FIGURES

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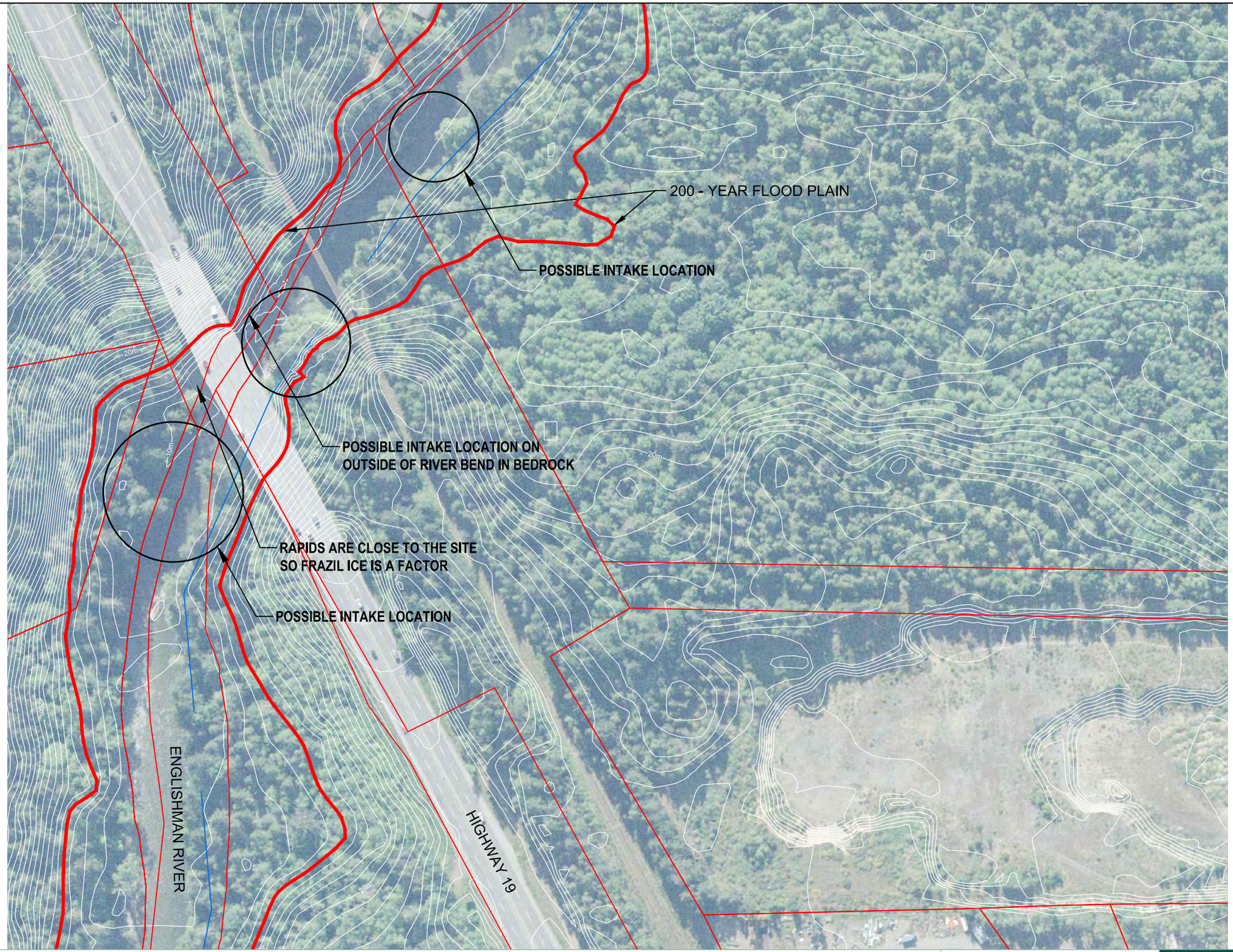

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CLIENT

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EBA Engineering Consultants Ltd.

ENGLISHMAN RIVER INTAKE AND TREATMENT FACILITIES

SITE #1

PROJECT NO.	DWN	CKD	REV
N13101242	JAB	RJW/SH	0
OFFICE: VANC	DATE: May 26, 2010		

Figure 1

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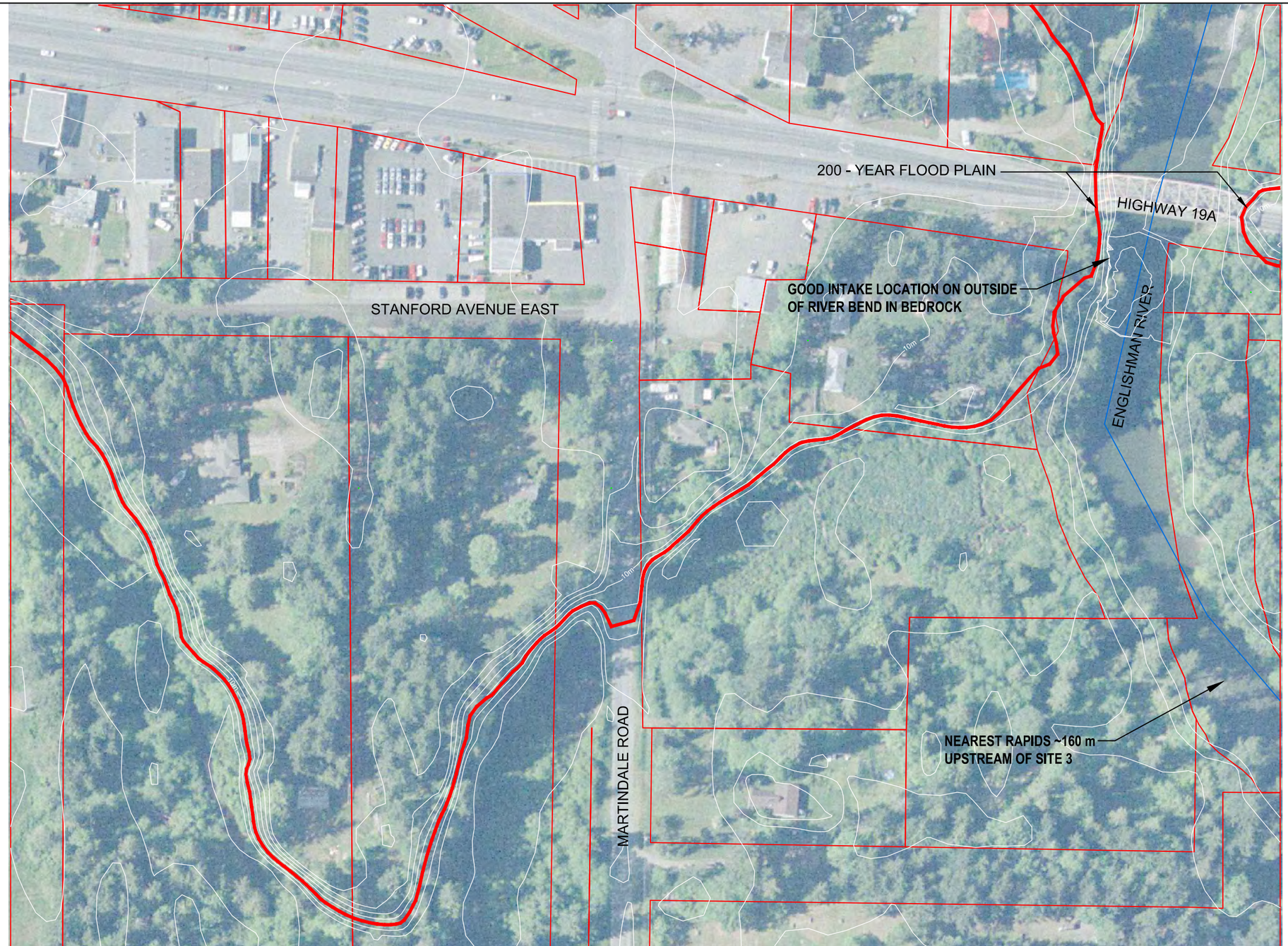

