McKenzie Interchange Highway Improvement Project, Colquitz River and Cuthbert Holmes Park Culvert Outfall and Riparian Mitigation and Restoration
Prescription Summary and Environmental Construction Workplan

Pre-restoration photos of impaired areas targeted for restoration. From top left and clockwise: Partial Cloverleaf Outfall Area, E Outfall, Colquitz River Mainstem Infill and Colquitz River Grassy Riparian Zone

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PROJECT BACKGROUND and SUMMARY

This document is a summary of proposed restoration works associated with the Ministry of Transportation and Infrastructure (MOTI) McKenzie Interchange Project (MIP) in and along the Colquitz River and District of Saanich's Cuthbert Holmes Park (CHP). This is intended as an overview with additional details available in other documents, including survey and design drawings, and other correspondence, that may be provided on request.

In June 2018 Sean Wong, MOTI Senior Biologist was requested by MIP Environmental Manager Joanne Letkeman to review the proposed engineer designed Outfall Energy Dissipation Bay at the SE partial cloverleaf (parclo).

In fall 2018 a stormwater outfall discharge to the E, described as the E outfall, was added to assess for possible environmental restorative measures.

The MIP then solicited input for riparian replacement for a preliminary 430m^2 of originally unaccounted project footprint impacts.

These restoration areas are within a main zone of influence of MIP and discussions are occurring with community members regarding opportunity for support or in-kind at other nearby environmental restoration projects.

MIP is providing the funding to meet their commitments for treatment of the parclo outfall and 430m^2 riparian replacement. Where re-purposed materials, such as surplus aggregate or soil, are provided by the prime contractor at no additional cost to MIP this results in additional in-kind.

MOTI's environmental programs are supporting incremental restoration above and beyond MIP obligatory environmental commitments through additional funding and technical expertise. In-kind is being contributed through other project partners and submissions for external fisheries restoration funding have been made.

Community stakeholders are actively engaged and providing valued input and recommendations, meet regularly onsite and have frequent communications. This is enabling a collaborative restoration plan to meet MIP commitments for parclo stormwater treatment and riparian replacement with incremental restoration superseding MIP obligations.

STORMWATER TREATMENT and HABITAT RESTORATION PRESCRIPTION

1. Parclo Outfall Treatment

The drainage engineer initial concept for the parclo outfall was an armoured channel with rock lined banks and berms about 75m L x 10.5m W at the primary culvert outfall.

Because the proposed armoured channel created a footprint swath through a functional and tidally influenced riparian zone and tributary to the Colquitz River through CHP, an alternative softer and more environmentally compatible water quality treatment pond and wildlife habitat feature within about 350m^2 of the existing disturbed zone between the parclo embankment toe and riparian zone is developed as an alternative and preferred option.

MIP management requested confirmation that the preferred option would not result in undue downstream erosion and sedimentation or other concerns. This drainage was assessed under high stress flood and field conditions, subsequent to highest observed discharge and tidal (King tides) condition in fall/winter 2018/19 and these assessments confirmed that the environmental treatment should work well and be long-term stable and functional.

A hydrological assessment was done via MOTI in-house Water Resources Engineer-in-training Andrew Anderson to confirm no negative impacts anticipated by the proposed backflooding of the outlet of the lower elevation culvert.

The parclo outfall stormwater treatment wetland pond design concept and considerations include:

- Because the flow contributions are mainly from urban and highway runoff and are stormwater, it is preferred to make the pond inaccessible to fish. For the vast majority of the time, the pond outlets should preclude fish access because of the vertical differential of about 1m from the pond outlet control to the downstream channel, other than extreme flood conditions and king tides.
- Constructing an outer raised perimeter with ~1m±0.2 boulder sized durable angular rock using the existing riparian zone as the south border of the pond. This perimeter raised rock foundation bank is being done largely to raise the pond outlet elevation to reduce fish access into this feature.
- Constructing the pond, banks and features with undulating and varying topography with increased edges, surface area, roughness, complexity and biodiversity features.
- Excavating depressions to 1.8m± or 0.5m and lower than the low water level to provide increased aquatic pond volume and quiescent sediment settlement areas.
- Constructing mounds and small islands for plantings, habitat complexing and terrestrial wildlife features.
- Habitat complexing by adding in-pond and terrestrial woody debris, including artificial snags, and rock features.
- Installation of bird and bat nesting boxes.
- Installation of cross logs at the outlets to serve as organic skimming (oil) booms.
- Placement of growing medium from above the estimated low water elevation* and above.
- * The 2.3m low water elevation is based on the standing water elevation observed during August 2018 during drought conditions with virtually no significant measurable rainfall from earlier in the summer and many days of above average and record high temperatures. While this was the low water elevation observed, there will be increased exposed water surface area and evapotranspiration, and this may result in water elevations dropping below 2.3m.
- The primary pond outlet is set at 3.0m or 0.7m above the 2.3m low water level and secondary or overflow outlet at 3.15.

