Page 1 (Form C) of the attached General Instrument - Part 1.

4. The Transferees have requested that the Transferors enter into a covenant over the Lands, pursuant to Section 219 of the *Land Title Act*, in the terms hereinafter set forth.

5. Section 219 of the *Land Title Act* provides that there may be annexed to any land a condition or covenant that the land, or any specified portion thereof, is not to be built upon or is not to be used in a particular manner.

6. **WITNESS THAT**, in consideration of the sum of One Dollar ($1.00) and other valuable consideration now paid by the Transferees to the Transferors (the receipt and sufficiency whereof is hereby acknowledged), the Transferors hereby agree to grant a covenant over part of the Lands, pursuant to Section 219 of the *Land Title Act*, to the Transferees on the following terms:

   (a) Hereafter, no building shall be constructed or mobile home located, nor shall there be any removal of vegetation or other changes by the hand of man made, within the area designated as "Covenant" (hereinafter referred to as the "Covenant Area") on a Reference Plan for Covenant Purposes Over Part of the North West 1/4 of Section 26; Part of North East 1/4 of Section 26, Except Part in Plan VIP68872; Part of South East 1/4 of Section 26; Part of South West 1/4 of Section 26, all Within Township 4, Comox District, Plan 552C, prepared by Robert David Tupper, British Columbia Land Surveyor, completed and certified correct on the 22nd day of March, 2001, a copy of which is attached hereto and registered in the Victoria Land Title Office under number VIP 68497, without the prior written permission of the Regional Manager of Ministry of Water, Land and Air Protection, Fish, Wildlife, and Habitat Protection Branch.

/// Permissions

Transferor = landowner

Trails

7. Notwithstanding the restrictions imposed in Paragraph 6 (a), nothing herein contained shall prohibit or restrict the construction and maintenance of interpretive trails, including signage relevant thereto, within the Covenant Area.

indemnification

8. The Transferors will indemnify and save harmless the Transferees and their servants and agents against all losses, damages, costs, and expenses, including fees of solicitors and other professional advisors, arising out of any breach, violation, or non-performance of any term, condition, covenant, or other provision of this Covenant.

9. No term, condition, covenant, or other provision of this Covenant will be considered to have been waived by the Transferees unless the waiver is expressed in writing by the Transferees.

10. Any waiver by the Transferees of any term, condition, covenant, or other provision of this Covenant or any waiver by the Transferees of any breach, violation, or non-performance of any term, condition, covenant, or other provision of this Covenant does not constitute and will not be construed as a waiver of any further or other term, condition, covenant, or other provision of this Covenant or any further or other breach, violation, or non-performance of any term, condition, covenant, or other provision of this Covenant.

Binding on all Parties

11. The terms, conditions, covenants, and other provisions of this Covenant will extend to, be binding upon, and enure to the benefit of the parties to this Covenant and their respective successors and assigns.

12. In this Covenant, unless the context otherwise requires, the singular includes the plural and vice versa.

13. This Covenant will be interpreted according to the laws of the Province of British Columbia.

14. Where there is a reference to an enactment in this Covenant, the reference will include any subsequent enactment of the Province of British Columbia of like effect and all enactments referred to are enactments of the Province of British Columbia.

15. If any part of this Covenant is found to be illegal or unenforceable, that part will be considered separate and severable and the remaining parts will not be affected thereby and will be enforceable to the fullest extent permitted by law.

16. All obligations on and benefits accruing to the persons comprised in the Transferees or the Transferors apply only in respect of such benefits or obligations which arise during the period in which any such person is registered as owner of any portion of the Lands.

17. This Covenant runs with the Land and will be registered as a charge against the title to the Land under Section 219 of the *Land Title Act*.

18. Nothing contained or implied in this Covenant shall impair, limit, prejudice, or affect the Transferees' rights and powers in the exercise of their functions pursuant to any public or private statutes or any other enactment including the Transferees' bylaws, orders, policies, and regulations and all such powers and rights may be fully and effectively exercised in relation to the Lands as if this Covenant had not been executed and delivered by the Transferors.

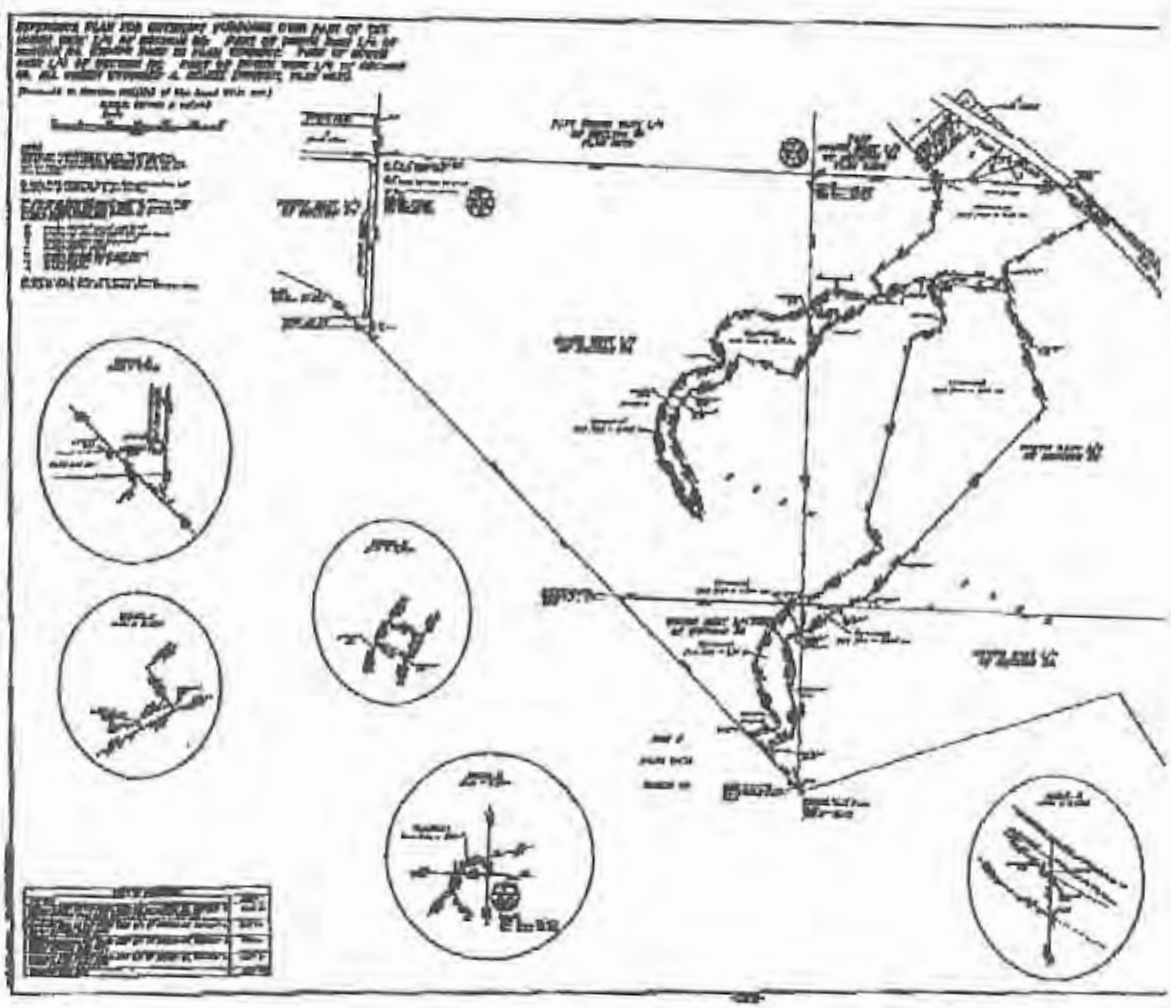
19. The Transferors will do or cause to be done all things and execute or cause to be executed all documents and give such further and other assurances which may be reasonably necessary to give proper effect to the intent of this Covenant.

20. This Covenant will not be modified or discharged except in accordance with the provisions of Section 219(9) of the *Land Title Act*.

21. Pursuant to Section 207 of the Land Title Act, and in consideration of the sum of One Dollar ($1.00) of lawful money of Canada (the receipt and sufficiency of which is hereby acknowledged), **WEYERHAEUSER COMPANY LIMITED, INC. NO. A51955** hereby grants this covenant priority to the mortgage registered in its favour in the Victoria Land Title Office under number **EW61133.**

22. Pursuant to Section 207 of the Land Title Act, and in consideration of the sum of One Dollar ($1.00) of lawful money of Canada (the receipt and sufficiency of which is hereby acknowledged), **KOKANEE MORTGAGE MIC LTD., INC. NO. 260348** hereby grants this covenant priority to the mortgage registered in its favour in the Victoria Land Title Office under number **EV154497.**

PAGE 7 OF 7 PAGES



Appendix 5

Registered General Instrument Covenants FB0144410 and FB0144412, Dated February 8th 2008, in favour of the Comox Strathcona Regional District

LAND TITLE ACT FB0144412 -8 FEB 2008 12 08 FB0144410
FORM C
(Section 233)
Province of British Columbia
GENERAL INSTRUMENT - PART 1 **PAGE 1 OF 43 PAGES**

Reference No.: 1036.RARcov.srw.doc
1. APPLICATION:
Richard D. Wright, BCLS, CLS, Notary Public
2211 Quamichan Park Road, Duncan, BC V9L 3B5
Phone 748 5823

via: Kerry A. Pollner
Registry Co Ltd 10108

Signature of applicant's agent

2. PARCEL IDENTIFIER(S) AND LEGAL DESCRIPTION OF LANDS:

008-966-371 **THE NORTHEAST ¼ OF SECTION 26, TOWNSHIP 4, COMOX DISTRICT, PLAN 552C, EXCEPT PART IN PLAN VIP68872 AND VIP79067 AND EXCEPT PART IN PLAN VIP** 84506

3. NATURE OF INTEREST:

Description	Document Reference	Person Entitled to Interest
COVENANT, SECTION 219 and STATUTORY RIGHT-OF-WAY, SECTION 218	**ENTIRE DOCUMENT**	**TRANSFEREE**
PRIORITY AGREEMENT Granting Covenant No. FB 144410 **Priority over Mortgage No. EX161963, CA577133, and FB101890**	Page 8	

GA CHARGE 08/02/08 12:09:17 01 V1 792148 $196.95

4. TERMS: Part 2 of this instrument consists of (select one only)

(a)	Filed Standard Charge Terms	___	D.F. No.
(b)	Express Charge Terms	X	Annexed as Part 2
(c)	Release	___	There is no Part 2 of this instrument

A selection of (a) includes any additional or modified terms referred to in item 7 or in a schedule annexed to this instrument. If (c) is selected, the charge described in item 3 is released or discharged as a charge on the land described in Item 2.

5. TRANSFEROR:
OYSTER BAY INVESTMENTS LTD., INC. NO. 681619 (Covenant and Statutory Right of Way)
KOKANEE MORTGAGE MIC LTD., INC. NO. 260348 (Priority)
WINSLOW DEVELOPMENTS LTD., INC. NO. 0296178 (Priority)

6. TRANSFEREE:
COMOX STRATHCONA REGIONAL DISTRICT,
600 Comox Road, Courtenay, B.C., V9N 3P6

7. ADDITIONAL OR MODIFIED TERMS:
N/A

1/3 includes 144410 to 144412 See book

8. EXECUTIONS: The instrument creates, assigns, modifies, enlarges, discharges or governs the priority of the interest(s) described in Item 3 and the Transferor(s) and every other signatory agree to be bound by this instrument, and acknowledge(s) receipt of a true copy of the filed standard charge terms, if any.

OFFICER SIGNATURES	EXECUTION DATE	PARTY(IES) SIGNATURE(S)
As to signature(s): RICHARD D. WRIGHT, BCLS, CLS NOTARY PUBLIC 2211 QUAMICHAN PARK ROAD DUNCAN BC V9L 5E9	2007/ 11 / 13	OYSTER BAY INVESTMENTS LTD., INC. NO. 681619 by its authorized signatory: Mike Riesterer, As Transferor
As to ~~both signatures~~ LEAH C. CARD Barrister & Solicitor FULTON & COMPANY LLP #300 - 350 LANSDOWNE STREET KAMLOOPS, BC V2C 1Y1	2007/ 11 / 16	KOKANEE MORTGAGE MIC LTD., INC. NO. 260348, by its authorized signatory(ies): Print Name:
As to both signatures BRIAN R PURCELL BARRISTER & SOLICITOR SUITE 500 NORTH TOWER 5811 COONEY ROAD RICHMOND, B.C. V6X 3M1 TELEPHONE 604-276-2765	2007/ 11 / 15	Print Name: As to Priority only WINSLOW DEVELOPMENTS LTD., INC. NO. 0296178, by its authorized signatory(ies): Print Name: GLENN BRANDT
As to both signatures	2007/ / /	Print Name: As to Priority only COMOX STRATHCONA REGIONAL DISTRICT by its authorized signatory(ies): Print Name:
		Print Name: As Transferee

OFFICER CERTIFICATION:

Your signature constitutes a representation that you are a solicitor, notary public or other person authorized by the Evidence Act, R.S.B.C. 1996, c.124, to take affidavits for use in British Columbia and certifies the matters set out in Part 5 of the Land Title Act as they pertain to the execution of this instrument.

TERMS OF INSTRUMENT - PART 2

WHEREAS:

A. The **"Transferor"** means the Transferor as set out in Item 5 on Page 1 (Form C) of the attached General Instrument - Part 1

B. The **"Transferee"** means the Transferee as set out in Item 6 on Page 1 (Form C) of the attached General Instrument - Part 1

C. The **"Land"** means the Land as set out in Item 2 on Page 1 (Form C) of the attached General Instrument - Part 1

D. The Land contains amenities of great importance to the Transferor, the Transferee, and the public. In particular, protection of the aquatic habitat adjacent to Mayfly Creek and identified water courses on the Land provides summer and winter habitat for fish (water quality and quantity are important) and the adjacent storage areas for the dry season.

E. A statutory right of way pursuant to Section 218 of the *Land Title Act* in favour of the Transferee is necessary for the operation and maintenance of the undertakings of the Transferee.

F. Section 219 of the *Land Title Act* provides, among other things, that a covenant, whether of a negative or positive nature, in respect of the use of land, or subdivision of land, or the use of buildings on, or to be erected on, land or to protect, preserve, conserve, maintain, enhance the Land or a specified amenity in relation to the Land may be registered as a charge against the title to the Land.

NOW THEREFORE this Agreement witnesses that pursuant to Sections 218 and 219 of the *Land Title Act* and in consideration of the premises and the covenants contained in this Agreement and for the sum of One Dollar ($1.00) now paid by the Transferee to the Transferor, the receipt and sufficiency of which is hereby acknowledged by the parties, the parties hereto covenant and agree with the other as follows:

1.0 Definitions

1.0 Definitions

1.1) **"HWM"** means the visible high water mark of a stream where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the stream a character distinct from that of its banks, in vegetation, as well as in the nature of the soil itself, and includes the active floodplain;

1.2) **"SPEA"** means the streamside protection and enhancement area:
   a) adjacent to a stream that links aquatic to terrestrial ecosystems and includes both existing and potential riparian vegetation and existing and potential adjacent upland vegetation that exerts an influence on the stream, and
   b) the size of which is determined according to this regulation on the basis of the assessment report as defined below provided by a qualified environmental professional in respect of a development proposal;

1.3) **"LWD"** means large wood debris.