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ENGLISHMAN RIVER INTAKE AND TREATMENT FACILITIES

SITE #3

PROJECT NO.	DWN	CKD	REV
N13101242	JAB	RJW/SH	0
OFFICE: VANC	DATE: May 6, 2010		

Figure 2

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CLIENT

Associated Engineering

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ENGLISHMAN RIVER INTAKE AND TREATMENT FACILITIES

SITE #5

PROJECT NO.	DWN	CKD	REV
N13101242	JAB	RJW/SH	0
OFFICE: VANC	DATE: May 6, 2010		

Figure 3

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APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

DESIGN REPORT – GENERAL CONDITIONS

This Design Report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This Design Report pertains to a specific site, a specific development, and a specific scope of work. The Design Report may include plans, drawings, profiles and other support documents that collectively constitute the Design Report. The Report and all supporting documents are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, analyses or other contents of the Design Report when it is used or relied upon by any party other than EBA's Client, unless authorized in writing by EBA. Any unauthorized use of the Design Report is at the sole risk of the user.

All reports, plans, and data generated by EBA during the performance of the work and other documents prepared by EBA are considered its professional work product and shall remain the copyright property of EBA.

2.0 ALTERNATIVE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless so stipulated in the Design Report, EBA was not retained to investigate, address or consider, and has not investigated, addressed or considered any environmental or regulatory issues associated with the project specific design.

4.0 CALCULATIONS AND DESIGNS

EBA has undertaken design calculations and has prepared project specific designs in accordance with terms of reference that were previously set out in consultation with, and agreement of, EBA's client. These designs have been prepared to a standard that is consistent with industry practice. Notwithstanding, if any error or omission is detected by EBA's Client or any party that is authorized to use the Design Report, the error or omission should be immediately drawn to the attention of EBA.

5.0 GEOTECHNICAL CONDITIONS

A Geotechnical Report is commonly the basis upon which the specific project design has been completed. It is incumbent upon EBA's Client, and any other authorized party, to be knowledgeable of the level of risk that has been incorporated into the project design, in consideration of the level of the geotechnical information that was reasonably acquired to facilitate completion of the design.

If a Geotechnical Report was prepared for the project by EBA, it will be included in the Design Report. The Geotechnical Report contains General Conditions that should be read in conjunction with these General Conditions for the Design Report.

6.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

Appendix E - LGL Technical Memorandum

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Environmental Assessment of Alternative Water Intake Sites in Englishman River

***Prepared by*:**

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May 2010

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1.0 Introduction

The Arrowsmith Water Service (AWS) is a joint venture of the City of Parksville, the Regional District of Nanaimo and the Town of Qualicum Beach that was formed to secure a bulk water supply from the Englishman River. The bulk water supply is intended to supplement existing supply sources owned and operated by the individual jurisdictions. The first project completed by the venture was the construction of the Arrowsmith Dam in the headwaters of the Englishman River. The reservoir created by the dam stores water to allow augmentation of low summer flows. An existing City of Parksville river intake downstream of Highway 19A extracts river water to supplement the well water supply during the peak demand period between June and October.

The current project being proposed by AWS is the construction of a new river intake, water treatment plant (WTP) and water distribution system. The first phase of this proposed project is being undertaken by a multi-disciplinary team and consists of the following components:

- Document, summarize and review previous studies.
- Confirm and review current conditions.
- Recommend key ecosystem indicators and considerations to use in determining the best location for any infrastructure related to an intake and treatment plant.
- Recommend the type and location of the future river intake.
- Recommend a location for the future intake and treatment facilities respecting the future routing of bulk water supply to other jurisdictions.
- Prepare conceptual design drawings and details and a cost estimate suitable for the AWS to plan and budget for the required new facilities, including an appropriate staging plan.
- Recommend bulk water supply line routes from the intake facility to the treatment works and user areas.
- Make recommendations for AWS requirements where deemed appropriate.

As part of the component to determine the preferred future river intake location, an environmental assessment was undertaken by LGL Limited to examine each potential intake site. The results of an environmental assessment and recommendations for mitigation are the subject of this report. The objectives of the environmental assessment were to determine the current capability of the habitat at each site for fish and wildlife populations, to identify and assess the severity of potential harmful effects on fish and wildlife species or their habitats based on the expected construction, operation and maintenance of each proposed intake and treatment plant site, and to recommend mitigation measures as appropriate. Following the assessment phase of each potential intake sites and an evaluation of environmental, geotechnical, engineering and socio-

economic considerations, a preferred water intake and treatment site will be recommended to AWS.