- When fully charged the maximum pond depth is about 1.2m, plus depth the water elevation may charge above the outlet controls.
- For the most part the high king tides were not observed to backflood to the pond outlet areas, however, during the most extreme river flood stage and king tides there was some inundation reported in this area by stakeholder Dorothy Chambers.
- Basal till soils are anticipated in excavation areas below a thin layer of organics. Basal till is relatively dense and impermeable and therefore precludes ground infiltration and establishment of vegetation and other biological activity.
- The basal till therefore functions as a pond liner and the pond will then function more as a retention and detention treatment feature with low infiltration expected. This is different than rain garden type treatments which incorporate infiltration into the groundwater zone.
- Because there is some leakage in the gaps in the pond perimeter is expected because total sealing of the rock gaps may not occur, some exfiltration through the constructed pond perimeter bank is anticipated. This may result in the water level receding slightly quicker during low inflows into the pond.
- Salvaged and packing this less permeable basal till into the inner perimeter rock face may be done to reduce leakage through the rock voids.
- Stakeholders suggested integrating oyster shells into the water quality treatment ponds and this is planned by sourcing oyster shells from processors in Fanny Bay.
- Capping exposed and submerged basal till with an enhanced substrate, such as alluvial material and oyster shells will be done.
- An engineered treatment pond designed and constructed by others is planned within the parclo and upstream of the outfall discharge and the wetland pond at the culvert outfalls provides pre-treatment prior to discharge to this feature.
- Two outlets from the pond are proposed, the primary outlet will discharge to and maintain flows to the main downstream tidal channel and a secondary overflow toward an adjacent low-lying riparian area that also receives inflows.

2. <u>E Outfall Treatment</u>

The MIP did not originally plan any further treatment beyond the existing ~20m^2 rock armoured settling pond. Therefore, this water quality treatment and habitat feature is incremental restoration beyond what was originally planned by the MIP.

A wetland pond with raised banks constructed using surplus excavated materials within the grass and weed dominated meadow 500m^2+ area is proposed to provide incremental water quality treatment and biodiversity features and roughly bordered by a shrub boundary. Some of the shrubs are non-native English hawthorn and invasive plants may be removed to create additional pond or native riparian habitat.

A main difference between this wetland pond feature and the one at the parclo outfall is it does not have a raised boulder perimeter bank because there is an existing topographical and elevation break that precludes fish access from the Colquitz River. In comparison to the narrow area along the parclo outfall treatment zone, there is a much wider area to enable construction of banks to enable additional native riparian revegetation and terrestrial habitat complexing.

Organics will be salvaged and placed as the topdressing on the outer sides, top of the berm and above the low water elevation ± where native riparian and wetland revegetation is targeted.

If expected basal till soils are encountered and exposed during excavations, a layer of alluvial gravel and oyster shells will be placed as a surficial treatment below the low water mark ± to provide improved substrate for added surface area and biological activity, including periphyton, microbial breakdown of contaminants and benthic invertebrates.

Large woody debris, rock habitat complexing and will be added to the pond feature, including for additional surface area, roughness, cover, in-pond and terrestrial, including for addition of bat rocket boxes and bird cavity nesting boxes.

The pond outlet elevation control is set at the estimated low summer water level of 4.1m exhibited at the existing E outfall settling pond.

The meadow area remains moist with an underfoot spongy feeling throughout the summer, and this in combination with year-round water in the settling pond helps demonstrate a good likelihood of creating pond and wetland habitat.

Though with the increased water exposure and surface area of the pond surface, it is expected that higher evapotranspiration may occur leading to the pond level lowering through dry periods, or possibly becoming ephemeral during drought conditions.

A small number of native bulrush exist within the meadow area, these native plants will be salvaged and transplanted into the new pond feature.

The majority of this wetland pond and wildlife feature is on CHP and is supported by Saanich Parks and community stakeholders.

3. <u>Riparian Replacement</u>

MIP riparian replacement is for unaccounted footprint impacts is preliminarily estimated at 430m^2.

Through site assessments and engagement and consultation with community stakeholders and Saanich Parks, a riparian replacement plan has been developed to exceed MIP requirements. Considerations and recommendations for the riparian replacement include:

- The SE section of District of Saanich's Cuthbert Holmes Park (CHP), E of Admirals Road, S of the Trans-Canada Highway 1 and along the right/N bank of the Colquitz River is an excellent candidate area for riparian and additional restoration.
- This target restoration area includes largely historically disturbed ground to the banks of the river, is tidally influenced and could easily be accessed via machine access via existing I/C construction access points to the E of Admirals Road.
- There are several thousand m^2 of previously disturbed and grass dominated area in this zone, far exceeding MIC replacement requirements, with the highest value riparian benefits are immediately contiguous to the Colquitz River and are the priority area to maximize riparian benefits.
- With heavy equipment machine access, this enables larger scale restorative works, including possible addition of instream and terrestrial woody debris features, removal of less desirable grass, weeds and invasive plants, ground scarification, delivery of soil for placement of growing media, excavation and other earthworks.
- Mechanical removal or burying of the grass and weed dominated areas and planting with native species, including salvaged plants, live cuttings, nursery stock is planned.