1.4) **"Report"** means the Riparian Areas Regulation Assessment Report attached hereto.

1.5) **"Covenant Area"** means the SPEA as identified in the Report.

2.0 Intentions

2.1) The Transferor and Transferee agree that this Agreement is intended
   a) to forever protect, preserve, and maintain the Covenant Area in a natural state as set out in this Agreement, and
   b) to prevent any occupation or use of the Covenant Area that will significantly impair or interfere with the natural state of the Covenant Area.

2.2) The parties agree that this Agreement is to be interpreted, performed, and applied in accordance with the intention of the Agreement as set out in Section 2.1.

2.3) This Agreement shall be perpetual to reflect the public interest in the protection, preservation, conservation, and maintenance of the natural state of the Covenant Area for ecological and environmental reasons.

3.0 Use and Preservation of the Covenant Area

3.1) The Transferor covenants and agrees to protect, preserve, conserve, maintain and keep the Covenant Area in its natural or existing state.

3.2) Without limiting the covenant contained in Section 3.1, the Transferor covenants and agrees that:
   a) it will maintain all native vegetation of which none shall be removed without written permission of the Transferee, with the exception of trees certified as dangerous by an arborist (or equivalent expert) and invasive non native vegetation, with prior notice and approval of the Transferee;
   b) it will not to deposit any fill; and
   c) materials deleterious to water quality shall not be stored or dumped within the Covenant Area. These materials may include, but are not limited to herbicides/pesticides, fertilizers, silt/sediment, compost, yard waste (including grass clippings), and petroleum based products.

4.0 Dispute Resolution

4.1) If there is a disagreement regarding a breach of this Agreement which has occurred or is threatened, or if there is disagreement as to the meaning of this Agreement, the Transferor or the Transferee may give notice to the other parties requiring a meeting of all parties within 10 business days of receipt of the notice.

4.2) The parties must attempt to resolve the disagreement, acting reasonably and in good faith, within 15 business days of receipt of the notice.

4.3) If the parties are not able to resolve the disagreement within that time, the parties may appoint a mutually acceptable person to mediate the matter and the parties must act reasonably and in good faith and cooperate with the mediator and with each other in an attempt to resolve the matter within 20 business days after the mediator is appointed.

5.0 Right of Access for Monitoring and Enforcement

5.1) The Transferor grants to the Transferee a license, and a statutory right of way pursuant to Section 218 of the *Land Title Act*, permitting the Transferee to do the following:

a) to enter upon the Land to inspect the Covenant Area:

i) at least once each calendar year, with the date for each inspection to be agreed upon by the parties before August 31 each year, but if the parties cannot agree on those days by August 31 in any year, the Transferee is entitled to enter upon and inspect the Covenant Area in accordance with this Section 5.1(a)(ii); and

ii) at all reasonable times upon prior notice by the Transferee to the Transferor of at least 24 hours, unless, in the opinion of the Transferee, there is an emergency or other circumstance which does not make giving such notice practicable, in the sole discretion of the Transferee,

b) as part of inspection of the Covenant Area, to take samples, photographs and video recordings as may be necessary to monitor compliance and enforce the terms of this Agreement;

c) to enter upon and protect, preserve, conserve, maintain, enhance, restore or rehabilitate, in the Transferee's sole discretion the Covenant Area to as near the condition described in the Report as is practicable if an act of nature or human agency other than as described in Section 5.1(d), destroys, impairs, diminishes or negatively affects or alters the Covenant Area from the condition described in the Report;

d) to enter upon and protect, preserve, conserve, maintain, enhance, restore or rehabilitate, in the Transferee's sole discretion and at the expense of the Transferor, the Covenant Area to as near the condition described in the Report as is practicable, if an action of the Transferor or any other person acting with the actual or constructive knowledge of the Transferor:

i) destroys, impairs, diminishes, negatively affects or alters the Covenant Area from the condition described in the Report; or

ii) contravenes any term of this Agreement;

e) to carry out or evaluate, or both, any program agreed upon among the parties for the protection, preservation, conservation, maintenance, enhancement, restoration or rehabilitation of all or any portion of the Covenant Area; and

f) to place survey pegs or other markings on the Land to increase the visibility of existing survey pegs or other markings.

5.2) The Transferee may bring vehicles, equipment and personal property onto the Land when exercising their rights under this Agreement.

5.3) For the purposes of Sections 5.1(c) and (d), the Transferee have the sole discretion to protect, preserve, conserve, maintain, enhance, restore or rehabilitate the Covenant Area.

6.0 Enforcement

6.1) If the Transferee, in its sole discretion, believes that the Transferor has neglected or refused to perform any of the obligations set out in this Agreement or is in breach of any term of this Agreement, the Transferee may serve on the Transferor a notice setting out particulars of the breach and of the Transferee's estimated maximum costs of remedying the breach. The Transferor has 60 days from receipt of the notice, or conclusion of the dispute resolution provision under Section 4.0 of this Agreement if invoked, to remedy the breach or make arrangements satisfactory to the Transferee for remedying the breach, including with respect to the time within which the breach shall be remedied.

6.2) If the Transferor does not remedy a breach described in Section 6.1 within the time specified in Section 6.1, the Transferee is entitled to enter the Land and remedy the breach or carry out the arrangements referred to in Section 6.1 and the Transferor shall reimburse the Transferee for any expenses incurred in doing so, up to the estimated maximum costs of remedying the breach as set out in the notice under Section 6.1. Expenses incurred by the Transferee under this section are a debt owed by the Transferor to the Transferee.

6.3) The Transferor and the Transferee agree that the enforcement of this Agreement shall be entirely within the discretion of the Transferee and that the execution and registration of this covenant against the title to the Land shall not be interpreted as creating any duty on the part of the Transferee to the Transferor or to any other person to enforce any provision or the breach of any provision of this Agreement.

7.0 Release

7.1) The Transferor hereby releases and forever discharges the Transferee of and from any claim, cause of action, suit, demand, expenses, costs and legal fees whatsoever which the Transferor can or may have against the Transferee for any loss or damage or injury that the Transferor may sustain or suffer arising out of or connected with the breach of any covenant in this Agreement.

8.0 Indemnity

8.1) The Transferor shall indemnify and save harmless the Transferee of and from any claims, suits, demands, action, cause of action, cost, fee, expense or legal fee whatsoever which anyone has or may have against the Transferee or which the Transferee incurs as a result of any loss, damage or injury arising out of or connected with the breach of any covenant in this Agreement.

9.0 Regulatory Power

9.1) Nothing contained or implied herein shall prejudice or affect the rights and powers of the Transferee in the exercise of its functions under any public or private statutes, bylaws, orders or regulations, all of which may be fully and effectively exercised in relation to the Land as if this Agreement had not been executed and delivered by the Transferor.

10.0 No Warranty

10.1) It is mutually understood, acknowledged and agreed by the parties hereto that the Transferee has made no representations, covenants, warranties, guarantees, promises or agreements (oral or otherwise) with the Transferor other than those contained in this Agreement.

11.0 General

11.1) The Transferor agrees to execute all other documents and provide all other assurances necessary to give effect to the covenants contained in this Agreement.

11.2) The Transferor shall pay the legal fees of the Transferee in connection with the preparation and registration of this Agreement.

11.3) The Transferor covenants and agrees for itself, its heirs, executors, successors and assigns, that it will at all times perform and observe the requirements and restrictions hereinbefore set out and they shall be binding upon the Transferor as personal covenants only during the period of its respective interest in the Land.

11.4) The restrictions and covenants herein contained shall be covenants running with the Land and shall be perpetual, and shall continue to bind all of the Lands when subdivided, and shall be registered in the Victoria Land Title Office pursuant to Sections 218 and 219 of the *Land Title Act* as covenants in favour of the Transferee as a first charge against the Land.

11.5) This Agreement shall enure to the benefit of the Transferee and shall be binding upon the parties hereto and their respective heirs, executors, successors and assigns.

11.6) Wherever the expressions "Transferor" and "Transferee" are used herein, they shall be construed as meaning the plural, feminine or body corporate or politic where the context or the parties so require.

11.7) A copy of the registered covenant document is to be forwarded to the parties for record keeping.

11.8) The page numbers noted on Page 10 of 44 Pages are the page numbers noted on the bottom right hand corner of the Report.

IN WITNESS WHEREOF the parties hereto hereby acknowledge that this Agreement has been duly executed and delivered by the parties executing Form C attached hereto.

CONSENT TO GRANT OF SECTION 219 COVENANT BY CHARGEHOLDER

KNOW ALL MEN BY THESE PRESENTS that **KOKANEE MORTGAGE MIC LTD. , INC. NO. 260348** the holder of a charge by way of Mortgage No. EX161963 registered against the within described property in the Land Title Office at Victoria, British Columbia, for and in consideration of the sum of One Dollar ($1.00) paid by the Transferee to the said Chargeholder (the receipt whereof is hereby acknowledged), agrees with the Transferee, its successors and assigns, that the within Section 219 Covenant shall be an encumbrance upon the within described property in priority to the said charge in the same manner and to the same effect as if it had been dated and registered prior to the said charge.

KNOW ALL MEN BY THESE PRESENTS that **WINSLOW DEVELOPMENTS LTD., INC. NO. 0296178,** the holder of a charge by way of Mortgage No. EX161963 registered against the within described property in the Land Title Office at Victoria, British Columbia, for and in consideration of the sum of One Dollar ($1.00) paid by the Transferee to the said Chargeholder (the receipt whereof is hereby acknowledged), agrees with the Transferee, its successors and assigns, that the within Section 219 Covenant shall be an encumbrance upon the within described property in priority to the said charge in the same manner and to the same effect as if it had been dated and registered prior to the said charge.

Appendix 6

BC Reg. 40/2016, the ‘Water Sustainability Act’ and ‘Dam Safety Regulation

B.C. Reg. 40/2016
O.C. 114/2016

Deposited February 29, 2016
effective February 29, 2016

This archived regulation consolidation is current to December 31, 2015 and includes changes enacted and in force by that date. For the most current information, click here.

Water Sustainability Act

DAM SAFETY REGULATION

Contents

Part 1 — Definitions, Interpretation and Application

Definitions and interpretation

1 (1) In this regulation:

"Act" means the *Water Sustainability Act*;

"classification" means the classification of a dam determined in accordance with section 3 *[dam failure consequences classification]* or 31 *[transition — dam failure consequences classification]*;

"dam" means

(a) a barrier constructed for the purpose of enabling the storage or diversion of water diverted from a stream or an aquifer, or both, and

(b) other works that are incidental to or necessary for the barrier

described in paragraph (a);

"dam safety officer" means an engineer or an officer who is designated in writing by the comptroller as a dam safety officer;

"emergency plan", in relation to a dam, means

(a) a plan

(i) that, immediately before February 29, 2016, was the emergency preparedness plan for the dam under the former regulation, or

(ii) that is prepared under section 9 *[dam emergency plan]* by an owner of the dam and accepted by a dam safety officer, and

(b) the revisions, if any, to the plan referred to in paragraph (a) (i) or (ii), as applicable, set out in a record prepared by an owner of the dam and accepted by a dam safety officer;

"engineering professional" means a person who is

(a) a professional engineer as defined in the *Engineers and Geoscientists Act*, or

(b) a holder of a limited licence under the *Engineers and Geoscientists Act* that permits the person to practise professional engineering and who is acting within the scope of the limited licence;

"formal inspection", in relation to a dam, means a thorough on-site inspection of the dam and dam site conducted by a person who is an owner of the dam or an agent of an owner of the dam and who is responsible for the safety of the dam;

"former regulation" means the British Columbia Dam Safety Regulation, B.C. Reg. 44/2000;

"hazardous conditions", in relation to a dam, means conditions, including, without limitation, defects or insufficiencies of the dam, that

(a) are or are likely to be hazardous to the dam, or

(b) may reasonably be anticipated to cause all or part of the dam, or any operation or action at or in connection with the dam, to be or become potentially hazardous to

(i) public safety,

(ii) the environment, or

(iii) land or other property;

"instrumentation", in relation to a dam, means instruments and equipment used to measure the following:

(a) hydrological and hydraulic characteristics in relation to the dam,

including, without limitation,

(i) water levels in the dam and reservoir and at the weirs, and

(ii) water flow throughout the dam;

(b) water clarity in the reservoir and below the dam;

(c) seismic, geological and geotechnical characteristics in relation to the dam, including, without limitation, movement of the dam, seismic activity, pore pressures and stresses applied to the dam;

(d) temperature variations of the dam;

(e) weather conditions that may affect the operation of the dam;

(f) other parameters in relation to the dam;

"jurisdictional area", in relation to a local emergency authority, means the jurisdictional area, as defined in the *Emergency Program Act*, for which the local authority has responsibility under that Act;

"local authority" has the same meaning as in the *Emergency Program Act*;

"local emergency authority", in relation to a dam, means a local authority that is, under subsection (2), a local emergency authority for the dam;

"operation, maintenance and surveillance manual", in relation to a dam, means

(a) a manual

(i) that, immediately before February 29, 2016, was the operation, maintenance and surveillance manual for the dam under the former regulation, or

(ii) that is prepared under section 8 *[operation, maintenance and surveillance manual]* by an owner of the dam and accepted by a dam safety officer, and

(b) the revisions, if any, to the manual referred to in paragraph (a) (i) or (ii), as applicable, set out in a record prepared by an owner of the dam and accepted by a dam safety officer;

"owner", in relation to a dam, means

(a) the following persons:

(i) a person who is a licensee in relation to a licence for the dam;

(ii) a person who must under the Act, but does not, hold a licence for the dam;

(iii) a person who was a licensee in relation to a licence for the dam immediately before the suspension, cancellation,

termination or abandonment of the licence, and

(b) if there is no person to whom paragraph (a) applies, the following persons:

(i) an owner, as defined in the Act, of the land on which the dam is located;

(ii) a person who had the dam constructed;

"potential safety hazard", in relation to a dam, means conditions that are not yet, but have the potential to become, hazardous conditions in relation to the dam;

"Provincial Emergency Program" means the Provincial Emergency Program continued under section 2 (1) *[Provincial Emergency Program]* of the *Emergency Program Act*;

"site surveillance" means the monitoring of a dam and the area surrounding or adjacent to the dam

(a) through visual observation, and

(b) if there is instrumentation relating to the dam, through the systematic collection of instrumentation readings and analysis and interpretation of the readings;

"submit", in relation to a record that, under this regulation, must or may be submitted to a dam safety officer, means submit the record in the manner required under section 25 (1) *[submission of records to and acceptance of records by dam safety officer]*.