2.0 Background

A constraint mapping exercise was undertaken by the project team to select a list of potential sites for more detailed evaluation. The exercise was undertaken over a broad area of the Englishman River, extending from below the existing water intake to above the Morison Creek confluence. Five categories were selected for scoring in the constraint mapping process:

- land use compatibility,
- heritage / archaeology concerns,
- ecological impacts,
- geotechnical conditions, and
- water system considerations

Each of the five categories was further subdivided into a number of issues or topics and scored separately by the project team. Based on the scoring results, the lower section of the Englishman River (from just above the Hwy 19 bridge down to just above the mouth) was identified as the preferred location for the new intake and water treatment plant.

Koers & Associates Engineering investigated potential intake sites within this lower section of Englishman River and identified five potential intake / water treatment sites in their memo report (Koers & Associates Engineering 2010). Following discussions with AWS representatives, three of the five potential sites, Sites 1, 3 and 5, were short-listed for a more detailed evaluation.

3.0 Physical Description of the Alternative Water Intake Sites

The three candidate intake locations being assessed for environmental considerations and reported on in this report are all located downstream of Allsbrook Canyon (Figure 1). A more detailed physical description of the alternative water intake and water treatment plant sites is described in Koers & Associates Engineering (2010).

Site 1 is an intake site located on the left (west) bank immediately upstream of the Highway 19 bridge crossing of the Englishman River. The west bank consists of bedrock that extends from just upstream of Highway 19 to just downstream of the railway crossing. As a consequence of the extensive zone of bedrock on the banks and channel bed, it appears that the channel position and banks at this site have remained relatively stable since at least 1949 (Gaboury 2005). With the bedrock bank and relatively deep water at this site, it is anticipated that a bank type intake structure would be selected. A raw water

main from the intake to the east bank would need to be installed across the river to allow for connection to the water treatment plant located in the City of Parksville Engineering and Operations Compound. The raw water main would be brought across the river in the railway right-of-way on the north side of the bridge and run upslope to the water treatment plant site.

Site 3 is located on the left (west) bank immediately upstream of the Highway 19A bridge crossing. The west bank consists of a sandstone and bedrock conglomerate. With similar bedrock conditions as Site 1, it appears that Site 3 has remained in a stable channel position since at least 1949 (Gaboury 2005). Because of the bedrock bank and relatively deep water in the adjacent pool, it is anticipated that a bank type intake structure would be selected. A sensitive wetland of Shelley Creek is located ~30 m upstream of the intake site on the left bank.

Site 5 is located on the left (west) bank immediately downstream (north) of the existing City of Parksville water intake site. The west bank consists of primarily sand. A riverbank filtration gallery is envisioned for this site. Site 5 has remained in a relatively stable channel position since at least 1949 but has exhibited more lateral migration than either Sites 1 or 3 (Gaboury 2005).

4.0 Assessment Methods

Existing data and reports on the Englishman River environment that were pertinent to potential environmental concerns / impacts associated with the siting and construction of the water intake and treatment facilities were reviewed. Specifically, our baseline data and report review included:

- Identifying all environmental issues and concerns raised in previous studies for potential effects from proposed intake and treatment facility site developments;
- Confirming the conditions specified in the current water license for the existing water intake site and for operation of the Arrowsmith Dam; and
- Confirming the conditions specified in the Arrowsmith Lake Reservoir Provisional Operational Rule regarding flow maintenance for the Englishman River.

4.1 Assessment of Wildlife and Vegetation Values

The assessment of the wildlife and vegetation values at each proposed intake site involved three steps:

Step 1: The collation of existing information on the presence of federal (COSEWIC) or provincial (BC CDC) species of concern in the vicinity of the proposed site, based on historical collections or observations.

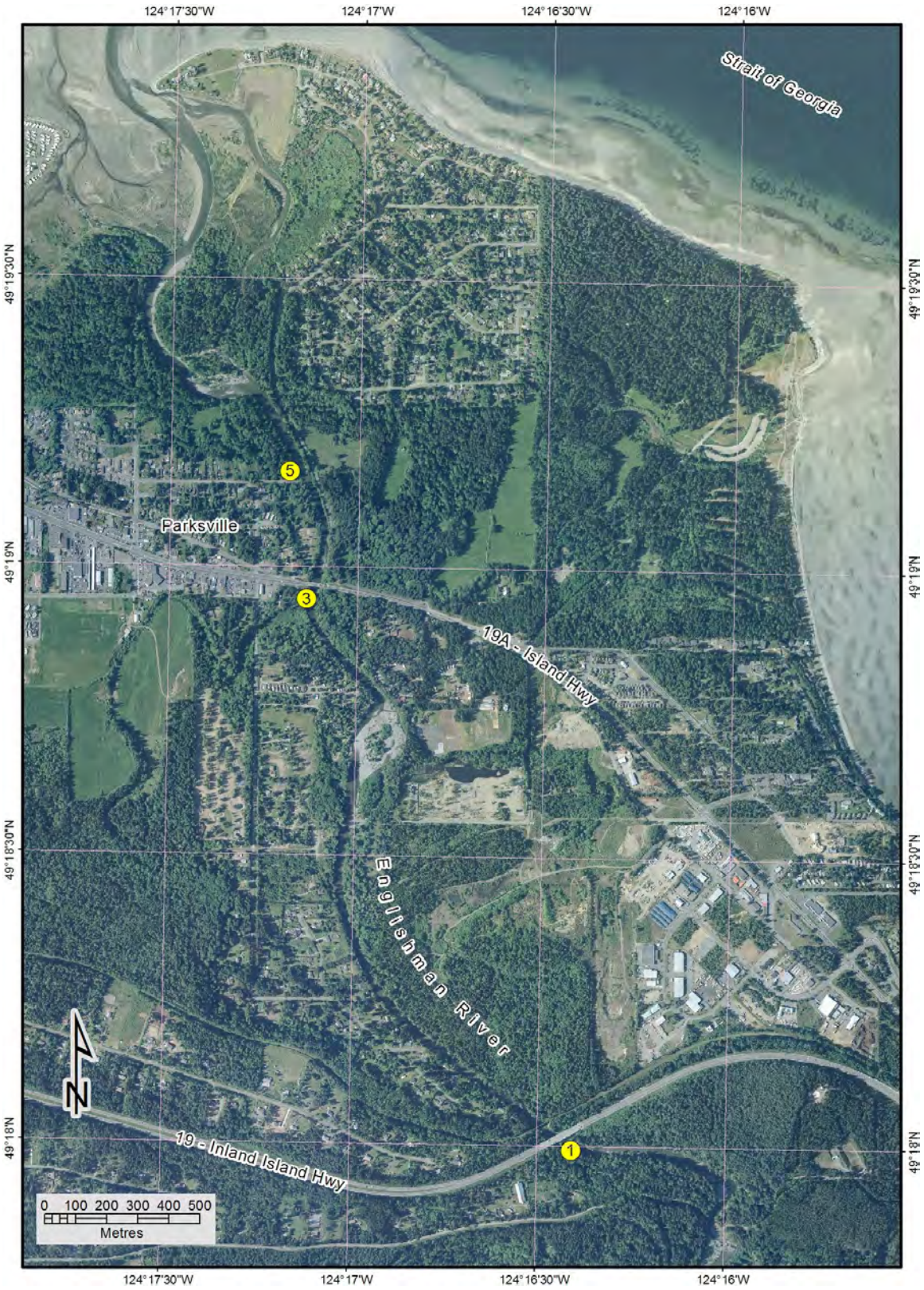


Figure 1. Map of lower Englishman River showing three alternative water intake sites.