- Because CHP is owned by Saanich, their endorsement is required for any restorative measures and works on CHP and this is a critical in-kind partnership contribution that has been established.
- A site survey and drafting of the collected geo-referenced data is in progress and the preliminary survey shows potential restoration areas.
- MOTI's environmental programs may be used for restoration measures beyond MIC project commitments and funding.
- Rather than typical smooth and uniform grading, soil will be placed and landscaped with uneven and undulating topography and contours to create small hummocks and valleys and enable more diverse vegetation and biodiversity features.

In addition to the riparian replacement along the Colquitz River, wetland and riparian plantings for the will provide native riparian replacement within the ~850m^2+ wetland pond sites.

Creation of Tidal marsh benches in tidally influenced areas along the cleared and disturbed areas along the Colquitz River right/N bank targeted for riparian restoration would add additional ecosystem and estuary function.

Terrestrial woody debris complexing and rock features will also be added, with logs installed as artificial snags and bat roosting and maternity rocket boxes and nest boxes for bird cavity nesters installed on the snags or log poles.

A minimum of 500m2 of river riparian, within 15m of the channel edge is targeted. The MIP indicated they may have several thousand surplus m3 of surplus strippings containing some organic soil. If some of this becomes available, it may enable much more soil placement and riparian restoration, but this is contingent on obtaining the soil at no additional cost and it being suitable to establish plantings.

If drought and heatwaves continue to be prevailing summer weather, supplementary watering may be needed to ensure suitable viability of plantings. Supplementary fall planting may also help increase revegetation success.

4. <u>Tidal, Instream and Other Restoration and Enhancement</u>

- Additional restoration may include:
    - Terrestrial, instream and tidal woody debris and boulder habitat complexing.
    - Creation of tidal marsh benches and intertidal dendritic channels.
    - Installation of bird and bat nest boxes.
    - Placement of in-channel gravel for spawning, as an improved substrate for benthic invertebrates, a test for possible forage fish spawning and to create a vegetated tidal saltmarsh estuary bench.
    - Salmon outplanting or instream incubation of embryos.

If suitable large woody debris is sourced, placing some in-channel would add hydraulic features and additional habitat complexity and cover. This could be done from the exposed and open riparian restoration banks that are planned for riparian restoration.

The river tidal area is low gradient and low energy so if stems are sufficiently long, they could be buried into the banks to hold in-place, or it may be anchored to ballast rock to keep it stable.

Rock features, like boulder clusters, could also be placed in-channel to increase habitat diversity.

Sean Wong suggested removing organic sediments and replacing with constructed alluvial tidal marsh benches and points in the mud/sediment flat channel with deeper intertidal channel construction and additions of large woody debris downstream of the parclo outfalls. Questions and concerns were raised by Sara Stallard and Yogi Carolsfeld on whether this may alter existing desirable features like biofilm (for shorebird feeders like sandpipers).

The aggraded soils in the tidal outfall channel appear to be dominated by organics and would be salvaged for riparian planting substrate and some of it could also be integrated into the marsh benches.

On probing the mud sediments, a distinct hydrogen sulphide odour was detected, so it is expected the sediments are anoxic and not as hospitable to biological life compared to a substrate that would have increased flow exposure, like gravel.

The banks along this channel have a softer and deeper surficial organic layer and the excavations would be expected to generate sloppier material handling and deeper machine rutting and tracking.

Field discussions were to assess this item further to determine if this tidal marsh bench and channel restoration should be done within the parclo outlet channel and if supported, a smaller (e.g. <50m^2) area could be attempted as a test or pilot tidal marsh bench and channel restoration area within the parclo outflow channel.

There are some previously cleared open banks along the mainstem right bank that could be pulled back through excavation and grading to provide dendritic, finger-like, dead-end tidally influenced channels. Desirable substrate like gravel would be added to replace some of the mixed fill and contouring done to provide tidal backwatering and raised marsh benches along the channels. Riparian restoration will be done higher on the backshore and up the adjacent bank. The dendritic channels are proposed 0.5-2m wide, 3-10m long, 2-5% gradient and constructed such that the downgrade toward the mainstem and shape will allow fish entrance under higher tides, but also enable fish outmigration with low stranding risk.