(2) For the purposes of the definition of "local emergency authority" in subsection (1), a local authority is a local emergency authority for a dam if any land in the jurisdictional area of the local authority

(a) is in the immediate vicinity of the dam or the reservoir of the dam, or

(b) is downstream or downslope of the dam and may be adversely affected by

(i) a complete or partial collapse of the dam, or

(ii) an uncontrolled release of all or part of the water impounded by the dam.

(3) For the purposes of this regulation, the construction of a newly constructed dam is conclusively deemed to be completed on the date on which the dam first becomes capable of storing or diverting water.

(4) For the purposes of sections 2 (1) *[application of regulation to minor dam]* and 7 *[application of Part 3]*, the height of a dam is the vertical distance to the top of the dam measured,

(a) in the case of a dam across a stream, from the natural bed of the stream at the downstream outside limit of the dam, and

(b) in the case of a dam that is not across a stream, from the lowest elevation at the outside limit of the dam.

Application of regulation to minor dam

2 (1) Unless otherwise ordered under subsection (2), this regulation does not apply to a dam that meets both of the following criteria:

(a) the dam is less than 7.5 m in height;

(b) the dam is capable of impounding at full supply level a maximum total storage volume of water in the reservoir of the dam of 10 000 m^3 or less.

(2) Subject to section 7 *[application of Part 3]*, the comptroller or a water manager may order that this regulation applies to a dam described in subsection (1) of this section if the comptroller or water manager is satisfied that the dam is or may become potentially hazardous to

(a) public safety,

(b) the environment, or

(c) land or other property.

Part 2 — Requirements Applicable to All Dams

Dam failure consequences classification

3 (1) An owner of a newly constructed dam must, as soon as practicable and, in any event, no later than 60 days, after completion of the construction of the dam,

(a) determine the classification of the dam in accordance with section 2 *[determination of classification]* of Schedule 1, and

(b) submit to a dam safety officer, immediately after the determination is completed, a record setting out a proposed classification for the dam.

(2) An owner of a dam for which the classification has been determined under the former regulation or this regulation must,

(a) no less frequently than is specified in item 1 of the table in Schedule 2 for the classification of the dam, redetermine the classification of the dam in accordance with section 2 of Schedule 1 to assess whether the classification of the dam has changed, and

(b) if the classification of the dam has changed, submit to a dam

safety officer, immediately after the redetermination is completed, a record setting out a proposed new classification for the dam.

(3) Despite subsections (1) and (2), the comptroller or a water manager may order an owner of a dam to comply with subsection (1) or (2), as applicable, on or before a specified date.

(4) On receipt of a record under subsection (1) (b) or (2) (b) or paragraph (b) (ii) of this subsection from an owner of a dam proposing a classification, or a new classification, for the dam, or on receipt of information or records from an owner of a dam under paragraph (b) (i) of this subsection, a dam safety officer must give written notice to the owner of the dam who submitted the record or the information or records, as the case may be, advising that

(a) the dam safety officer has accepted the classification, or new classification, proposed by the owner, or

(b) the dam safety officer has not accepted the classification, or new classification, proposed by the owner and requiring the owner to submit to the dam safety officer, on or before the date specified by the dam safety officer, either of the following:

(i) information or records, or further information or records, as the case may be, that demonstrate that the classification, or new classification, proposed by the owner is correct;

(ii) a record setting out a different proposed classification, or new classification, as the case may be, for the dam.

(5) In the case of a dam described in subsection (1),

(a) until a record setting out a proposed classification for the dam is submitted under subsection (1) (b), the classification of the dam is deemed, for the purposes of this regulation, to be significant, and

(b) between the date on which the record referred to in paragraph (a) of this subsection is submitted to a dam safety officer and the date on which a dam safety officer gives notice under subsection (4) (a) in relation to the dam,

(i) if the proposed classification for the dam is high, very high or extreme, the classification of the dam is deemed, for the purposes of this regulation, to be the proposed classification, and

(ii) if the proposed classification for the dam is low or significant, the classification of the dam is deemed, for the purposes of this regulation, to be significant.

(6) In the case of a dam described in subsection (2) in respect of which an owner of the dam submits under subsection (2) (b) a record setting out a proposed new classification for the dam, between the date on which the record is

submitted and the date on which a dam safety officer gives notice under subsection (4) (a) in relation to the dam, the classification of the dam is deemed, for the purposes of this regulation, to be the more severe in consequence of the existing classification and the proposed new classification.

(7) Despite subsections (5) and (6), if the comptroller or a water manager makes an order under subsection (3),

(a) the comptroller or water manager may, in the order, specify a classification for the dam that applies between the date on which the order is made and the date on which a dam safety officer gives notice under subsection (4) (a) in relation to the dam, and

(b) the classification of the dam is, during the period described in paragraph (a) of this subsection, deemed for the purposes of this regulation to be the classification specified in the order.

(8) For certainty, the requirements of this regulation that apply in relation to a classification of a dam also apply in relation to a deemed classification of the dam under subsection (5), (6) or (7).

(9) When a dam safety officer gives notice under subsection (4) (a) in relation to a dam, the classification of the dam for the purposes of this regulation is the classification accepted by the dam safety officer as set out in the notice.

Owner must comply on determination or change of classification

4 Subject to this regulation, if the classification of a dam is determined for the first time or changes, an owner of the dam must, as soon as practicable after the owner becomes aware of the classification, or changed classification, as the case may be, comply with the provisions of this regulation that apply to a dam having that classification or changed classification.

Responsibility of owner for dam condition and safety

5 (1) An owner of a dam must properly inspect, maintain and repair the dam and related works in a manner that keeps the dam and works in good operating condition.

(2) An owner of a dam must exercise reasonable care to avoid the risk of significant harm resulting from a defect, insufficiency or failure of the dam or other conditions at the dam or operations or actions at or in connection with the dam to any of the following:

(a) public safety;

(b) the environment;

(c) land or other property.

Prevention of unauthorized operation

6 An owner of a dam must exercise reasonable care to safeguard the dam from unauthorized operation.

Part 3 — Requirements Applicable to Certain Dams

Division 1 — Application of Part 3

Application of Part 3

7 This Part applies in relation to a dam if the dam meets the criteria set out in one or more of the following paragraphs:

(a) the dam is

(i) 1 m or more in height, and

(ii) capable of impounding at full supply level a total storage volume of water in the reservoir of the dam greater than 1 000 000 m^3;

(b) the dam is

(i) 2.5 m or more in height, and

(ii) capable of impounding at full supply level a total storage volume of water in the reservoir of the dam greater than 30 000 m3;

(c) the dam is 7.5 m or more in height;

(d) the dam has a classification of significant, high, very high or extreme.

Division 2 — General Safety Requirements

Operation, maintenance and surveillance manual

8 (1) An owner of a dam for which there is not already an operation, maintenance and surveillance manual and that has a classification of significant, high, very high or extreme must

(a) prepare a manual, in the form and with the content specified by the comptroller or a water manager, that describes the operation, maintenance and surveillance procedures for the dam, and

(b) submit the manual to a dam safety officer for acceptance by the dam safety officer.

(2) Subject to subsection (3), an owner of a newly constructed dam must comply with subsection (1) as soon as practicable and, in any event, no later than 60 days, after completion of the construction of the dam.

(3) The comptroller or a water manager may order an owner of a dam to comply

with subsection (1) on or before a specified date.

(4) An owner of a dam for which there is an operation, maintenance and surveillance manual must, no less frequently than is specified in item 8 of the table in Schedule 2 for the classification of the dam,

(a) review and, if necessary, revise the operation, maintenance and surveillance manual, and

(b) submit to a dam safety officer, for acceptance by the dam safety officer,

(i) a record setting out the revisions, if any, or

(ii) a written report advising that no revisions are necessary.

(5) Despite subsection (4), if the classification of a dam for which there is an operation, maintenance and surveillance manual changes to a classification that is more severe in consequence, an owner of the dam must comply with subsection (4) (a) and (b) as soon as practicable after the owner becomes aware of the change of classification or on or before a later date specified by a dam safety officer.

(6) An owner of a dam must follow the operation, maintenance and surveillance manual, if any, for the dam.

Dam emergency plan

9 (1) An owner of a dam for which there is not already an emergency plan and that has a classification of significant, high, very high or extreme must

(a) prepare a plan, in the form and with the content specified by the comptroller or a water manager, that includes

(i) a record describing the actions to be taken by the owner if there is an emergency at the dam, and

(ii) a record containing information for the use of the local emergency authorities for the dam for the purpose of preparing local emergency plans under the *Emergency Program Act*, and

(b) submit the plan to a dam safety officer for acceptance by the dam safety officer.

(2) Subject to subsection (3), an owner of a newly constructed dam must comply with subsection (1) as soon as practicable and, in any event, no later than 60 days, after completion of the construction of the dam.

(3) The comptroller or a water manager may order an owner of a dam to comply with subsection (1) on or before a specified date.

(4) A record described in subsection (1) (a) (i) must include contact information for the persons and the government agencies and other organizations that

are to be contacted by the owner of the dam if there is an emergency at the dam.

(5) A record described in subsection (1) (a) (ii) must include the name and contact information of the person who is the emergency contact for the dam.

(6) An owner of a dam must, promptly after a plan prepared for the dam under subsection (1) is accepted by a dam safety officer, deliver a copy of the record described in subsection (1) (a) (ii) to each local emergency authority for the dam.

(7) An owner of a dam for which there is an emergency plan must, no less frequently than is specified in item 6 of the table in Schedule 2 for the classification of the dam,

(a) review and, if necessary, revise the names and contact information in the records described in subsections (4) and (5) of this section, and

(b) submit to a dam safety officer, for acceptance by the dam safety officer,

(i) a record setting out the revisions, if any, or

(ii) a written report advising that no revisions are necessary.

(8) Subject to subsection (7), an owner of a dam for which there is an emergency plan must, no less frequently than is specified in item 8 of the table in Schedule 2 for the classification of the dam,

(a) review and, if necessary, revise the emergency plan, and

(b) if the record is revised, submit the revised record to a dam safety officer for acceptance by the dam safety officer.

(9) Despite subsection (8), if the classification of a dam for which there is an emergency plan changes to a classification that is more severe in consequence, an owner of the dam must comply with subsection (8) (a) and (b) as soon as practicable after the owner becomes aware of the change of classification or on or before a later date specified by a dam safety officer.

(10) If a record described in subsection (1) (a) (ii) for a dam is revised under this regulation, an owner of the dam must, promptly after the revision is accepted by a dam safety officer, deliver a copy of the revised record to each local emergency authority for the dam.

Record identifying emergency contact

10 (1) An owner of a dam that has a classification of low must

(a) prepare a record, in the form and with the content specified by the comptroller or a water manager, that sets out the name and contact information of the person who is the emergency contact for

the dam,

(b) submit the record to a dam safety officer, and

(c) deliver a copy of the record to each local emergency authority for the dam.

(2) Subject to subsection (3), an owner of a newly constructed dam must comply with subsection (1) as soon as practicable and, in any event, no later than 60 days, after completion of the construction of the dam.

(3) A dam safety officer may specify a date on or before which an owner of a dam must comply with subsection (1) and, if the dam safety officer specifies a date, the owner must comply with subsection (1) on or before the specified date.

(4) An owner of a dam for which a record referred to in subsection (1) has been prepared must, no less frequently than is specified in item 7 of the table in Schedule 2 for the classification of the dam,

(a) review and, if necessary, revise the record, and

(b) if the record is revised,

(i) submit the revised record to a dam safety officer, and

(ii) deliver a copy of the revised record to each local emergency authority for the dam.

(5) If none of the owners of a dam have complied with subsection (1) within the required time, a dam safety officer may designate one of the owners of the dam to be the emergency contact for the dam.

(6) An owner of a dam who becomes the emergency contact for the dam under this section must, as soon as practicable, give to each other owner whose address is known to the owner written notice that the owner is the emergency contact.

Signs must be posted

11 (1) In this section:

"emergency contact", in relation to a dam, means the person identified as the emergency contact for the dam in the record referred to in section 9 (5) *[dam emergency plan]*;

"sign" means a sign that meets the requirements of subsection (4).

(2) Subject to subsection (3), an owner of a dam that has a classification of significant, high, very high or extreme and that is located partly or entirely on Crown land, or on land that is surrounded by or adjacent to Crown land, must ensure that 2 signs are at all times posted,

(a) at each end of the top of the dam, or

(b) if a sign posted at an end of the top of the dam would not be clearly visible under all seasonal conditions to persons approaching the dam, at another location on Crown land at which the sign would be so visible.

(3) An owner of a dam is required to post only one sign under subsection (2) if a dam safety officer considers it would be impractical or unnecessary to post the other sign.

(4) Each sign that must be posted under subsection (2) must meet all of the following requirements:

(a) the sign must contain, in lettering that is clearly legible from a distance of 15 m, the following information:

(i) the name of the dam;

(ii) if the dam impounds water from a stream, the name of the stream;

(iii) the following words: "If you see any dam safety concerns, please contact:", followed by

(A) the name and emergency telephone numbers for day and for night of the emergency contact for the dam, and

(B) the emergency telephone number for the Provincial Emergency Program;

(b) the sign must be at least 75 cm high and 60 cm wide;

(c) the sign must be clearly visible under all seasonal conditions to persons approaching the dam;

(d) the sign and the post, if any, must be constructed from metal or other durable materials having strength suited to the location of the sign and the local environmental conditions;

(e) the sign must meet the other requirements, if any, specified by the comptroller or a water manager.

(5) An owner of a dam may, under this section, post a sign on Crown land whether or not the owner has any other authority to occupy the Crown land.

(6) This section is subject to the requirements of any other enactment that relate to the location, appearance or construction of a sign referred to in this section.

Division 3 — Activities at or near Dam

Authorization, change approval or order for alteration or improvement to or replacement of dam

12 An alteration or improvement to or replacement of all or part of a dam must be authorized under the Act by an authorization, change approval or order unless the

alteration, improvement or replacement is for the purpose of

(a) routine maintenance of the dam or related works,

(b) addressing hazardous conditions in relation to the dam in accordance with section 14 (1) *[hazardous conditions]*, or

(c) conducting an investigation described in section 16 *[invasive investigations]* in accordance with that section.

Requirements if alteration or improvement to or replacement of dam

13 (1) An owner of a dam must, within 30 days after completion of an alteration or improvement to or replacement of all or part of the dam, submit to a dam safety officer

(a) a written report on the work and the manner in which the alteration, improvement or replacement was performed, and

(b) a copy of the as-built drawings.

(2) A report under subsection (1) (a) may be combined with a report under section 14 (2) (a) *[hazardous conditions]*, 15 (2) (a) *[potential safety hazard]* or 17 (5) *[removing, decommissioning, deactivating or stopping operation of dam]*.

(3) An owner of a dam must, promptly after an alteration or improvement to or replacement of all or part of the dam is completed,

(a) review and, if necessary, revise the operation, maintenance and surveillance manual and the emergency plan, if any, for the dam, and

(b) submit to a dam safety officer for acceptance by the dam safety officer,

(i) a record setting out the revisions, if any, or

(ii) a written report advising that no revisions are necessary.