The British Columbia Conservation Data Centre (BC CDC) was consulted prior to the on-site investigations to determine if any species with federal or provincial designation as "species of concern" have been previously documented near a proposed intake site or in any areas that will be subject to habitat disturbance during the construction phase or during subsequent operational and maintenance phases.

Step 2: A field survey at the site to determine if any such species are present within the immediate vicinity, as well as the compilation of a list of additional species that may be present at the site (based on habitat conditions) but were not observed during the site visit.
On-site visits were conducted to determine if any wildlife or plant species of conservation concern occur within the potential disturbance footprint of the project. Surveys were conducted for the species groups that are currently addressed by COSEWIC and the BC CDC: mammals, birds, reptiles, amphibians, fish, butterflies, dragonflies, terrestrial molluscs, vascular plants, and plant communities. These were intuitively-controlled searches in which the surveyors used their understanding of the individual species and their habitat requirements in order to be most successful in locating them. A complete list of all plant and wildlife species that were encountered at or near the site was compiled, as well as any additional species that may potentially occur but were not documented during the site visits. Any species with COSEWIC or BC CDC designation as "species of concern" were documented thoroughly, with waypoints taken at all observation locations and detailed notes compiled on the habitat characteristics and potential use of the site by these species.

Step 3: An assessment of the potential for disturbance or destruction of rare species or their habitats based on the results of (1) and (2) as well as an understanding of the types of activities that will accompany the construction, operation and maintenance of the intake and treatment facility infrastructure. Mitigation measures recommended as needed.
Following the completion of steps (1) and (2), an assessment was completed that addressed the potential for any destruction or disturbance of any species with COSEWIC or BC CDC designation as a "species of concern". The assessment looked at the known or suspected locations of any such species in relation to proposed project activities (construction, maintenance, etc.) and assessed the potential for these activities to have any deleterious effects on these species. Where it was determined that there may indeed be negative impacts, recommendations were made to mitigate these potential impacts.

4.2 Assessment of Fish Values

The assessment of fish values at each proposed intake site involved three steps:

Step 1: The review and summarization of relevant fish population and habitat information.
Existing information on fish populations and habitat within the lower Englishman River mainstem as it pertains to each candidate intake site was obtained from published reports and unpublished assessment data. Additional fisheries data were acquired through meetings with provincial and federal agency representatives from Fisheries and Oceans Canada (DFO) and BC Ministry of Environment (MoE). In addition, agency staff and key stakeholders concerned with fish and fish habitat in the lower Englishman River were consulted to obtain a better understanding of their specific concerns with the proposed water intake structure. Representatives from Mid-Vancouver Island Habitat Enhancement Society (MVIHES), BC Nature Trust and BC Conservation Foundation (BCCF) were consulted.

Step 2: A field survey to assess and classify fish habitats in the immediate vicinity of each candidate intake site.
Key habitat characteristics for mainstem habitats proximal to each candidate intake and treatment facility site were tabulated to identify the existing habitat condition, and type and severity of potential impacts with proposed site development. The spatial distribution of critical spawning and rearing habitats of chum, Chinook, coho and pink salmon and steelhead in mainstem and off-channels proximal to each candidate intake and treatment facility were determined. Habitat data collected in the field included:

- Classification of habitat – spawning, rearing, overwintering, migration corridor;
- Classification of channel type - riffle, pool, glide;
- Wetted and bankfull channel width and depth;
- Channel gradient;
- Streambed substrate composition (Wentworth classification);
- Channel stability - bank and bed erosion potential, and causes of disturbance;
- Riparian vegetation – species, condition, importance to adjacent fish habitat;
- Fish rearing habitat: percent pools, residual pool depth, quality and quantity of adult holding pools, type and effectiveness of cover, extent of and access to off-channel habitat;
- Fish spawning habitat: range and median size of substrate, % fines, total area of suitable spawning substrate for resident / anadromous fishes; and
- Other disturbance indicators affecting existing habitat condition.

Step 3: An assessment of the potential for harmful effects on fish species or their habitats based on the results of (1) and (2) as well as an understanding of the types of activities that will accompany the construction, operation and maintenance of the intake and treatment plant infrastructure. Mitigation measures recommended as needed.
Following the completion of steps (1) and (2), we identified:

- All fish species likely inhabiting the watercourses proximal to each intake and those species that are of particular concern for protection or mitigation; and
- The types and distribution of existing fish habitats proximal to each intake and those habitats that are of particular concern for protection or mitigation.

For all three sites, the potential harmful effects on fish species or their habitats were predicted based on the expected construction, operation and maintenance of the proposed intake and plant. The context for the evaluation of these effects on fish and fish habitat is relative to the quality and quantity of fish habitat within specific river sections under existing conditions. Where it was determined that there may be negative short or long term potential impacts, recommendations were made to mitigate these impacts.

5.0 Results

5.1 Wildlife and Vegetation Communities

Three sites adjacent to the Englishman River were assessed for their suitability for a Water Treatment Plant (WTP) and water intake apparatus. Each of the proposed sites was visited on 21 April 2010 to document the presence of any species-at-risk as well as to determine which sites would be preferred based on the expected ecological impacts to terrestrial habitats and wildlife (i.e., the indicators).