Kiara Robertson, Environmental Technician and Surveyor of Westwood Environmental, has preliminarily identified vegetation in the restoration zone to flag non-disturbance native plant zones and invasive plant zones where no special vegetation protection is needed. Grass, weeds and some invasive plants (e.g. Himalayan blackberry) areas are evident and are the main targeted areas for aggressive earthworks for riparian reclamation.

The initial intertidal estuary vegetation assessment indicates it is mainly native species, including colonized areas along a rock gabion bench. This bodes well for natural intertidal vegetation colonization, if the benches or platforms are built to the proper elevation and with a suitable substrate to provide natural recolonization. Some hand or machine transplants from donor sites can also be done to kickstart intertidal revegetation.

Upright logs will be installed as artificial snags with some hole drilling to promote insect use and cavity formation. Bird boxes for cavity nesters like swallows and songbirds will be installed. Christian Engelstoft of the Habitat Acquisition Trust (HAT) field reviewed the site and recommended installation of at least two bat rocket roosting and maternity boxes and Christian and HAT will be retained as technical support for the bat box installations.

Dorothy Chambers of Salmon in the City provided salmon escapement data for the Colquitz River fish fence ranging from 218 to 1584 (mean 724) coho salmon from the years she has been involved with the counts from 2012-2018. Dorothy indicates only a solitary male chum salmon was observed these years, and in previous years records show sporadic chum observations, with a high reported in the first year, 2001, of records of 75.

Because of the distance from Colquitz River estuary along the inland Gorge Waterway to Victoria Harbour being 5km+, and no nearby systems with large chum returns, it is theorized there is a low chance of strays entering into this area compared to streams much closer to systems with high escapement. If this is the case, there may be insufficient chum returns to re-establish a viable population and outplanting a suitable stock may cause them to imprint and return as spawners to rebuild a naturalized population.

Many of the streams in this area and up the Saanich Peninsula are lacking natural gravel recruitment, so suitable gravel spawning habitat may also limit chum re-establishment. MOTI has desirable aggregate in its Telegraph Road Gravel Pit in Mill Bay and some of this material is being used at the restoration site and could be placed instream for spawning habitat to address this potential limiting factor to chum salmon production. In addition to spawning augmentation, the gravel should be where it will also provide other substrate benefits, such as increased benthic invertebrate habitat and hyporheic flows, and without undue negative impacts, like excessive dewatering or habitat infilling, which could occur from excessive gravel deposition or aggradation.

Sub-excavation to remove undesirable substrates and backfilling and contouring with spawning gravel may be the best means to optimize gravel functionality and benefits.

Discussions with Peter McCully, Biologist and Technical Support with the Goldstream Volunteer Salmonid Enhancement Association (GVSEA) indicates support to explore chum salmon re-establishment after the MIP concerns are resolved and if appropriate permits are obtained. Peter and GVSEA have been very active partners on this type of initiative with many other community groups and MOTI partnership projects.

Community stakeholders suggested rain gardens to help with treatment of stormwater runoff and infiltration to the groundwater table. The dominant sub-surface soils observed are impermeable basal till, so that type of soil is not conducive to infiltration for rain garden type of water quality structures. However, the stockpile and staging area has been built using a porous aggregate base, and in its decommissioning a vegetated rain garden with infiltration through the aggregate base could be done. A wetland pond type feature is not probable because this area is situated higher and drier in comparison to the proposed outfall ponds, but a rain garden could be a green feature to capture and treat some of the runoff discharging to this area.

The initial restoration scope was the parclo outfall treatment, but based on the ever-expanding scope and opportunity, there may be other collaborative and opportunistic restoration developed and implemented.

COMMUNITY ENGAGEMENT and CONSULTATION

The most active community stakeholder in the development of this restoration prescription for the Colquitz River restoration is Dorothy Chambers, who is providing very valuable local knowledge, coordination and many field reviews and other direct communications on the fisheries and habitat conservation, protection and partnership restoration opportunities for this watershed.

Eva Riccius, Andrew Burger and Rick Hatch of Saanich Parks also offered access to CHP for mutual restoration works, which is essential for these opportunities to proceed, as well as field time and many communications for the restoration plan.

Julian Anderson of Friends of Cuthbert Holmes Park met many times in the field and provided history on CHP, including aerial imagery.

Ian Bruce of Peninsula Streams Society discussed mutual collaborations and other restoration, including possible downstream beach nourishment and instream habitat restoration upstream through Saanich's Copley Park.

Kitty Lloyd and Natalie Bandringa of the Capital Regional District (CRD) facilitated and coordinated the Gorge Waterway Initiative, consisting of some 20 community groups and five local government organizations, interaction and input, through their formal meeting process.