Hazardous conditions

14 (1) An owner of a dam who becomes aware of hazardous conditions in relation to the dam must promptly do all of the following:

(a) follow the emergency plan, if any, for the dam;

(b) operate the dam in a manner, and initiate any remedial actions, including modifying the operations at the dam, that will

(i) safeguard the public, and

(ii) minimize damage to the environment or land or other property;

(c) inform the following persons and other entities of the nature of

the hazardous conditions:

(i) the Provincial Emergency Program;

(ii) persons who are in the immediate vicinity of the dam;

(iii) the local emergency authorities for the dam whose jurisdicational areas may be adversely affected by the hazardous conditions;

(d) if the nature of the hazardous conditions places persons in imminent danger,

(i) advise persons who are in the immediate vicinity of the dam to vacate the endangered area, and

(ii) inform the local emergency authorities for the dam whose jurisdictional areas may be adversely affected by the hazardous conditions of the imminent danger;

(e) inform the comptroller, a water manager or a dam safety officer of

(i) the nature of the hazardous conditions,

(ii) the actions being taken by the owner to rectify the hazardous conditions, and

(iii) the time and exact nature of the information given under this section to any person in relation to the hazardous conditions;

(f) perform such further hazard response activities as the comptroller or a water manager orders.

(2) An owner of a dam must, as soon as practicable and, in any event, no later than 30 days, after hazardous conditions at the dam have been rectified, submit to a dam safety officer

(a) a written report on the actions taken by the owner to rectify the hazardous conditions and the effectiveness of those actions, and

(b) on request of the dam safety officer, copies of records in the custody or under the control of the owner in relation to those actions.

Potential safety hazard

15 (1) An owner of a dam who becomes aware of a potential safety hazard in relation to the dam must do all of the following:

(a) promptly notify a dam safety officer of the potential safety hazard;

(b) on or before the date specified by a dam safety officer

(i) prepare a plan, in the form and with the content specified

by the dam safety officer, that sets out, in order of priority, any actions required to rectify the potential safety hazard, and

(ii) submit the plan to a dam safety officer for acceptance by the dam safety officer;

(c) if the plan referred to in paragraph (b) is accepted by a dam safety officer, implement the plan, on or before the date specified by a dam safety officer, in the order of priority identified in the plan and in accordance with any requirements or conditions specified in an authorization, change approval or order.

(2) An owner of a dam must, as soon as practicable and, in any event, no later than 30 days, after a potential safety hazard at a dam has been rectified, submit to a dam safety officer

(a) a written report on the actions taken by the owner to rectify the potential safety hazard and the effectiveness of those actions, and

(b) on request of the dam safety officer, copies of records in the custody or under the control of the owner in relation to those actions.

Invasive investigations

16 (1) In this section, **"invasive investigation"** means an investigation that involves drilling, trenching, excavating a test pit or performing another invasive activity within or in close proximity to a dam.

(2) An owner of a dam who intends to conduct an invasive investigation must,

(a) at least 60 days before the date on which the owner expects the invasive investigation to begin, give to a dam safety officer written notice of the proposed investigation, and

(b) at least 30 days before the date on which the owner expects the invasive investigation to begin

(i) prepare a plan, in the form and with the content specified by a dam safety officer, in relation to the invasive investigation, and

(ii) submit the plan to a dam safety officer for acceptance by the dam safety officer.

(3) An owner of a dam must not begin an invasive investigation until a plan referred to in subsection (2) (b) has been accepted by a dam safety officer.

(4) An owner of a dam must ensure that all drilling, trenching, test pit excavations and other invasive activities involved in an invasive investigation are directly supervised by an engineering professional who has qualifications and experience in dam design, construction and analysis.

Removing, decommissioning, deactivating or stopping operation of dam

17 (1) In this section, **"restricted activity"** means any of the following:

(a) removing all or a significant part of a dam;

(b) decommissioning a dam;

(c) deactivating a dam, or stopping the normal operation of a dam, for a period longer than one year.

(2) An owner of a dam who intends to perform a restricted activity must,

(a) at least 120 days before the date on which the owner expects to begin work on the restricted activity, give to a dam safety officer written notice of the proposed restricted activity, and

(b) at least 90 days before the date on which the owner expects to begin work on the restricted activity,

(i) prepare a plan, in the form and with the content specified by a dam safety officer, in relation to the activity, and

(ii) submit the plan to a dam safety officer for acceptance by the dam safety officer.

(3) An owner of a dam must not begin work on a restricted activity until a plan referred to in subsection (2) (b) has been accepted by a dam safety officer.

(4) Without limiting subsection (3), an owner of a dam must notify a dam safety officer of the owner's intention to begin work on a restricted activity at least 30 days before the date on which the owner expects to begin the work.

(5) An owner of a dam who has performed a restricted activity must submit to a dam safety officer, for acceptance by the dam safety officer, a written report on the work performed and the manner in which it was performed, no later than 60 days after completion of the restricted activity or on or before a later date specified by a dam safety officer.

(6) An owner of a dam who is performing or has performed work in relation to a restricted activity must take such further actions as the comptroller or a water manager orders to mitigate any adverse impact on

(a) a person,

(b) the environment, or

(c) land or other property.

Division 4 — Monitoring and Review of Dam Safety

Site surveillance, formal inspections and tests

18 An owner of a dam must do all of the following:

(a) in order to assess the condition of the dam during the operation

of the dam or the alteration or improvement to or replacement of the dam, conduct

(i) a site surveillance of the dam no less frequently than is specified in item 2 of the table in Schedule 2 for the classification of the dam, and

(ii) a formal inspection of the dam no less frequently than is specified in item 3 of the table in Schedule 2 for the classification of the dam;

(b) test, no less frequently than is specified in item 4 of the table in Schedule 2 for the classification of the dam, the operation of

(i) the outlet facilities, spillway gates and other mechanical components of the dam, and

(ii) the electrical and communication equipment relating to the dam;

(c) promptly after an activity described in this section has been performed, record the results of the activity.

Instrumentation

19 (1) An owner of a dam must do all of the following:

(a) install the instrumentation necessary to adequately monitor the dam and the area surrounding or adjacent to the dam;

(b) maintain or replace the instrumentation referred to in paragraph (a) to ensure continuity of readings;

(c) collect readings from the instrumentation referred to in paragraph (a) and analyze and interpret the readings no less frequently than is specified in item 5 of the table in Schedule 2 for the classification of the dam.

(2) An owner of a dam who intends to install, modify, replace or remove instrumentation relating to the dam must submit to a dam safety officer, for acceptance by the dam safety officer,

(a) a record describing the proposed installation, modification, replacement or removal at least 60 days before the date on which the owner expects the installation, modification, replacement or removal to occur, or

(b) an annual plan outlining all installations, modifications, replacements and removals of instrumentation proposed for the following year.

(3) An owner of a dam must not install, modify, replace or remove instrumentation relating to the dam until the record or plan referred to in subsection (2) (a) or (b), as applicable, has been accepted by a dam safety

officer.

Dam safety review and report

20 (1) An owner of a dam that has a classification of high, very high or extreme must, no less frequently than is specified in item 9 of the table in Schedule 2 for the classification of the dam,

(a) ensure that an engineering professional who has qualifications and experience in dam safety analysis

(i) carries out a review, in accordance with the requirements of the comptroller or a water manager,

(A) to determine if the dam is safe, and

(B) if it is determined that the dam is not safe, to determine what actions are required to make the dam safe, and

(ii) prepares, in the form and with the content specified by the comptroller or a water manager, a report on the safety of the dam, and

(b) submit to a dam safety officer, for acceptance by the dam safety officer, a copy of the report referred to in paragraph (a) (ii).

(2) Despite subsection (1), if the classification of a dam changes to a classification that is more severe in consequence, other than a change from a low classification to a significant classification, an owner of the dam must comply with subsection (1) (a) and (b) on or before December 31 of the calendar year that is 2 years after the calendar year in which the classification changes, unless the comptroller or a water manager specifies another date.

Division 5 — Information and Records to Be Submitted

Information and records to be submitted to dam safety officer

21 (1) In this section, **"inspection"**, in relation to a dam, includes, without limitation, site surveillance of the dam and a formal inspection of the dam.

(2) An owner of a dam must, on request of a dam safety officer, submit to the dam safety officer, in the form, with the content and on or before the date specified by the dam safety officer, the following records relating to an inspection, test or review carried out in relation to a dam:

(a) a record setting out the results of the inspection, test or review;

(b) records setting out the data obtained from any test or measurement taken, and analysis and interpretation of the data, including, but not limited to,

(i) a record setting out instrumentation readings, and analysis

and interpretation of the readings,

(ii) visual records or observations,

(iii) drawings,

(iv) soil, aggregate and concrete test results, and

(v) any other test results.

(3) Despite subsection (2), an owner of a dam must promptly submit to a dam safety officer the records referred to in that subsection if an inspection, test or review carried out in relation to the dam reveals hazardous conditions or a potential safety hazard.

(4) A dam safety officer may request an owner of a dam to submit to the dam safety officer any of the following information and records that the dam safety officer considers necessary to evaluate the condition or the hazard potential of the dam and operations and actions at or in connection with the dam:

(a) information and records relating to the dam and those operations and actions, including, but not limited to,

(i) information and records respecting hydraulic, hydrological, seismic, geological and geotechnical characteristics, conditions and concerns,

(ii) foundation investigation results,

(iii) design details and as-built drawings,

(iv) structural analyses,

(v) construction records,

(vi) operation manuals,

(vii) records relating to instrumentation,

(viii) safety reports,

(ix) inundation studies, and

(x) plans, that have not been previously submitted to a dam safety officer, to be implemented if there is an emergency at the dam;

(b) the following records relating to the design or construction of the dam or an alteration to or improvement or replacement of the dam:

(i) drawings, including, without limitation, plans and as-built drawings;

(ii) design notes and specifications;

(iii) hydraulic, hydrological, geological and geotechnical data;

(iv) reports and other similar records;

(c) information and records, including, without limitation, information and records respecting hydraulic, hydrological, seismic, geological and geotechnical characteristics, conditions and concerns,

relating to the following:

(i) the nature and use of the land that is in the immediate vicinity of the dam or the reservoir of the dam, downstream of the dam or downslope of the dam;

(ii) the nature and use of the stream or aquifer from which the water is being stored or diverted;

(d) information relating to the watershed upstream of the dam.

(5) An owner of a dam, must, on receiving a request of a dam safety officer under subsection (4), submit the requested information or record in the form, with the content and on or before the date specified by the dam safety officer.

(6) If information or a record in relation to a dam that is required to be submitted to a dam safety officer under this section does not exist or is otherwise not available for submission, the comptroller or a water manager may order an owner of the dam to conduct an inspection, investigation, survey or test, or prepare a record in relation to an inspection, investigation, survey or test, that is necessary to provide the information or record.

Part 4 — General

Division 1 — Dams with Multiple Owners

Owners' designate

22 (1) The owners of a dam in respect of which there are 2 or more owners must, on request of a dam safety officer and on or before the date specified by the dam safety officer,

(a) designate one of the owners for the purposes of receiving, providing and retaining information and records in relation to the dam as required or authorized by this regulation, and

(b) submit to the dam safety officer the designated owner's name, address and other contact information as required by the dam safety officer.

(2) If the owners of a dam to which subsection (1) applies have not complied with that subsection within the specified time, a dam safety officer may designate one of the owners for the purposes of this section.

(3) An owner of a dam who is designated under this section must, as soon as practicable after the designation, give to each other owner whose address is known to the owner written notice of the designation.

Compliance by any owner satisfies requirement

23 For certainty, if a dam has 2 or more owners, a requirement imposed by this

regulation on an owner of the dam is satisfied if any of the owners of the dam complies with the requirement.

Exemption for owner of dam with multiple owners

24 An owner of a dam in respect of which there are 2 or more owners is exempt from the requirements of this regulation in relation to the dam if

(a) the comptroller is satisfied that proper arrangements have been made for one or more of the other owners to take responsibility for meeting the requirements of this regulation in relation to the dam, and

(b) either of the following applies in relation to the owner:

(i) all the owners have agreed that one or more of the other owners acceptable to the comptroller are to be responsible for the dam;

(ii) the owner holds rights to store not greater than 5% of the quantity of water the storage rights to which are granted under the Act in respect of the dam.

Division 2 — Records

Submission of records to and acceptance of records by dam safety officer

25 (1) A record that under this regulation must or may be submitted to a dam safety officer must be submitted in the manner specified by the dam safety officer.

(2) If a record submitted under this regulation by an owner of a dam to a dam safety officer for acceptance by the dam safety officer

(a) is not in the form or does not contain the content required under this regulation, or

(b) if there are no requirements under this regulation as to the form or content of the record, is not acceptable in form or content to the dam safety officer,

the dam safety officer may give to the owner written notice advising that the record has not been accepted, specifying the deficiencies in the record and requiring that they be rectified.

(3) If a dam safety officer gives notice to an owner of a dam under subsection (2) in relation to a record,

(a) the owner must promptly rectify the deficiencies specified in the notice, and

(b) the dam safety officer is not required to accept the record until the owner has rectified the deficiencies specified in the notice.

(4) If a dam safety officer accepts a record that was submitted under this regulation to the dam safety officer for acceptance, the dam safety officer must give written notice of the acceptance to the owner of the dam who submitted the record.

(5) For the purposes of this regulation, a record relating to a dam is accepted by a dam safety officer when the dam safety officer gives notice under subsection (4) in relation to the record.

Retention of records

26 (1) For the purposes of section 116 (1) *[records and reporting]* of the Act, each person who is or was an owner of a dam must keep information or a record described in section 116 (1) (a), (b) or (c) of the Act that relates to the dam for the period between

(a) the date on which the information or record is obtained or prepared by the person, and

(b) the date that is 10 years after the date on which written notice is given to a dam safety officer, by a person who is an owner of the dam when the dam is decommissioned, stating that the decommissioning of the dam is complete and the dam has been completely removed.

(2) Subsection (1) does not apply to a person in relation to information or a record if another person has been designated under section 22 *[owners' designate]* for the purpose of retaining the information or record.

(3) For the purposes of section 116 (1) (b) of the Act, an owner of a dam must, in addition to the records referred to in section 116 (1) (a) or (c) of the Act, keep all other information and records in relation to the dam that, under this regulation, the owner is, or may be, required to submit to the comptroller, a water manager, an engineer or a dam safety officer.

Division 3 — Advice of Independent Expert

Advice of independent expert may be required

27 (1) If the comptroller or a water manager considers it advisable to obtain independent expert advice in relation to an issue respecting a dam or works relating to a dam, the comptroller or water manager may order an owner of the dam to retain an independent expert, satisfactory to the comptroller or water manager, who has qualifications and experience described in subsection (2), to prepare a written report on resolving the issue.

(2) An independent expert retained under subsection (1) must have the following qualifications and experience:

(a) in the case of an issue respecting a dam, qualifications and

experience in dam design, construction and analysis or in dam operation and maintenance, as appropriate;

(b) in the case of an issue respecting works relating to a dam, qualifications and experience in hydraulic, hydrological, geological, geotechnical, mechanical or structural engineering or other discipline, as appropriate.

(3) An owner of a dam who is ordered by the comptroller or a water manager to retain an independent expert under subsection (1) must submit to the comptroller or water manager a copy of the written report referred to in that subsection promptly after the owner receives the report.