Prior to completing the field assessment we queried the BC Conservation Data Centre database to determine if species-at-risk have been documented from any of the three proposed locations. Although each of the three sites selected for the potential WTP and intake are disturbed to some degree, the potential for impacts to species-at-risk remains. Therefore, the number of species-at-risk, their habitats, or the presence of sensitive ecosystems was selected as key indicators against which impacts were gauged. During the field assessment at each site, the potential environmental impact to those indicators was qualitatively assessed based on the observation of species-at-risk, their habitats, or sensitive ecosystems. Our assessment was based on the assumption that species-at-risk and/or their habitats are associated with specific habitat features or sensitive ecosystems (such as maturing second-growth forest). This permitted a

qualitative yet consistent approach to assessing the potential impacts to the key indicators for each site assessed.

5.1.1 Site 1

Site 1 is characterized by the presence of three terrestrial ecosystems: i) riverside riparian vegetation (primarily on the northern bank of the Englishman River, locally on the southern bank at the crossover point), ii) second-growth coniferous forest, and iii) previously disturbed environments on the 20,000 m^2 property that is proposed as the location of the WTP. An assessment of potential impacts to these ecosystems was made relative to the potential impacts to key indicators. For each terrestrial ecosystem evaluated for Site 1 the impacts from the proposed project are qualitatively assessed as low to moderate, depending on the terrestrial ecosystem being impacted. Overall, and compared to Sites 3 and 5, the environmental impacts associated with Site 1 are assessed as moderate. Each ecosystem is discussed below.

i) Riverside Riparian Vegetation

The proposed plan calls for the installation of the intake site along the northern bank of the Englishman River on the upstream side of the highway bridge, with the associated pipe running east for ~180 m along the north bank before crossing the river within the currently-existing railway right-of-way. This would necessitate some disturbance to the existing vegetation communities along the north bank of the river, including the potential removal of several mature trees near the proposed intake site. Much of the vegetation along this corridor, however, has already been significantly disturbed by the construction of either the highway bridge or the railway bridge, and most of the vegetation consists of shrubby re-growth with little tree regeneration (Figure 2). It is expected that any disturbance associated with the installation of the intake site and associated pipeline would have little or no disturbance to the vegetation of the site that would be more significant than the levels of disturbance that have already occurred due to highway and railway bridge construction. As such, the potential impacts to key indicators are expected to be low. No species-at-risk were observed at this location during the field visit. However, because riparian ecosystems tend to support a different, and often more diverse flora and fauna than adjacent upland habitats, there is some potential for species-at-risk to occur in this area. Despite this, the impacts to species-at-risk are expected to be minimal to nil given the level of impact that has occurred at the site in the past.

Figure 2. Two photographs of the vegetation along the northern bank of the Englishman River near the proposed intake site. Looking downstream from the highway bridge (A) and looking upstream from the highway bridge (B) (and includes the area near the proposed intake site).

ii) Second-growth coniferous forest

Moderate environmental impacts are anticipated within the upland second-growth coniferous forests where the construction of the pipeline connecting the intake site with the WTP would require the removal of a number of trees (primarily Douglas-fir *Pseudotsuga menziesii*) along a ~250 m stretch of pipe. This area is dominated by mid-seral second-growth Douglas-fir, with a minor component of other tree species such as Bigleaf Maple (*Acer macrophyllum*), Red Alder (*Alnus rubra*), Western Hemlock (*Tsuga heterophylla*), and Western Redcedar (*Thuja plicata*). The understory, which is dominated by Sword Fern (*Polystichum munitum*) and Salal (*Gaultheria shallon*), is relatively sparse and poorly developed in most areas due to the high canopy cover afforded by the Douglas-fir trees. Unusual habitat features that were documented along this proposed corridor during the site visit include an area of low-lying Red Alder bottomland located on the east side of the proposed corridor (nearest UTM: 407360, 5461766) and a small grove of Shore Pine (*Pinus contorta* var.*contorta*) located at the northwestern corner of the disturbed area that is proposed as the site of the WTP (representative UTM: 407518, 5461809) (Figure 3). These habitat types are less widely distributed within the region than second-growth coniferous forest, and thus any disturbances to these habitats have a greater potential to impact species of plants and wildlife that are sporadic or rare. Given the scarcity of such habitats in the area, it is recommended that any construction or development activities avoid disturbance to these habitat features whenever possible.

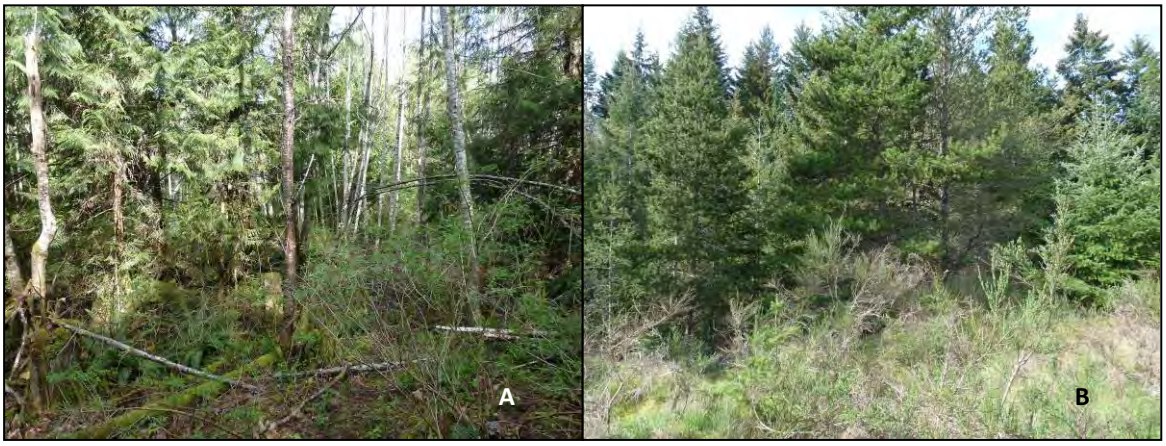


Figure 3. Sensitive habitats documented along the proposed pipeline corridor between the Englishman River and the proposed WTP site: A) Red Alder bottomland; B) Shore Pine grove.

iii) Previously Disturbed Areas

The proposed site for the development of the WTP is atop an open area that has been severely disturbed and degraded and retains little, if any, natural ecological conditions. Much of the site is an open gravel pit, where the vegetation is dominated by weedy and native species that commonly colonize such disturbed sites, such as Scotch Broom (*Cytisus scoparius*) and rock moss (*Racomitrium* spp.), while the southern portions of the area have a more diverse assemblage of introduced weeds such as Himalayan Blackberry (*Rubus armeniacus*), Scotch Broom, Common Draba (*Draba verna*), and Orchard Grass (*Dactylis glomerata*) as well as weedy native species (Miner's-lettuce [*Claytonia perfoliata*]) and a few young, regenerating coniferous trees (primarily Douglas-fir) (
Figure **4**). Given the severely disturbed nature of this area of the potential development, there are few, if any, significant environmental impacts expected, provided that the development remains within the currently disturbed area and does not impact adjacent areas of natural forest.