Sara Stallard of South Island Aquatic Stewardship Society and Joachim (Yogi) Carolsfeld of World Fisheries Trust met onsite and provided comments, including questions or concerns about conversion of mud flats to tidal marsh benches and channels. Sara also is helping to coordinate plant salvaging and surplus woody debris re-purposing from a CRD trail development.

MOTI MIP and environmental management, executive, professional and technical staff and programs are directly supporting and implementing the restoration.

Many others with technical and local expertise, including the aforementioned Peter McCully, are also engaged and involved with the planned restoration.

SCHEDULING

Because the prime contractor, Westpro/Pomerleau was generating surplus materials useful for restoration, a stockpile and staging area was constructed, in a blackberry and grass dominated area about 50m from the Colquitz River right bank, at the NW end of CHP to receive and sort some of the blast rock aggregate useful for the restoration starting April 23, 2019.

Weather has been dry and warm, with no measurable rainfall since site mobilization and this weather is forecast into mid-May, making relatively dry ground with low flows/runoff that are quite similar to typical summer conditions.

Additional equipment and materials are being mobilized with physical restoration commencing the week of May 6 and estimated to be about one month for main earthworks, depending on site conditions, scheduling and working around the prime contractor's activities and the restoration scope.

Other less intrusive activities, like fall plantings, may occur after the main earthworks.

The project recently announced that the main MIP project completion has been set forward from Fall 2019 to Summer 2020. This conceivably provides a future window for additional works, while the main construction site controls and limited access are in-place.

ENVIRONMENTAL CONSTRUCTIION WORKPLAN and SCHEDULING

Because of the environmental sensitivities, required field supervision and field fits, Sean Wong will be onsite as the fish habitat restoration specialist for environmentally sensitive and habitat restoration works, select contractors outside of the MIP construction contractor and delivery will be used for earthworks, and field labour and technicians will be brought in for manual labour and technical services where needed.

The first excavator onsite and the one scheduled for May 6 mobilization both have environmentally friendly hydraulic fluids and spill kits are onsite.

Flow management and site isolation for the two wetland ponds will be via installation of 375mm Ø HDPE temporary bypass and crossing culverts, delivered to the site May 2. Two 50mm/2" Ø water transfer pumps, straw bales and other erosion and sediment control supplies, including sediment fencing (not likely needed as it is most effective for containing sediments at eroding toe slopes), non-woven geotextile, polyethylene and sandbags are also already onsite or are being delivered on May 6.

Controlled but aggressive earthworks are planned to achieve substantial reclamation and restorative treatments. Balancing the temporary and short-term disturbance toward much longer-term habitat and ecosystem benefits and recovery are part of the workplan. For example, placing soil to achieve improved native riparian also exposes a new sediment source. Native plantings and hand seeding coastal native bunch grass seed will is the preferred revegetation approach, but in comparison to hydroseeding, which tends to form more monoculture and less diverse habitat, will not as quickly establish a full vegetative cover. This trade-off is preferred to provide a more natural restored riparian zone.

For dendritic channel construction, works can be done in isolation by constructing during lower tides or leaving an in-situ berm or plug of existing material in-place and then removing the plug as the last component.

A high pressure warm and dry system has been present in the area since mid-late April and into the long-term mid May forecast. This greatly reduces risks of erosion and sediment concerns, however, works may temporarily shutdown in the event of heavy rain or runoff.

Works will also be taken in manageable amounts that can be buttoned-up within good working conditions and low erosion and sediment risk.

Native revegetation, hand-seeding of coastal native bunchgrass seed and straw mulch application will be done along reclaimed areas above the high water or terrestrial vegetation line.

Granular alluvial substrate and oyster shells will be used to cap basal till areas, which are not necessarily highly erodible, but this capping will provide an improved substrate.

While there may be resident fish present in the restoration zone and out-migrating coho smolts, cautious and controlled activities are expected to mitigate and protect instream resources during works.

In-channel woody debris and spawning gravel placement will be done under controlled supervision and may result in localized and short duration increased turbidity, but will be actively monitored to the short-term disturbance does not cause excessive impacts.

Working in the tidal areas when the tide is out, temporary site isolation by turbidity curtains or fish screens and pumping turbid water to upland filtration areas will also be done where necessary to protect aquatic resources and control erosion and sedimentation.

Ongoing adaptive environmental management, field fits and opportunistic restoration will continue through project implementation.

Aerial Imagery and Mapping

Partial Cloverleaf Outfalls and Wetlan

Recommended riparian replacement, instream complexing and tidal marsh bench restoration polygon roughly outlined in red through Cuthbert Holmes Park. Some details on the overlay of the MIC are subject to change, however, a trailhead and parking area are shown E of Admirals Road, and that area could provide temporary construction staging and access for the target restoration zone.