Division 4 — Offences

General offences

28 (1) An owner of a dam who does any of the following commits an offence:

(a) fails to determine under section 3 (1) (a) *[dam failure consequences classification]*, or redetermine under section 3 (2) (a), the classification of the dam as and when required to do so;

(b) fails to submit to a dam safety officer a record under section 3 (1) (b) setting out a proposed classification for the dam, or a record under section 3 (2) (b) setting out a proposed new classification for the dam, as and when required to do so;

(c) fails to properly inspect, maintain or repair the dam or related works contrary to section 5 (1) *[responsibility of owner for dam condition and safety]*;

(d) fails to exercise reasonable care to avoid the risk of significant harm as required under section 5 (2);

(e) fails to exercise reasonable care to safeguard the dam from unauthorized operation contrary to section 6 *[prevention of unauthorized operation]*.

(2) An owner of a dam who does any of the following commits an offence:

(a) fails to review or revise the operation, maintenance and surveillance manual for the dam as and when required to do so under section 8 (4) (a) or (5) *[operation, maintenance and surveillance manual]* or 13 (3) (a) *[requirements if alteration or improvement to or replacement of dam]*;

(b) fails to submit to a dam safety officer the applicable record in relation to a review of the operation, maintenance and surveillance manual for the dam as and when required to do so under section 8 (4) (b) or (5) or 13 (3) (b);

(c) fails to follow the operation, maintenance and surveillance manual for the dam contrary to section 8 (6);

(d) fails to deliver a record to a local emergency authority for the dam as and when required to do so under section 9 (6) or (10) *[dam emergency plan]* or section 10 (4) (b) (ii) *[record identifying emergency contact]*;

(e) fails to review or revise the emergency plan for the dam as and when required to do so under section 9 (7) (a), (8) (a) or (9) or 13 (3) (a);

(f) fails to submit to a dam safety officer the applicable record in relation to a review of the emergency plan for the dam as and when required to do so under section 9 (7) (b), (8) (b) or (9) or 13 (3) (b);

(g) fails to comply with section 10 (1) (a), (b) or (c) on or before the date specified by a dam safety officer contrary to section 10 (3);

(h) fails to review or revise the record setting out the name and contact information for the emergency contact for the dam as and when required to do so under section 10 (4) (a);

(i) fails to submit to a dam safety officer the applicable record in relation to a review of the record referred to in paragraph (h) as and when required to do so under section 10 (4) (b) (i);

(j) contravenes section 11 *[signs must be posted]*.

(3) An owner of a dam who does any of the following commits an offence:

(a) fails to submit to a dam safety officer a written report or other record as and when required to do so under section 13 (1), 14 (2) *[hazardous conditions]*, 15 (2) *[potential safety hazard]* or 17 (5) *[removing, decommissioning, deactivating or stopping operation of dam]*;

(b) fails to notify a dam safety officer of a potential safety hazard in relation to the dam as and when required to do so under section 15 (1) (a);

(c) fails to give notice of a proposed activity in relation to the dam as and when required to do so under section 16 (2) (a) *[invasive investigations]* or 17 (2) (a) or (4);

(d) fails to prepare or submit to a dam safety officer a plan for an activity in relation to the dam as and when required to do so under section 15 (1) (b) (i) or (ii), 16 (2) (b) (i) or (ii) or 17 (2) (b) (i) or (ii);

(e) fails to implement a plan in relation to a potential safety hazard at the dam as and when required to do so under section 15 (1) (c);

(f) begins an activity referred to in section 16 or 17 in relation to the dam before a plan respecting the activity has been accepted by a dam safety officer contrary to section 16 (3) or 17 (3), as applicable;

(g) fails to ensure that an invasive activity is directly supervised by an engineering professional who has qualifications and experience as required under section 16 (4).

(4) An owner of a dam who does any of the following commits an offence:

(a) fails to conduct a site surveillance of the dam as and when required to do so under section 18 (a) (i) *[site surveillance, formal inspections and tests]*;

(b) fails to conduct a formal inspection of the dam as and when required to do so under section 18 (a) (ii);

(c) fails to test the operation of mechanical components of the dam as and when required to do so under section 18 (b) (i);

(d) fails to test the operation of electrical or communication equipment relating to the dam as and when required to do so under section 18 (b) (ii);

(e) fails to record the results of an activity referred to in paragraph (a), (b), (c) or (d) when required to do so under section 18 (c);

(f) fails to install, maintain or replace instrumentation relating to the dam as required under section 19 (1) (a) or (b) *[instrumentation]*;

(g) fails to collect, analyze or interpret readings from instrumentation relating to the dam as and when required to do so under section 19 (1) (c);

(h) fails to submit to a dam safety officer a record or a plan for a proposed installation, modification, replacement or removal of instrumentation relating to the dam as and when required to do so under section 19 (2);

(i) installs, modifies, replaces or removes instrumentation relating to the dam before the notice or plan referred to in paragraph (h) has been accepted by a dam safety officer contrary to section 19 (3);

(j) fails to ensure that an engineering professional who has qualifications and experience as required under section 20 (1) *[dam safety review and report]* carries out a review of, and prepares a report on, the safety of the dam as and when required to do so under section 20 (1) (a) or (2);

(k) fails to submit to a dam safety officer the report referred to in paragraph (j) as and when required to do so under section 20 (1) (b) or (2);

(l) fails to submit to a dam safety officer information or a record in relation to the dam as and when required to do so under section 21 (2), (3) or (5) *[information and records to be submitted to dam safety officer]*;

(m) fails to submit to the comptroller or a water manager a copy of a report of an independent expert in relation to the dam as and when required to do so under section 27 (3) *[advice of independent expert may be required]*.

(5) An owner of a dam who commits an offence under this section is liable on conviction to the following:

(a) in the case of an offence that is not a continuing offence, a fine of not more than $200 000 or imprisonment for not longer than 6 months, or both;

(b) in the case of a continuing offence, a fine of not more than $200 000 for each day the offence is continued or imprisonment for not longer than 6 months, or both.

High penalty offences

29 (1) An owner of a dam who does any of the following commits an offence:

(a) fails to follow the emergency plan for the dam contrary to section 14 (1) (a) *[hazardous conditions]*;

(b) fails to operate the dam or initiate a remedial action at the dam contrary to section 14 (1) (b);

(c) fails to inform or advise a person or other entity respecting hazardous conditions in relation to the dam contrary to section 14 (1) (c) or (d);

(d) fails to inform the comptroller, a water manager or a dam safety officer respecting hazardous conditions in relation to the dam as and when required to do so under section 14 (1) (e).

(2) An owner of a dam who commits an offence under this section is liable on conviction to the following:

(a) in the case of an offence that is not a continuing offence, a fine of not more than $1 000 000 or imprisonment for not longer than one year, or both;

(b) in the case of a continuing offence, a fine of not more than $1 000 000 for each day the offence is continued or imprisonment for not longer than one year, or both.

Part 5 — Transition

Definition of previously unregulated dam

30 In this Part, "previously unregulated dam" means a dam

(a) to which, immediately before February 29, 2016, the former regulation did not apply, and

(b) to which Part 3 *[Requirements Applicable to Certain Dams]* of this regulation applies.

Transition — dam failure consequences classification

31 (1) If, immediately before February 29, 2016, the former regulation did not apply in relation to a dam, an owner of the dam must, on or before December 31, 2016,

(a) determine the classification of the dam in accordance with section 2 *[determination of classification]* of Schedule 1, and

(b) submit to a dam safety officer, immediately after the determination is completed, a record setting out a proposed classification for the dam.

(2) Section 3 (4), (5), (8) and (9) *[dam failure consequences classification]* applies in relation to a dam described in subsection (1) of this section as if it were a dam described in section 3 (1).

(3) An owner of a dam who, in 2015, conducted a review of conditions downstream of the dam under section 6.1 of the former regulation must begin complying with section 3 (2) of this regulation in 2016.

(4) An owner of a dam who, between January 1, 2016 and February 28, 2016, conducted a review of conditions downstream of the dam under section 6.1 of the former regulation must begin complying with section 3 (2) of this regulation in 2017.

(5) If, immediately before February 29, 2016, section 6.1 of the former regulation applied in relation to a dam and a review of conditions downstream of the dam was not conducted under that section between January 1, 2015 and February 28, 2016, an owner of the dam must comply with section 3 (2) of this regulation on or before March 31, 2016.

(6) Section 3 (4), (6), (8) and (9) applies in relation to a dam described in subsection (3), (4) or (5) of this section as if it were a dam described in section 3 (2).

(7) The classification of a dam to which the former regulation applied immediately before February 29, 2016 continues, for the purposes of this regulation, to be the classification of the dam under the former regulation until the date on which the classification is determined in accordance with this section.

Transition — operation, maintenance and surveillance manual

32 (1) An owner of a previously unregulated dam that has a classification of significant, high, very high or extreme must comply with section 8 (1) (a) and (b) *[operation, maintenance and surveillance manual]* within one year after the date on which a dam safety officer gives notice to an owner of the dam that the dam safety officer accepts a proposed classification for the dam under section 31.

(2) If, between January 1, 2006 and December 31, 2015, an operation, maintenance and surveillance manual was submitted to a dam safety officer under section 3 (2) (b) of the former regulation in relation to a dam that has a classification of very high, and subsection (3) of this section does not apply in relation to the dam, an owner of the dam need not comply with section 8 (4) (a) and (b) of this regulation in respect of the first review of the operation, maintenance and surveillance manual until the calendar year that is 10 years after the calendar year that includes the date on which the operation, maintenance and surveillance manual was submitted to the dam safety officer under section 3 (2) (b) of the former regulation.

(3) If the most recent review of the operation, maintenance and surveillance manual for a dam that has a classification of very high was completed under section 3 (3.1) of the former regulation between January 1, 2006 and December 31, 2015, an owner of the dam need not comply with section 8 (4) (a) and (b) of this regulation in respect of the immediately following review of the operation, maintenance and surveillance manual until the calendar year that is 10 years after the calendar year that includes the date on which the most recent review of the operation, maintenance and surveillance manual was completed under section 3 (3.1) of the former regulation.

Transition — dam emergency plan

33 (1) An owner of a previously unregulated dam that has a classification of significant, high, very high or extreme must comply with section 9 (1) (a) and (b) [dam emergency plan] within one year after the date on which a dam safety officer gives notice to an owner of the dam that the dam safety officer accepts a proposed classification for the dam under section 31 [transition — dam failure consequences classification].

(2) Despite section 9, if, immediately before February 29, 2016, there was, under the former regulation, an emergency preparedness plan for a dam, an owner of the dam must, on or before March 31, 2017,

(a) review and, if necessary, revise the plan to ensure that it contains the record described in section 9 (1) (a) (ii),

(b) submit to a dam safety officer, for acceptance by the dam safety officer,

(i) a record setting out the revisions, if any, or

(ii) a written report advising that no revisions are necessary,

and

(c) deliver a copy of the record described in section 9 (1) (a) (ii) to each local emergency authority for the dam.

(3) If, between January 1, 2006 and December 31, 2015, an emergency preparedness plan was submitted to a dam safety officer under section 3.1 (1) (b) of the former regulation in relation to a dam that has a classification of very high, and subsection (4) of this section does not apply in relation to the dam, an owner of the dam need not comply with section 9 (8) (a) and (b) of this regulation in respect of the first review of the emergency plan for the dam until the calendar year that is 10 years after the calendar year that includes the date on which the emergency preparedness plan was submitted to the dam safety officer under section 3.1 (1) (b) of the former regulation.

(4) If the most recent review of the emergency preparedness plan for a dam that has a classification of very high was completed under section 3.1 (3) of the former regulation between January 1, 2006 and December 31, 2015, an owner of the dam need not comply with section 9 (8) (a) and (b) of this regulation in respect of the immediately following review of the emergency plan for the dam until the calendar year that is 10 years after the calendar year that includes the date on which the most recent review of the emergency preparedness plan was completed under section 3.1 (3) of the former regulation.

Transition — record identifying emergency contact

34 An owner of a dam, other than a newly constructed dam, need not comply with section 10 *[record identifying emergency contact]* until March 31, 2017.

Transition — signs

35 An owner of a previously unregulated dam need not comply with section 11 *[signs must be posted]* until October 1, 2016.

Transition — monitoring and review of dam safety

36 (1) For the purposes of section 18 (a) *[site surveillance, formal inspections and tests]*, an owner of a previously unregulated dam must, on or before November 1, 2016,

(a) begin site surveillance of the dam, and

(b) conduct the first formal inspection of the dam.

(2) For the purposes of section 18 (b), an owner of a previously unregulated dam must, on or before November 1, 2016, conduct the first tests of the operation of

(a) the outlet facilities, spillway gates and other mechanical components of the dam, and

(b) the electrical and communication equipment relating to the dam.

(3) For the purposes of section 19 (1) (c) *[instrumentation]*, an owner of a previously unregulated dam must, on or before November 1, 2016, begin collecting, analyzing and interpreting readings from the instrumentation relating to the dam.

(4) An owner of a previously unregulated dam that has a classification of high, very high or extreme must comply with section 20 (1) (a) and (b) *[dam safety review and report]* within 5 years after the date on which a dam safety officer gives notice to an owner of the dam that the dam safety officer accepts a proposed classification for the dam under section 31 *[transition — dam failure consequences classification]*.

Transition — general offences

37 (1) An owner of a dam who does any of the following commits an offence:

(a) fails to determine under section 31 (1) (a) *[transition — dam failure consequences classification]* or redetermine under section 31 (3), (4) or (5) the classification of the dam as and when required to do so;

(b) fails to submit to a dam safety officer a record under section 31 (1) (b) setting out a proposed classification for the dam, or a record under section 31 (3), (4) or (5) setting out a proposed new classification for the dam, as and when required to do so;

(c) fails to prepare an operation, maintenance and surveillance manual for the dam as and when required to do so under section 32 (1) *[transition — operation, maintenance and surveillance manual]*;

(d) fails to submit to a dam safety officer the operation, maintenance and surveillance manual for the dam as and when required to do so under section 32 (1);

(e) fails to prepare an emergency plan for the dam as and when required to do so under section 33 (1) *[transition — dam emergency plan]*;

(f) fails to submit to a dam safety officer the emergency plan for the dam as and when required to do so under section 33 (1);

(g) fails to review or revise the emergency plan for the dam as and when required to do so under section 33 (2) (a);

(h) fails to submit to a dam safety officer the applicable record in relation to a review of the emergency plan for the dam as and when required to do so under section 33 (2) (b);

(i) fails to deliver a record to a local emergency authority for the dam as and when required to do so under section 33 (2) (c).