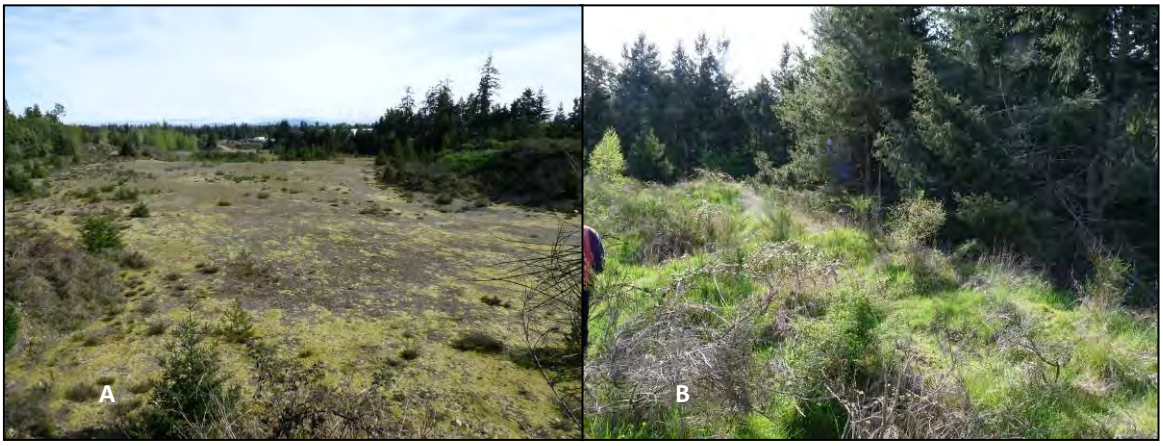


Figure 4. Previously disturbed habitats present within the footprint of the potential WTP site, including a large gravel pit area on the eastern half of the site (A), and a weedy, grassy area on the western portion of the site (B).

5.1.1.1 Species Diversity

Twenty-seven species of vascular plants and 22 species of wildlife (21 birds, 1 mammal), which are listed below, were documented at the site during the April site visit.

Vascular Plants

Douglas' Maple	*Acer glabrum* ssp.*douglasii*
Bigleaf Maple	*Acer macrophyllum*
Red Alder	*Alnus rubra*
Arbutus	*Arbutus menziesii*
American Winter Cress	*Barbarea orthoceras*
Few-seeded Bitter-cress	*Cardamine oligosperma*
Miner's-lettuce	*Claytonia perfoliata*
Scotch Broom	*Cytisus scoparius*
Orchard Grass	*Dactylis glomerata*
Common Draba	*Draba verna*
Salal	*Gaultheria shallon*
Oceanspray	*Holodiscus discolor*
Purple Dead-nettle	*Lamium purpureum*
Shore Pine	*Pinus contorta* var.*contorta*
Sword Fern	*Polystichum munitum*
Black Cottonwood	*Populus balsamifera* ssp.*trichocarpa*
Bitter Cherry	*Prunus emarginata*
Douglas-fir	*Pseudotsuga menziesii*
Himalayan Blackberry	*Rubus armeniacus*
Salmonberry	*Rubus spectabilis*
Trailing Blackberry	*Rubus ursinus*
Common Snowberry	*Symphoricarpos albus*
Common Dandelion	*Taraxacum officinale*

Western Redcedar	*Thuja plicata*
Western Hemlock	*Tsuga heterophylla*
Red Huckleberry	*Vaccinium parvifolium*
Scouler's Valerian	*Valeriana scouleri*

Mammals

Mule (Columbian Black-tailed) Deer	*Odocoileus hemionus columbianus*

Birds

Turkey Vulture	*Cathartes aura*
Rufous Hummingbird	*Selasphorus rufus*
Belted Kingfisher	*Megaceryle alcyon*
Pileated Woodpecker	*Dendrocopos pileatus*
Hutton's Vireo	*Vireo huttoni*
Common Raven	*Corvus corax*
Violet-green Swallow	*Tachycineta bicolor*
Chestnut-backed Chickadee	*Poecile rufescens*
Winter Wren	*Troglodytes troglodytes*
Golden-crowned Kinglet	*Regulus satrapa*
American Robin	*Turdus migratorius*
Orange-crowned Warbler	*Vermivora celata*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Spotted Towhee	*Pipilo maculatus*
Chipping Sparrow	*Spizella passerina*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Purple Finch	*Carpodacus purpureus*
House Finch	*Carpodacus mexicanus*
Pine Siskin	*Spinus pinus*

Species-at-risk

Several species-at-risk are known to occur in the Englishman River watershed. For example, Pacific Sideband, Red-legged Frog, Olive-sided flycatcher, and Common Nighthawk have been observed in the watershed (Hawkes et al. 2008). No species with federal or provincial designation as species-at-risk were documented within or around Site 1 during the April 2010 visit, and the B.C. Conservation Data Centre does not have any records of such species from the site; however, the absence of such species cannot be stated definitively. Species-at-risk that may occur at the site, but which were not detected during the site visit, include:

Terrestrial Molluscs

- Pacific Sideband (*Monadenia fidelis*)

Amphibians

- Red-legged Frog (*Rana aurora*)

Birds

- Olive-sided Flycatcher (*Contopus cooperi*)
- Northern Pygmy-Owl, *swarthi* ssp. (*Glaucidium gnoma swarthi*)
- Western Screech-Owl, *kennicottii* ssp. (*Megascops kennicottii kennicottii*)
- Barn Swallow (*Hirundo rustica*)
- Common Nighthawk (*Chordeiles minor*)
- Band-tailed Pigeon (*Patagioenas fasciata*)

These species would be associated primarily with the second-growth coniferous forests (Pacific Sideband, Olive-sided Flycatcher, Western Screech-Owl, Band-tailed Pigeon) or the open disturbed habitats of the proposed WTP site (Barn Swallow, Common Nighthawk). Development of the site may potentially impact individuals of some of these species, either through direct mortality or removal of habitat; however, given the scope of potential development of the site and the scale of the anticipated ecological impacts, it is not expected that there would be significant population-level effects to any of these species, should they occur on or near the footprint of activity.