Approximate riparian and tidal restoration polygon area shown on iMapBC map. This map represents the boundary, though only select locations are targeted for restoration because of scope or budget limitations and there is existing functional habitat, including some tidal and terrestrial areas and previous riparian and riverbank compensation works by others.

Site Photos

E view toward weed dominated proposed parclo wetland pond treatment.


Standing water was observed at the lower parclo culvert outfall and a trickle inflow at a temporary black HDPE pipe on Aug. 1, 2018 after no summer rain and prevailing hot weather. This moisture regime and inflow suggests a good opportunity for wetland and riparian habitat creation.

Undermining of the concrete apron of the higher elevation parclo outfall will be remediated by placement of keyed-in riprap for a short, armoured spillway in the erosion area under the apron about 2-3m long with a rough rock surface for increased turbulence, aeration and energy dissipation.

Downstream view along parclo outfall channel through riparian zone during high runoff and close to a King tide with backflooding effects. The high runoff has not demonstrated a need for a hard-engineered armoured channel through this zone and it is expected the proposed green treatment is a much better environmentally friendly option.

View from CHP target restoration site toward MIP showing historically cleared/disturbed ground with low biodiversity values and a possible machine access site off the existing construction staging area to the E of Admirals Road. A machine access and staging and stockpile area has been created in the Himalayan blackberry and grass meadow patch toward the NW or top right of the photo.

View from highway embankment toe SE toward grass and weed (many buttercups) dominated meadow targeted for a ~500m+ wetland pond water quality treatment and wildlife feature. Some of the shrub border is English hawthorn and these type of non-native or invasive vegetation may also be removed for this restoration.

View from meadow toward E outfall. The meadow are has always had visible surficial moisture and feels spongy underfoot.

View S toward Colquitz River from lot near the Admirals Road Bridge showing the grassy clearing that could benefit from increased soil scarification or soil addition, riparian plantings, discrete tidal dendritic channel and marsh bench construction and instream and terrestrial habitat complexing.

View toward Colquitz River from lot near Admirals Road shows historically cleared ground with grassy areas having low biodiversity value and beneficial for riparian and habitat complexing treatments.

Tidally influenced area upstream of Colquitz Admirals Road Bridge has low value riparian that would benefit from increased native vegetation for shade cover and other riparian benefits. Many of these areas from E of Admirals to the tidal channel from the parclo outfall are readily accessible by equipment, which enables more intensive and larger scale restorative measures, including woody debris complexing, excavation, placement of soil for enhanced planting medium, instream gravel placement and dendritic channel and marsh bench construction.

View toward river of another possible riparian and tidal restoration area.

Some shrub cover and woody debris exists along the right bank and adds habitat complexity and addition of more of these types of features are recommended.

View to the W toward Admirals Road Colquitz Bridge. Gabion baskets are under the lower tidal bench and beside an associated riparian replacement zone, somewhat delineated by the lower growing conifer/pine trees. Much more of this area could use similar native riparian plantings.

Upstream view along the gabion basket and previous riparian replacement zone. The intertidal vegetation established on the gabion basket bench is dominated by native species and provides a template for establishing nearby discrete tidal marsh benches.

Colquitz River Admirals Bridge riparian planting compensation site on CHP. The surviving plantings provide a partial template for selection of native plantings. There are various other adjacent locations that could benefit from more diverse native riparian planting and weed control, possibly as McKenzie I/C riparian replacement.

View from the largely open meadow zone toward the gabion basket riparian replacement area. The gap between the shrub patches are targeted for soil placement and native vegetation fill plantings.

View along tidal mudflat from MIC parclo outfall and toward Colquitz River confluence. Initial probing showed ~30-50cm organic layer and with noticeable hydrogen sulphide odour when disturbed it is likely the sediments are anoxic. There was no noticeable rooted vegetation growing on this mudflat. Excavation and removal of these sediments, using them as an enhanced riparian planting medium and creation of raised tidal marsh fingers and small islands will platforms to enable vegetated marsh benches with improved substrate for benthic invertebrates, increased flow and dissolved oxygen through the substrate, additional microbial life that increases water quality biological treatment and biodiversity. Woody debris could also be added (partially buried), and because importation of oyster shells is planned for the MIC outfall treatments, some could be added to augment constructed benches to benefit water

quality by further mineralization and precipitation of metals, while adding beneficial components for aquatic organisms and brackish marine estuaries. Further assessment will occur prior to pursuing restoration in this zone.