(2) An owner of a dam who does any of the following commits an offence:

(a) fails to conduct a site surveillance of the dam as and when required to do so under section 36 (1) (a);

(b) fails to conduct a formal inspection of the dam as and when required to do so under section 36 (1) (b);

(c) fails to test the operation of mechanical components of the dam as and when required to do so under section 36 (2) (a);

(d) fails to test the operation of electrical or communication equipment relating to the dam as and when required to do so under section 36 (2) (b);

(e) fails to collect, analyze or interpret readings from instrumentation relating to the dam as and when required to do so under section 36 (3);

(f) fails to ensure that an engineering professional who has qualifications and experience as required under section 20 (1) *[dam safety review and report]* carries out a review of, and prepares a report on, the safety of the dam as and when required to do so under section 36 (4);

(g) fails to submit to a dam safety officer the report referred to in paragraph (f) as and when required to do so under section 36 (4).

(3) A person who commits an offence under this section is liable on conviction to the following:

(a) in the case of an offence that is not a continuing offence, a fine of not more than $200 000 or imprisonment for not longer than 6 months, or both;

(b) in the case of a continuing offence, a fine of not more than $200 000 for each day the offence is continued or imprisonment for not longer than 6 months, or both.

Schedule 1

(sections 3 (1) and (2) and 31 (1))

Dam Classification

Definitions

1 In this Schedule:

"category", in relation to consequences of failure, means one of the following:

(a) loss of life;

(b) environmental and cultural values;

(c) infrastructure and economics;

"consequences of failure" means losses or damages that are caused by a failure of a dam;

"failure", in relation to a dam, means an uncontrolled release of all or part of the water impounded by the dam, whether or not caused by a collapse of the dam.

Determination of classification

2 (1) For the purposes of this regulation, the classification of a dam is to be determined in accordance with the following steps:

(a) for each category of consequences of failure in columns 3, 4 and 5 of the table, identify the losses or damages specified in the applicable column that most closely describe the losses or damages that are the most severe potential consequences of a failure of the dam;

(b) identify the dam failure consequences classification that is specified in column 1 of the table for the losses or damages referred to in paragraph (a) for each category;

(c) the dam failure consequences classification identified under paragraph (b) with the most severe potential consequences is the classification of the dam.

(2) For the purposes of identifying the consequences of failure in column 3 of the table, the descriptions in column 2 of the table of the population of individuals that may be at risk if there were a failure of the dam are to be considered.

Table

Item	Column 1	Column 2	Column 3	Column 4	Column 5
	Dam failure consequences classification	Population at risk	Consequences of failure		
			Loss of life	Environmental and cultural values	Infrastructure and economics
1	low	none[1]	no possibility of loss of life other than through unforeseeable misadventure	minimal short-term loss or deterioration and no long-term loss or deterioration of (a) fisheries habitat or wildlife habitat, (b) rare or	minimal economic losses mostly limited to the dam owner's property, with virtually no pre-existing potential for development within the dam inundation zone

				endangered species, (c) unique landscapes, or (d) sites having significant cultural value	
2	significant	temporary only[2]	low potential for multiple loss of life	no significant loss or deterioration of (a) important fisheries habitat or important wildlife habitat, (b) rare or endangered species, (c) unique landscapes, or (d) sites having significant cultural value, and restoration or compensation in kind is highly possible	low economic losses affecting limited infrastructure and residential buildings, public transportation or services or commercial facilities, or some destruction of or damage to locations used occasionally and irregularly for temporary purposes
3	high	permanent[3]	10 or fewer	significant loss or deterioration of (a) important fisheries habitat or important wildlife habitat, (b) rare or endangered species, (c) unique landscapes, or (d) sites having significant cultural value, and restoration or compensation in kind is highly possible	high economic losses affecting infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to scattered residential buildings
4	very high	permanent[3]	100 or fewer	significant loss or deterioration of (a) critical fisheries habitat or critical wildlife habitat, (b) rare or endangered species, (c) unique landscapes, or (d) sites having significant cultural	very high economic losses affecting important infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas

				value, and restoration or compensation in kind is possible but impractical	
5	extreme	permanent[3]	more than 100	major loss or deterioration of (a) critical fisheries habitat or critical wildlife habitat, (b) rare or endangered species, (c) unique landscapes, or (d) sites having significant cultural value, and restoration or compensation in kind is impossible.	extremely high economic losses affecting critical infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas

1. There is no identifiable population at risk.
2. People are only occasionally and irregularly in the dam-breach inundation zone, for example stopping temporarily, passing through on transportation routes or participating in recreational activities.
3. The population at risk is ordinarily or regularly located in the dam-breach inundation zone, whether to live, work or recreate.

Schedule 2

(sections 3 (2), 8 (4), 9 (7) and (8), 10 (4), 18, 19 (1) and 20 (1))

Minimum Frequency of Safety Activities

Interpretation of Schedule

1 In this Schedule:

"annually" means once in each calendar year;

"dam safety review" means a review carried out by an engineering professional under section 20 *[dam safety review and report]*;

"DEP" means the emergency plan for a dam;

"DSO" means a dam safety officer;

"monthly" means once in each calendar month;

"OMS manual" means the operation, maintenance and surveillance manual for a dam;

"quarterly" means once in each calendar quarter;

"semi-annually" means once in the period between January 1 and June 30

and once in the period between July 1 and December 31 of each calendar year.

Frequency of activities

2 (1) Column 1 of the table sets out an activity that must be carried out by an owner of a dam under Part 2 *[Requirements Applicable to All Dams]* or 3 *[Requirements Applicable to Certain Dams]*, as indicated in the table, and column 2, 3, 4, 5 or 6 of the table sets out the minimum frequency with which the activity must be carried out for each classification.

(2) If the minimum frequency with which an activity referred to in column 1 of the table must be carried out under subsection (1) is every 7 years or every 10 years, the minimum frequency is once in the period between the date on which the activity was previously carried out and December 31 of the calendar year that is 7 years or 10 years, as the case may be, after the calendar year that includes the date on which the activity was previously carried out.

Table

Item	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
	Activity	Frequency of Activity				
		Extreme classification	Very high classification	High classification	Significant classification	Low classification
Requirements under Part 2						
1	redetermine classification of dam and, if necessary submit to DSO written notice of proposed new classification	annually	annually	annually	annually	annually
Requirements under Part 3						
2	conduct site surveillance	weekly unless otherwise specified in the OMS manual	weekly unless otherwise specified in the OMS manual	weekly unless otherwise specified in the OMS manual	monthly unless otherwise specified in the OMS manual	quarterly
3	conduct formal inspection	semi-annually	annually	annually	annually	annually
4	test operation of (a) mechanical components of dam, and	annually unless otherwise specified in the OMS	annually unless otherwise specified in the OMS	annually unless otherwise specified in the OMS	annually unless otherwise specified in the OMS	annually

	(b) electrical and communication equipment	manual	manual	manual	manual	
5	collect readings from instrumentation and analyze and interpret the readings	annually unless otherwise specified in the OMS manual	annually unless otherwise specified in the OMS manual	annually unless otherwise specified in the OMS manual	annually unless otherwise specified in the OMS manual	if and when required by a dam safety officer
6	review contact information in DEP, revise if necessary and report to DSO	annually	annually	annually	annually	not applicable
7	review emergency contact information and, if necessary, revise and submit revision to DSO	not applicable	not applicable	not applicable	not applicable	annually
8	review OMS manual and DEP, revise if necessary and report to DSO	every 7 years	every 7 years	every 10 years	every 10 years	not applicable
9	ensure dam safety review carried out and submit report to DSO	every 7 years	every 10 years	every 10 years	not applicable	not applicable

[Provisions relevant to the enactment of this regulation: *Water Sustainability Act*, S.B.C. 2014, c. 15, sections 124, 126, 127, 129, 130 and 131]

Appendix 7

Liquifaction Characteristics of Intermediate Soil, Including Gravel: Hara, Toyota, Takada and Nakamura; 2012

Liquefaction characteristic of intermediate soil including gravel

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SUMMARY:
Liquefaction potential evaluation is one of the most important issues in the seismic design of structures. Although a lot of research on liquefaction characteristics of sands has been carried out so far, well-graded gravelly soil has not been investigated so much in terms of liquefaction. This study investigated a coastal area reclaimed using intermediate soil including gravel. To estimate the liquefaction characteristics at several spots of reclaimed land, in-situ investigations and laboratory tests were conducted. Results revealed that, when non-plastic fines were mixed in intermediate soil, liquefaction characteristics hardly changed with different the relative density.

Keywords: Liquefaction, Intermediate soil, Gravel, In-situ test, Triaxial test

1. INTRODUCTION

The scope of problems related to the dynamics of sandy soil during earthquakes has, over recent years, expanded to include not only cases of sand with small uniformity coefficients, but also gravel and soils with fine non-plastic components. During the 1995 Southern Hyogo Prefecture earthquake, Port Island and other landfill areas experienced liquefaction that resulted in extensive damage to many buildings, despite their being on granite soil with a silt layer composed of a wide range of grain sizes including 30–60% gravel, a soil composition previously considered resistant to liquefaction (Shibata et al., 1995). Liquefaction of gravelly soil was also confirmed in the 1987 Borah Peak earthquake in the United States (Andrus, 1994) and the 1993 Hokkaido earthquake (Kokusho et al., 1994). In many cases, it is difficult to appropriately determine strength coefficients and liquefaction conditions, because soil properties may include pockets of sand, gravel, and silt with widely differing grain sizes, not only in landfill areas but also in alluvial soils. Efforts in recent years to utilize resources to the fullest extent have resulted in an increasing trend toward the use of areas with low-quality, course-grained soil, as well as demolition scrap and industrial waste as landfill (Taya et al, 2004), making understanding the conditions in which liquefaction occurs in gravel and fine-grain soils all the more important.

Recent studies related to the effects of gravel components on liquefaction strength have focused on gravel content ratios, grain composition, relative density, and the like, but there remain many unanswered questions as compared to our understanding of sandy soils (Tanaka et al., 1987 and Hara and Kokusho, 2000 and Hara et al.,2005). In contrast, numerous recent studies on the effects of plasticity index, silt composition, and clay composition have made clear the effect of fine grain content and composition on resistance to liquefaction of sandy soils (Ishihara et al., 1989 and Hwang et al., 1993 and Kuwano et al., 1995).

The present study examines intermediate landfill soils with high gravel or fine grain content, performing in situ tests to determine penetration resistance and shear wave velocity values. We also performed laboratory testing on landfill ground samples to determine their physical properties, liquefaction strength, and deformation characteristics after liquefaction. Based on these experiments, we investigate the liquefaction characteristics of intermediate soils with gravel content.

2. INVESTIGATION SITE

We selected Hirogawa Island in Wakayama Prefecture as a case of a landfill site with soil including gravel at which to perform our investigation. Figure 1 shows a map of the area. The site is at the mouth of the Hiro River, and extends approximately 500 m in the north-south direction and 250 m in the east-west direction. Land use differs along the north-south direction: On the northern side are public facilities such as the town hall, a municipal gymnasium, a health and welfare center, and a multipurpose plaza. The southern side is predominantly residential subdivisions. Construction of the landfill began in 1993 and ended in 1995, and landfill is mainly composed of cuttings from the construction of the nearby Hirogawa wind farm and drilling remains from the creation of a tunnel for the Yuasa-Gobo highway. The excavated soil is largely Mesozoic sandstone and mudstone from south of the Aritagawa river basin. Country rock has experienced weathering due to the influence of groundwater.

Figure 2 shows a geologic cross section of the area, based on boring samples taken during construction of the health and welfare center adjacent to the Hirogawa town hall, along the line indicated by A and A´ in Figure 1. According to this diagram, the landfill layer (FL) extends more or less horizontally to approximately G.L. -4.75 m, and below that are interbedded slopes of alluvial sand (As), clay (Ac), and gravel (Ag) layers sloping west until reaching the sandstone layer (Ss). Figure 2 also shows the relation between depth and *N*-values obtained by a standard penetration test. *N*-values exceed 50 in some locations due to contact with gravel, but *N* values as low as 3–10 are also seen despite an overall good grain size distribution including gravel.

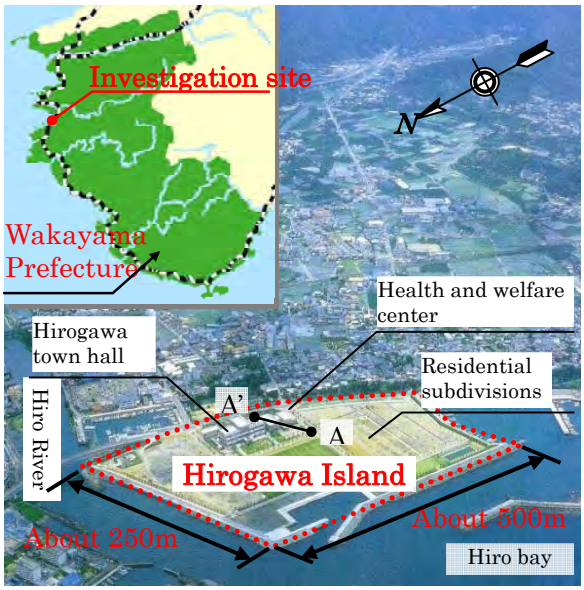

Figure 1. Location of Hirogawa Island

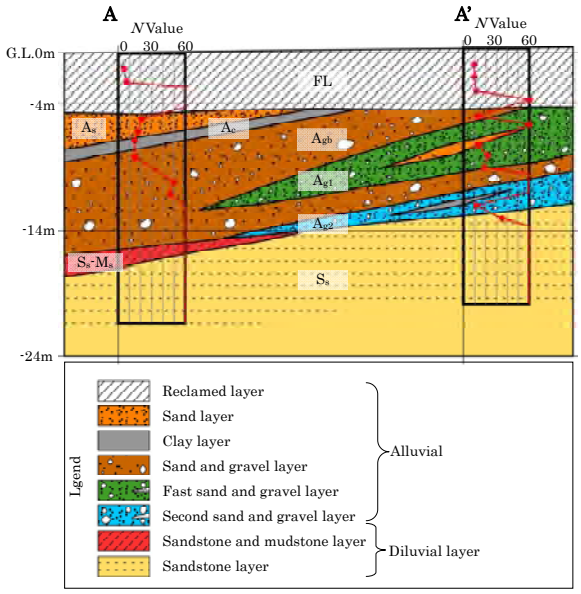

Figure 2. Geological section of Hirogawa Island

3. IN-SITU TEST ON RECLAIMED LAYER

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To investigate hardness in the depth direction, we conducted in situ Swedish weight sounding (SWS) tests and surface wave exploration (SWE) tests (Photo 1). Figure 3 shows a map of the testing area and the locations where in situ testing was performed. SWS tests were performed mainly in the area adjacent to the seawall near the municipal multipurpose plaza, and SWE tests were performed along five north-south and east-west survey lines in the surrounding area.