5.1.1.2 Potential Harmful Effects

Of the three terrestrial ecosystems considered for Site 1, the greatest potential impacts are associated with the second-growth coniferous forest along the proposed pipeline route to the WTP. The removal of a significant area of second-growth forest (for the installation of the connecting water pipeline) has the greatest potential to impact the key indicators used in the assessment. Development in both the riverside riparian (proposed intake site) and previously disturbed riparian areas along the mainstem (pipeline route on south bank) will have minimal to nil impacts on species-at-risk or their habitats.

Because of the potential impact to species-at-risk and their habitats as well as sensitive habitats along the connecting water pipeline route on the north side of the mainstem, this is not considered a preferred option. For each terrestrial ecosystem evaluated for Site 1 the impacts from the proposed project are qualitatively assessed as low to moderate, depending on the terrestrial ecosystem being impacted.

5.1.1.3 Opportunities for Mitigation

The disturbed landscapes that dominate the proposed WTP site offer opportunities for habitat mitigation and restoration that would help to offset some of the habitat loss associated with the rest of the development (particularly the pipeline). Areas within the footprint of the WTP, but which are not incorporated into the actual development, could potentially be restored to a more natural state by removing some of the more invasive exotic plant species (Himalayan Blackberry, Scotch Broom, etc.). This would allow for better regeneration of trees and native shrubs and herbs by removing some of the exotic species that compete with these native species for resources. Additional steps, such as the planting of several native trees and shrubs, may also be utilized. Ultimately, the

habitats that are currently severely degraded could potentially be restored to a moderately intact natural ecosystem with a relatively small amount of money and effort. We recommend that a planting plan of native grasses, shrubs and trees be developed to mitigate for the impacts to native habitats and to restore the riparian ecosystem at this site.

5.1.2 Site 3

Compared to Site 1, Site 3 is highly disturbed with an existing motel, highly modified Douglas-fir forested habitat, bedrock, and weedy species of plants (Figure 5). The site is also in some proximity to a Shelley Creek wetland (Figure 6) and as such mitigation measures may be needed to ensure that this ecosystem is not affected. Overall, the impacts expected from development at Site 3 are considered minimal to nil.

Figure 5. Proposed intake site (A) and the motel area where the WTP would potentially be built (B).

Figure 6. Shelley Creek wetland, located immediately west of the motel (and west of where the WTP would potentially be developed).

5.1.2.1 Species Diversity

Twenty-four species of vascular plants and 14 species of wildlife (12 birds, 1 mammal, 1 reptile) were observed during the site visit in April. These species are listed below.

Vascular Plants

Bigleaf Maple	*Acer macrophyllum*
Red Alder	*Alnus rubra*
Bur Chervil	*Anthriscus caucalis*
English Daisy	*Bellis perennis*
Henderson's Sedge	*Carex hendersonii*
Slough Sedge	*Carex obnupta*
Miner's-lettuce	*Claytonia perfoliata*
Red-osier Dogwood	*Cornus stolonifera*
Common Draba	*Draba verna*
Skunk Cabbage	*Lysichiton americanum*
False Lily-of-the-valley	*Maianthemum dilatatum*
Palmate Coltsfoot	*Petasites frigidus* ssp.*palmatus*
Reed Canarygrass	*Phalaris arundinacea*
Pacific Ninebark	*Physocarpus capitatus*
Black Cottonwood	*Populus balsamifera* ssp.*trichocarpa*
Douglas-fir	*Pseudotsuga menziesii*
Himalayan Blackberry	*Rubus armeniacus*
Salmonberry	*Rubus spectabilis*
Pacific Willow	*Salix lucida* ssp.*lasiandra*
Sitka Willow	*Salix sitchensis*
Common Dandelion	*Taraxacum officinale*
Fringecup	*Tellima grandiflora*
Western Redcedar	*Thuja plicata*
Western Hemlock	*Tsuga heterophylla*

Reptiles

Red-eared Slider	*Trachemys scripta*

Mammals

River Otter	*Lontra canadensis*

Birds

Canada Goose	*Branta canadensis*
Common Merganser	*Mergus merganser*
Rufous Hummingbird	*Selasphorus rufus*
Chestnut-backed Chickadee	*Poecile rufescens*
Red-breasted Nuthatch	*Sitta canadensis*
Golden-crowned Kinglet	*Regulus satrapa*
Hermit Thrush	*Catharus guttatus*

American Robin	*Turdus migratorius*
Orange-crowned Warbler	*Vermivora celata*
Spotted Towhee	*Pipilo maculatus*
Song Sparrow	*Melospiza melodia*
Pine Siskin	*Spinus pinus*

Species-at-risk

Several species-at-risk are known to occur in the Englishman River watershed. For example, Pacific Sideband, Red-legged Frog, Olive-sided flycatcher, and Common Nighthawk have been observed in the watershed (Hawkes et al. 2008). No species-at-risk were documented at Site 3 during the April 2010 site visit, and there are none that would be expected to use the portion of the site within the potential development footprint. Similarly, the B.C. Conservation Data Centre does not have any records of species-at-risk from the site, although the wetland and riparian portions could potentially house species-at-risk such as Great Blue Heron and Red-legged Frog. Despite the assessment that there would likely be little or no impact to the wetland portion of the property, the potential presence of species-at-risk suggests that any development of the adjacent upland areas should employ all mitigation measures available to reduce or eliminate impacts on the wetland.

A breeding population of the introduced Red-eared Slider (*Trachemys scripta*) was observed within the Shelley Creek wetland during the site visit. Three Red-eared Sliders were observed within an open-water portion of the wetland north of Martindale Road.

5.1.2.2 Potential Harmful Effects

The potential environmental impacts associated with the installation of a water intake system and construction of a WTP at Site 3 are expected to be low given the near complete absence of natural vegetation within the potential footprint of development. The bedrock along the northern bank of the Englishman River, which is where the intake system would be installed, is almost devoid of natural vegetation, and the few individuals that are present are all either common native species or, more often, weedy invasives. Similarly, the adjacent upland areas that would house the WTP are currently occupied by a motel and, as such, are already heavily degraded with little remaining natural vegetation. The only environmental issue that is foreseen within the actual footprint of development is the presence of a number of mature Douglas-fir trees that occur throughout the motel grounds. These trees would need to be removed to accommodate the WTP. There is virtually no natural understory vegetation associated with these trees, however, and they are only a small fragment of the extensive mixed forest that occurs nearby. Thus, their removal would not be considered a significant environmental impact.