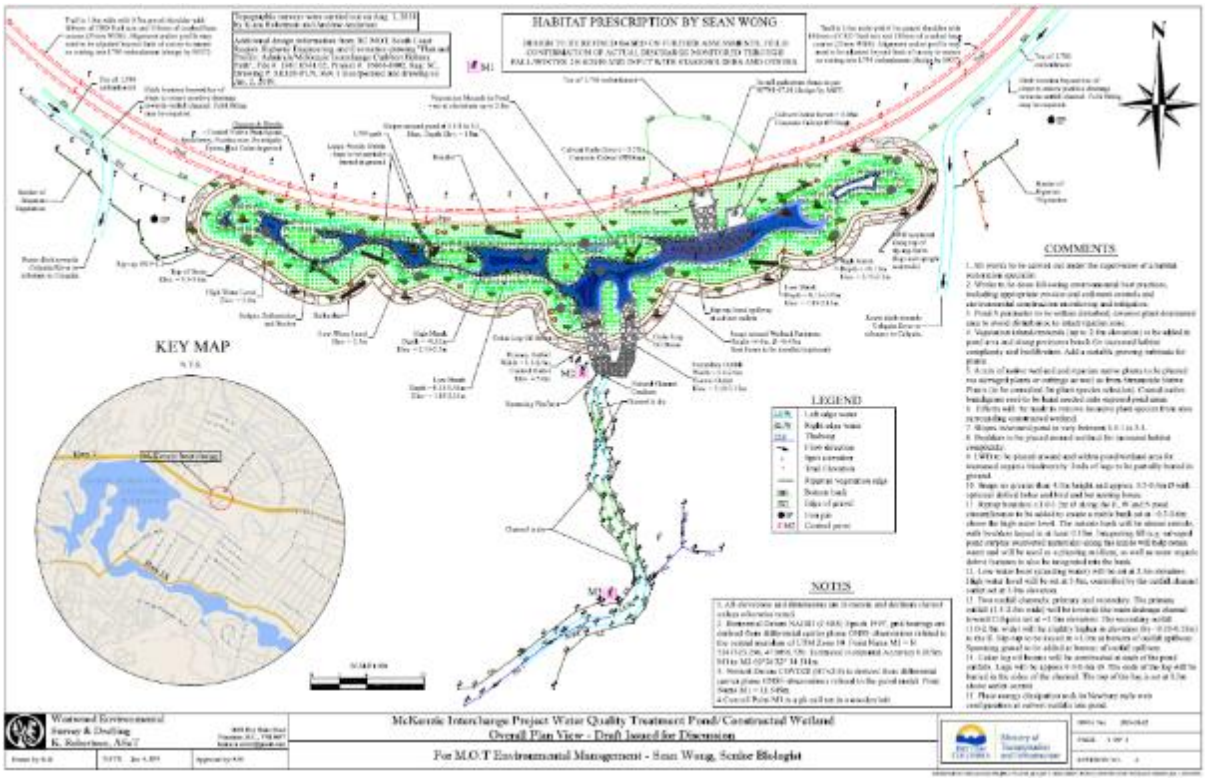
Existing tidally influenced marsh benches and dendritic channels downstream of the parclo outfall.

Upstream view along the tidal channel that of the parclo outlet channel.

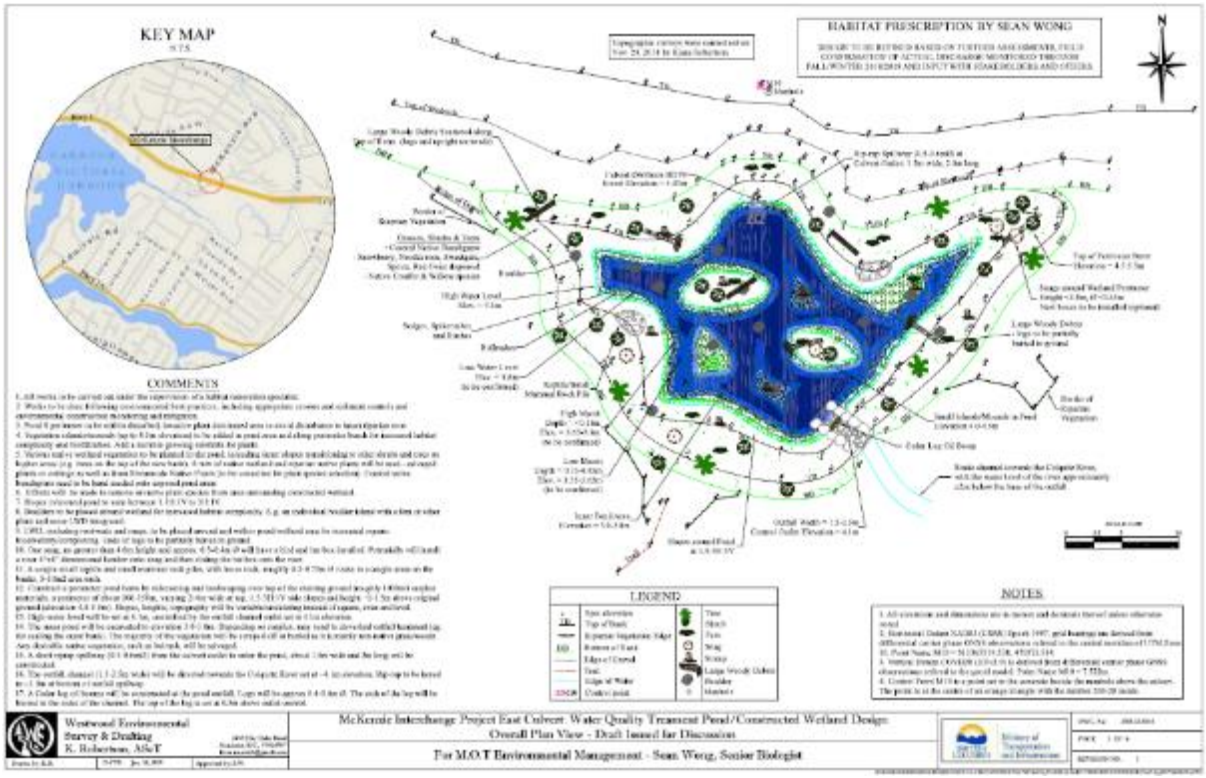
Upstream view of the tidal channel as it narrows through the riparian zone toward the parclo outfall.