Figure 4 shows an example of the relation between depth and *N*-value according to one of the SWS tests (Takada et al., 2010). Here, *N*-values are calculated according to the conversion method for gravel, sand, and sandy soils proposed by Inada. The histogram in the figure is an estimation based on insertion noise and vibration transmitted along the rod during penetration, and from soil that adhered

(a) Swedish weight sounding

(b) Surface save exploration

Photo 1. In-situ tests

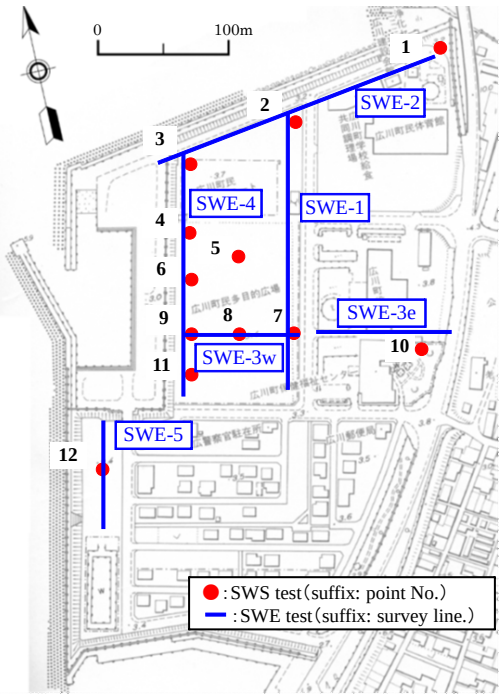


Figure 3. In-situ investigation site

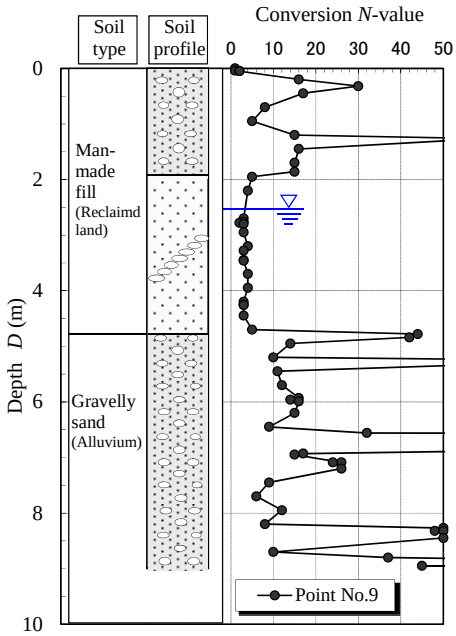


Figure 4. Soil profile at Hirogawa Island (Point No.9)

to the rod and screw. The groundwater depth (G.L. -2.6 m) is calculated from the mean value over multiple groundwater level measurements from the holes left by penetration tests. Penetration resistance values were obtained by an insertion rod contacting gravel to a depth of approximately G.L.-1.95 m, and values varied widely from N =10–50. In contrast, values below G.L. -1.95 m were an extremely loose N = 3–6, but N-values again suddenly increased below G.L. -4 m. While the test method and locations differ, results of SWS tests gave similar results to those shown in Figure 2, with a loose fill layer of approximately N = 11 in the area between G.L. -2 m and -4.5 m.

Figure 5 shows an example of the results of surface wave exploration obtained through the SWE tests performed along the SWE-3w survey line. The relation between ground depth and hardness as indicated by the magnitude of S-wave velocity fits well with Figure 2 and the N-value distribution. Namely, there is a layer of soil distributed approximately horizontally near the surface with hardness sufficient to exceed V_s = 260 m/s, but in the landfill layer below G.L. -2.5 m there is a soft layer deposit with low V_s values of 200–220 m/s, approximately the same as the mean values seen in granite soil landfill that liquefied during the Southern Hyogo Prefecture earthquake (Yamazaki et al., 1995). At depths below G.L. -4.5 m, V_s shows a clear trend of increasing with depth. While not shown in the diagram, cross-sectional surveys verified a soft layer with V_s values of 160–200 m/s at approximately

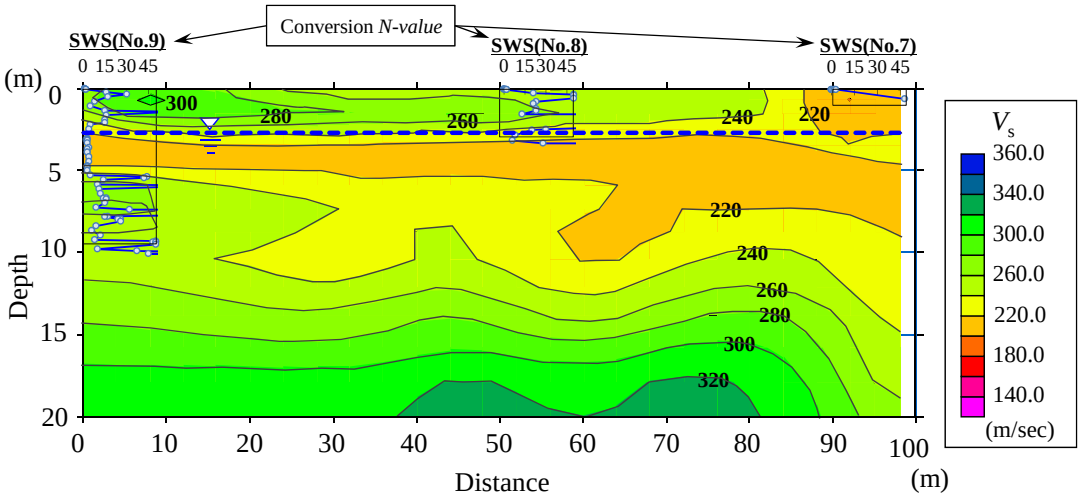


Figure 5. Surface wave exploration result (SWE-3w survey line)

G.L.-2.5 to -4.5 m horizontally along the SWE-5 survey line.

Results of the in situ testing described above indicate that the landfill layer of the soil in Hirogawa includes a soft layer with *N*-values of approximately 5 at a depth of G.L. -2 to -4.5 m, having S-wave velocities of 160–220 m/s. According to Kokusho and Yoshida, the gravelly soil in which liquefaction occurred had *N*-values of approximately 5 to 10, and S-wave velocities of 60–200 m/s. This indicates that based on in situ testing results alone, the soil in the areas tested has a high probability of experiencing liquefaction.

4. SOIL MATERIALS AND MINIMUM AND MAXIMUM DENSITY TEST

Test samples were composed of intermediate soil that included gravel with a maximum grain diameter of 26.5 mm taken from the soil used as landfill in Hirogawa ("Hirogawa soil," below). To prevent caking of the fine fraction through aggregation, disturbed samples were allowed to dry naturally for approximately one week after removal from the sampling site. Figure 6 shows a grain size distribution curve for the Hirogawa soil. There is a fairly broad range of granularity compositions in the samples, with fine grain composition F_c ranging from 0–50% and gravel composition ranging from 20–70%. After being passed through a 0.425 mm sieve, Hirogawa soil had a plasticity index Ip of 17, indicating some level of plasticity in the samples. The water absorption rate of gravel grains larger than 2 mm as determined by specific gravity and water absorption testing was a large Q = 12–20%, indicating significant porosity and extensive weathering. Rock slaking testing using the JHS 110-2006 method indicated a slaking rate R_s of 40–70%, suggesting high slaking behavior and a tendency to crumble after repeated exposure to moisture.

Figure 7 shows the relation between minimum and maximum density and fine grain content as indicated by the minimum and maximum density test apparatus shown in Figure 8. Figure 7 also shows similar relations for laboratory-prepared samples of hard alluvial gravel with differing grain sizes and undisturbed granite soil samples collected after the Southern Hyogo earthquake. The plotted values are means for 10 repetitions of the minimum density test and 5 repetitions of the maximum density test, using fine grain content equivalent to the intermediate value of the grain size distribution curve in Figure 6. From this, we can see that minimum and maximum compression of the Hirogawa soil have lower values than do alluvial gravel with large mean coefficients and granite soil with high grain fragmentation characteristics, despite differences in fine grain content.

5. TRIAXIAL TEST

We next used the cyclic triaxial test apparatus shown in Figure 9 to investigate the liquefaction

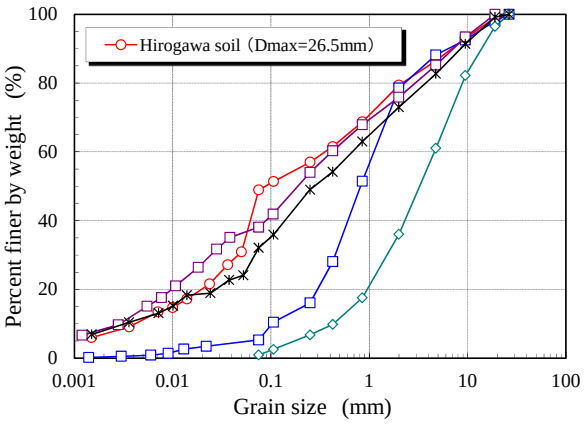


Figure 6. Grain size distribution curve for the Hirogawa soil

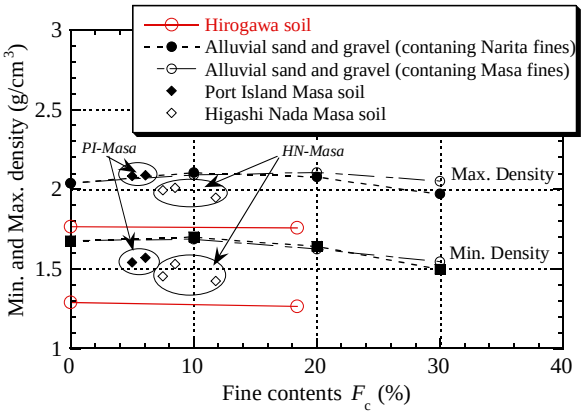


Figure 7. Minimum and Maximum density tests result for the Hirogawa soil

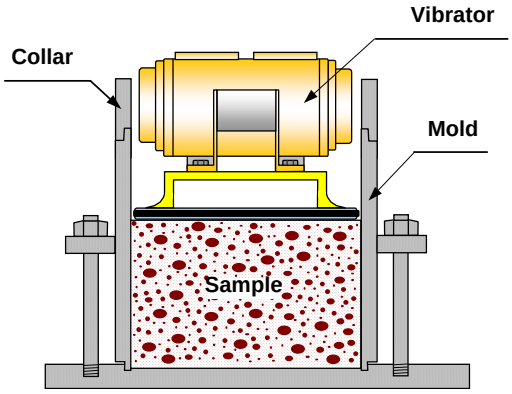


Figure 8. Minimum and Maximum density test apparatus

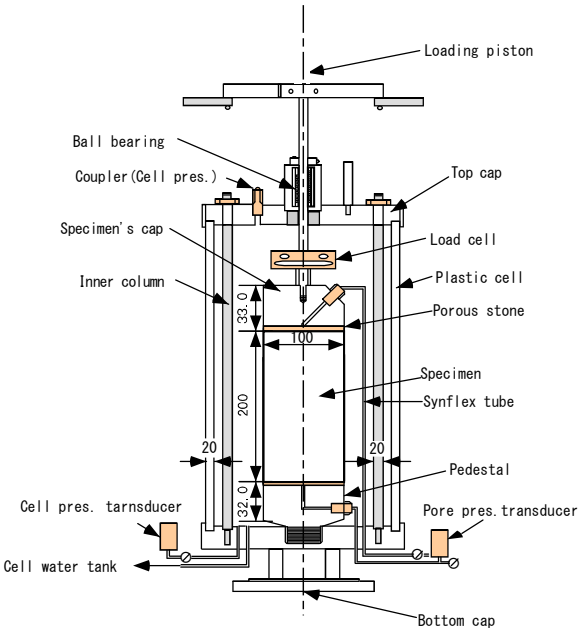


Figure 9. Cyclic triaxial test apparatus

characteristics of Hirogawa soil, and the effects of relative density and fine grain composition on its deformation after liquefaction (Hara and Kokusho, 2004). Figure 10 and Table 1 show the grain size distribution curve and the physical characteristics of the samples, respectively. Two samples were prepared in the laboratory for this test. Sample A was prepared with a grain composition of approximately the intermediate value of the grain size distribution curve in Figure 6. Sample B was prepared by washing Sample A through a 0.075 mm aperture sieve to remove the fine-grain fraction.

To minimize the influence of grain classification, the specimens were adjusted to an approximately 5% water content in separately prepared containers, then compressed into molds according to the wet tamping method using a 49 mm diameter rammer. After compression, each sample was prepared so that the relative specimen densities were $D_r \approx 40\%$, 50%, and 60%. After confirming that the pore pressure coefficient B was at least 0.96 assuming a back pressure of 98 kPa for each specimen, we applied isotropic compaction with effective confining pressure σ_c' =49 kPa, approximately equal to the effective overburden pressure on the landfill layer. Compression time was approximately 1 hour, during which we confirmed that water expulsion had completely leveled off. To confirm the overconsolidation effect on liquefaction characteristics, we used a portion of Sample A to prepare overconsolidated specimens with OCR =3.0 after pre-consolidation at the prescribed consolidation stress and drainage unloading.

Liquefaction tests were performed under undrained conditions using 0.1 Hz sine wave loads, cycled until a double amplitude axial strain DA of 5% was reached. Overall smoothness of the specimen sides

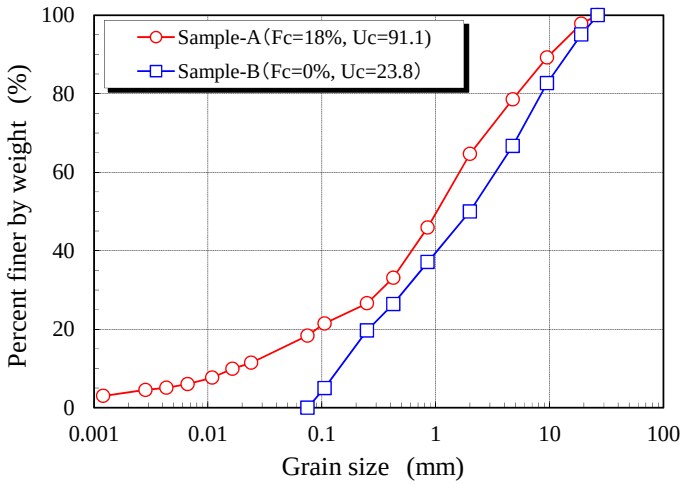
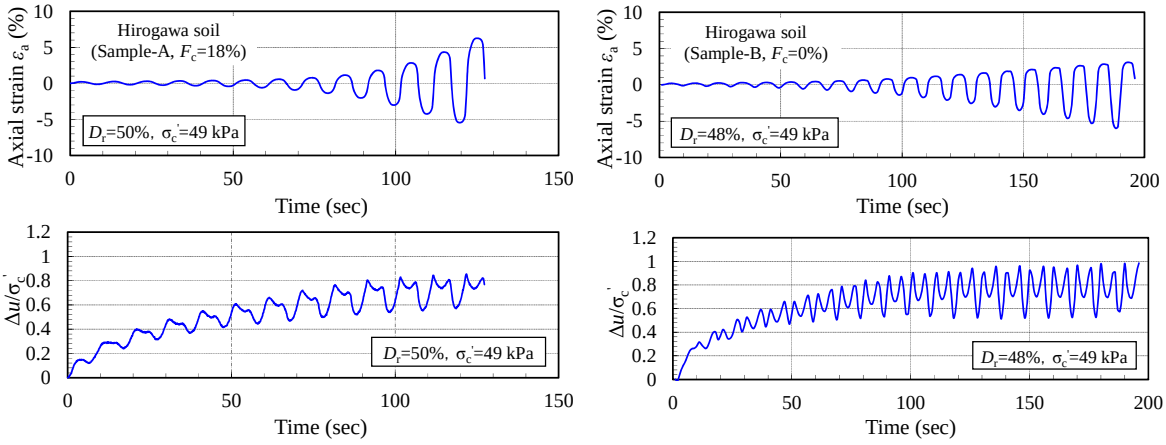