The sub-grade base of the temporary access, stockpile and staging area was built with coarse blast rock and capped with pit run gravel. Because this provides a porous soil profile, it could be used as an infiltration basin below a rain garden feature as some of this area is decommissioned and reclaimed. Organic strippings are salvaged for re-use in riparian planting areas.

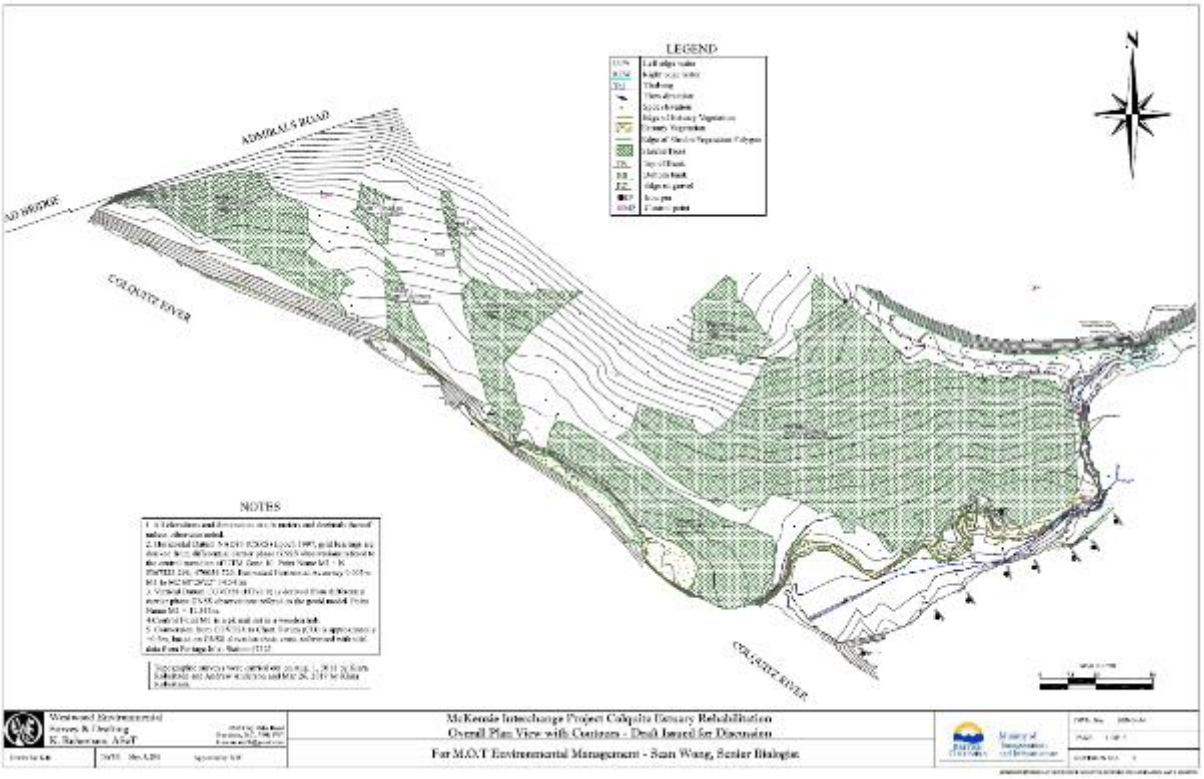
Select Drawings – pdfs of the full drawing sets are available on request



Parclo outfall wetland pond and wildlife feature proposed treatment.



E outfall wetland pond and wildlife feature proposed treatment.



Preliminary survey of CHP riparian and tidal restoration zone.