Figure 10. Grain size distribution curve for triaxial tests samples

Table 1. Physical characteristics for triaxial tests samples

Soil Material	ρ_s (g/cm^3)	ρ_{dmin} (g/cm^3)	ρ_{dmax} (g/cm^3)	e_{max}	e_{min}	I_p	D_{50}	U_c
Hirogawa soil (Sample-A)	2.736	1.758	1.263	1.166	0.556	17	1.03	91.1
Hirogawa soil (Sample-B)	2.686	1.289	1.765	1.084	0.522	NP	2.02	23.8

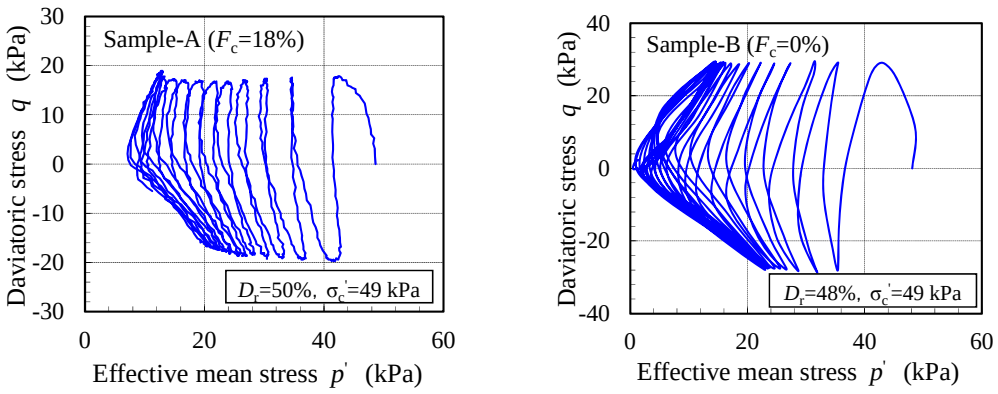


(a) Sample-A (b) Sample-B

Figure 11. Example of axial strain and excess pore water ratio time history of cyclic triaxial tests

was good, indicating little influence of membrane penetration correction.

Figure 11 shows an example of the axial strain and excess pore water ratio time history of the cyclic triaxial tests using a specimen with $D_r \approx 50\%$. For sample A (Figure 11(a)), cyclic shearing resulted in an accumulation of excess pore water pressure from the start of loading and a gradual increase in axial strain ε_a with the number of cycles, but the excess pore water pressure ratio $\Delta u/\sigma_c'$ did not reach 1.0, even after double amplitude axial strain DA reached 5%. In contrast, sample B (Figure 11(b)) exhibited a rapid increase in excess pore water pressure from the start of loading, and axial strain that



(a) Sample-A (b) Sample-B

Figure 12. Example of stress pass of cyclic triaxial tests

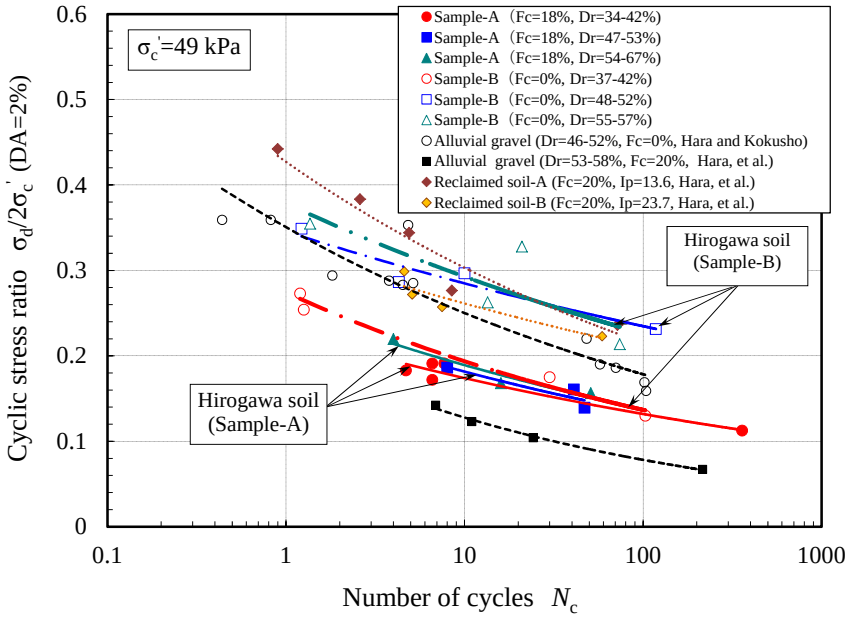


Figure 13. Undrained cyclic triaxial test results

increased with the number of cycles. Figure 12 shows the effective stress path of the results of the tests of Figure 11. Sample A shows behavior similar to loose sandy soil, where mean effective principal stress falls with the number of cycles. In contrast, Sample B indicates cyclic mobility behavior, where effective stress reduction is suppressed after reaching the phase transformation line.

Figure 13 shows the relation between the cyclic stress ratio $\sigma_d/2\sigma_c'$ and the number of cycles N_c from the undrained cyclic triaxial test when double axial strain amplitude DA reached 2%, at which necking effects are minor. Based on its plasticity index alone, the Specifications for Highway Bridges would exclude sample A from needing a determination of its susceptibility to liquefaction, but liquefaction strength R_{L20} is defined as a low 0.17 at N_c = 20 without consideration of D_r. In contrast, while the $D_r \approx$ 40% specimen from sample B has liquefaction strength similar to that of sample A, the liquefaction strength shows an overall increase with increasing relative density. Figure 13 also shows liquefaction strength curves for various alluvial sand, gravel, and landfill ground samples with plastic fine grains (Hara and Kokusho, 1998. and Hara et al., 2009). Comparing R_{L20} values, one sees that sample B has a higher strength than does sample A. This is because the gravel grain matrix is dominated by the fine-grain fraction in sample A, resulting in no change in the liquefaction strength even with an increased relative density, but in sample B, where the fine-grain fraction has been removed, sand and gravel grains are able to interlock, resulting in increased strength with higher relative density, thereby

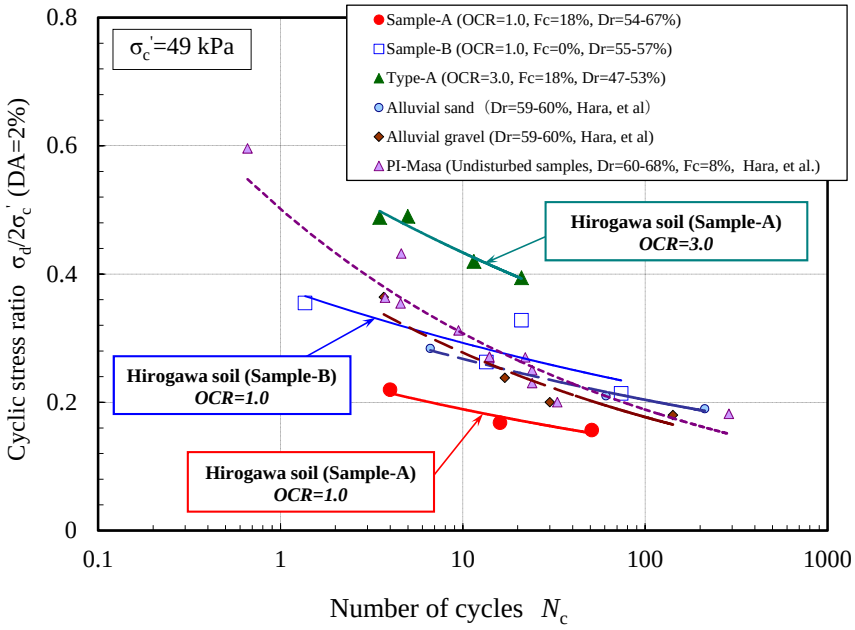


Figure 14. Undrained cyclic triaxial test results of D_r=60% the samples

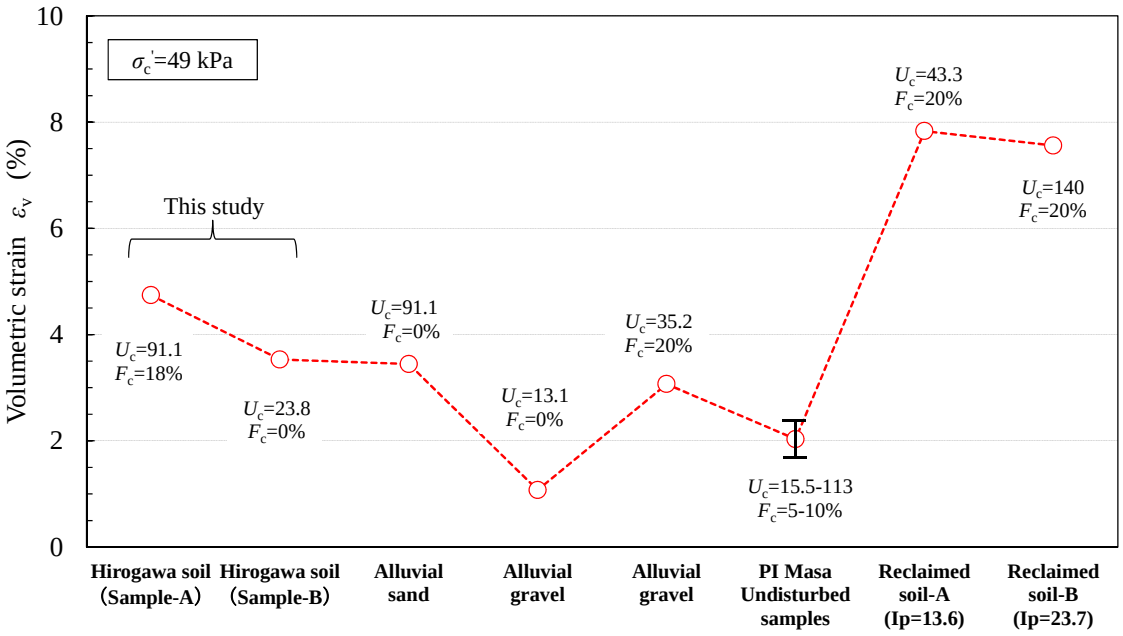


Figure 15. Consolidation test results carried out after cyclic loading

making it more like sandy gravel or clay that does not contain a fine-grain fraction. Figure 14 shows a comparison of liquefaction strengths for Hirogawa soil specimens with relative density D_r of 60% after consolidation. When the liquefaction strength of sample A, to which the overconsolidation history has been applied, is compared with that of an OCR = 1.0 sample, there is a significant increase even for those samples that include a fine-grain fraction, and the strength exceeds those of sample B and undisturbed samples of granite soil that has undergone soil stabilization treatment using rod compaction taken from Port Island.

Figure 15 shows the mean results of reconsolidation tests on a $D_r \approx 50\%$ specimen after liquefaction testing, giving volumetric strain ε_v values at an effective confining pressure σ_c' of 49 kPa. Here, volumetric strain was found immediately after removing the load when DA reached 10%, based on the amount of drained water in a burette when specimens were returned to the drained state at the point of completion of the initial consolidation before the liquefaction strength test. Variation in the amount of

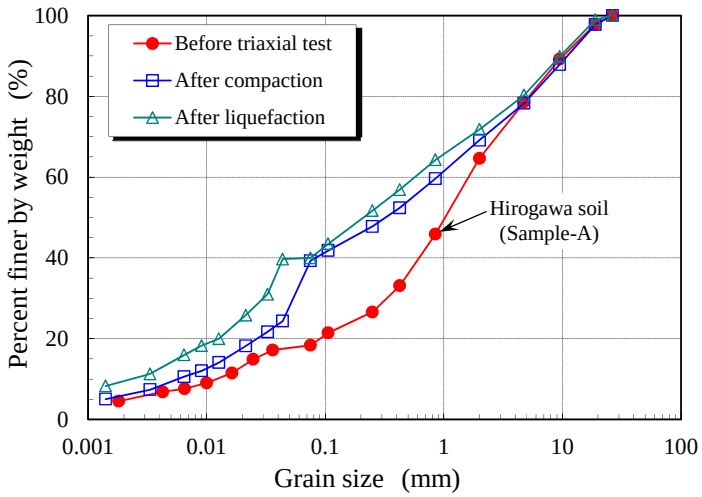


Figure 16. Comparison of grain size distribution curve

volumetric strain among the specimens was ε_v = 4.2–5.0% for sample A, and ε_v = 3.1–4.0% for sample B. Mean values for volume change associated with the dissipation of excess pore water pressure during the reconsolidation process were smaller for sample B, from which the fine-grain fraction had been removed, than for sample A. Figure 15 also shows the same relation for various D_r = 50% alluvial sand, sandy gravel, granite soil, and landfill ground samples with a plastic fine-grain fraction. The change in volume for the Hirogawa soil after liquefaction was smaller than for soils containing a plastic fine-grain fraction, but greater than for the alluvial gravel containing hard grains regardless of F_c. Values were similar to those of alluvial sand with a small mean coefficient and alluvial gravel with a non-plastic fine-grain fraction, and to granite soil with highly friable grains.

Figure 16 shows an example comparison of the grain size distribution curves for $D_r \approx 50\%$ specimens after cyclic undrained triaxial testing. Here, values in the after-compaction grain size distribution curve are the results of grain size testing of specimens disassembled immediately after their creation, and values shown for the grain size distribution curve after liquefaction testing are from specimens after cyclic shearing and reconsolidation testing. From this, we see a large shift to the left in the particle distribution after liquefaction compacting and liquefaction testing of the scope covered by the present study, indicating that compaction, reconsolidation, and shearing resulted in the destruction of mainly gravel grains larger than 2 mm. The grain destruction rate B_M (Marsal, 1967) as calculated from the grain size distribution curve was 25% immediately after compaction, and 20% after the consolidation and cyclic shearing process.

CONCLUSIONS

In situ and laboratory testing of intermediate gravelly soil (Hirogawa soil) resulted in the following major findings:

1. The *N*-value of intermediate gravelly soil from landfill ground is approximately 5 and S-wave velocity is 160–220 m/s, low values that are highly similar to gravelly soils in which liquefaction has been verified.
2. Grains in Hirogawa soil are highly porous and show extensive weathering, making them prone to slaking.
3. The liquefaction strength of Hirogawa soil varies widely according to the presence of fine grains. Removing the fine-grain fraction from samples allowed interlocking of grains, resulting in high strength.
4. Post-liquefaction consolidation characteristics were highly similar to those of loose sand, regardless of the ratio of fine grains.
5. Hirogawa soil experiences destruction of gravel grains during the process of compaction, consolidation, and cyclic shearing..

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