The Shelley Creek wetland (Figure 6), which is located within the development property but occurs downslope and to the west of the expected area of impact, is

considered a sensitive ecosystem (as assessed by LGL Ltd. biologists). Although the wetland is not expected to be affected by any construction activities, any construction activities should be completed with a recognition of the sensitivity of this wetland (and appropriate preventative measures, such as installation of sedimentation fences during construction) so that any issues such as erosion, sedimentation, or runoff that occur during construction or operation do not impact the wetland. Provided that the Shelley Creek wetland is not impacted during the construction or maintenance of the WTP, the minimal environmental impacts that are expected to be associated with development at this site render it the most desirable option of the three proposed options presented for the location of the WTP.

5.1.2.3 Opportunities for Mitigation

We recommend that a planting plan of native grasses, shrubs and trees be developed to mitigate for the impacts to native habitats and to restore the riparian ecosystem at this site. There is also the potential for the development of a small interpretive trail system along the edge of the Shelley Creek wetland which could be used by the local residents and could help highlight the ecological importance of this site. This would require little more than the establishment of a permanent trail along the western boundary of the wetland and the installation of one or more interpretive signs that illustrate and discuss components of the ecosystem that are characteristic. Removal of exotic species within the Shelley Creek wetland, such as Himalayan Blackberry, would also benefit the wildlife that use the wetland.

5.1.3 Site 5

Site 5 has been substantially impacted through current clearing activities and is characterized by a large cleared area and a substantial area of riparian mixed forest (Figure 7). Impacts to the cleared area are expected to be negligible; however, there would be impacts to the riparian mixed forest and associated habitats, which could impact species-at-risk or their habitats. The potential impacts to the key indicators are anticipated to be greatest at Site 5, rendering it the least-preferred option of all sites assessed.

Figure 7. Habitats present at Site 5: A) recently cleared land adjacent to Turner Road; B) alluvial mixed forest along the north bank of the Englishman River; and C) and D) permanently flooded pool bisecting the property, which may be a breeding site for Red-legged Frogs.

5.1.3.1 Species Diversity

Eleven species of vascular plants and 11 species of wildlife (all birds) were documented at the site during the April site visit. These species are listed below.

Vascular Plants

Grand Fir	*Abies grandis*
Bigleaf Maple	*Acer macrophyllum*
Red Alder	*Alnus rubra*
English Holly	*Ilex aquifolium*
Pacific Ninebark	*Physocarpus capitatus*
Sword Fern	*Polystichum munitum*
Douglas-fir	*Pseudotsuga menziesii*
Salmonberry	*Rubus spectabilis*
Common Snowberry	*Symphoricarpos albus*
Common Dandelion	*Taraxacum officinale*
Western Redcedar	*Thuja plicata*

Birds

Mallard	*Anas platyrhynchos*
Band-tailed Pigeon	*Patagioenas fasciata*
Anna's Hummingbird	*Calypte anna*
Eastern Phoebe	*Sayornia phoebe*
Red-breasted Nuthatch	*Sitta canadensis*
Brown Creeper	*Certhia americana*
Bewick's Wren	*Thryomanes bewickii*
Chipping Sparrow	*Spizella passerina*
Purple Finch	*Carpodacus purpureus*
Red Crossbill	*Loxia curvirostra*
Pine Siskin	*Spinus pinus*

Species-at-risk

Several species-at-risk are known to occur in the Englishman River watershed. For example, Pacific Sideband, Red-legged Frog, Olive-sided flycatcher, and Common Nighthawk have been observed in the watershed (Hawkes et al. 2008). One species with provincial (blue-listed) and federal (Special Concern) designation as a species-at-risk, Band-tailed Pigeon, was documented at Site 5 during the site visit. Two individuals (presumably a breeding pair) were observed flying out of the remaining alluvial forest on the southern portion of the property. This habitat is characteristic of typical Band-tailed Pigeon breeding habitat, and it is possible that the species nests in these trees. Removal of these trees thus has the potential to impact an area of suitable nesting habitat for this species.

Although Red-legged Frogs (provincially blue-listed, federal species of Special Concern) were not documented during the site visit, the permanent water body that bisects the property is an example of ideal breeding habitat for this species, and the surrounding alluvial forests provide excellent foraging habitat. Much of the provincial distribution of this species occurs within areas of the province that are subject to intense development pressures, and thus many local populations have been extirpated as forest pools have been degraded and developed. Any WTP development on the site would be advised to preserve this flooded area as well as adjacent riparian and wooded habitats.

Other species-at-risk that may potentially occur at the site include:

Terrestrial Molluscs

- Pacific Sideband (*Monadenia fidelis*)

Birds

- Great Blue Heron, *fannini* ssp. (*Ardea herodias fannini*)
- Olive-sided Flycatcher (*Contopus cooperi*)
- Common Nighthawk (*Chordeiles minor*)

5.1.3.2 Potential Harmful Effects

A large portion of the property (~50-60%) was in the process of being cleared during the April 2010 site visit, and thus any additional environmental impacts associated with the development of a WTP on this part of the site would likely be negligible. An extensive stand of riparian mixed forest and associated habitats occurs on the southern half of the property, however, and could be impacted by any intake and WTP construction (primarily through the removal of trees and native vegetation). The pipeline connecting the water intake site in the Englishman River with the proposed WTP would necessitate the removal of a portion of alluvial forest to accommodate the pipeline, which would further fragment this woodlot and compromise the ecological integrity of this habitat. Additionally, an area of permanent water bisects the property and could potentially be subject to contamination or sedimentation during the construction process. Given the potential for this water body to harbour breeding populations of a species-at-risk (specifically, Red-legged Frogs), any factors that affect the turbidity, temperature, or other characteristics of this pool could have negative impacts on this species. The potential environmental impacts (including impacts on species-at-risk known and suspected to occur at the site) render this option the least desirable of the three potential options for the location of the water intake and WTP.

5.1.3.3 Opportunities for Mitigation

Given the limited size of the property and the relatively small amount of natural vegetation that would remain if the site was chosen as the location of the WTP, there are expected to be few opportunities for mitigation available at the site. Retention of the riverside trail along the north banks of the Englishman River is recommended, however, as this trail is apparently utilized by the local public. We also recommend that a planting plan of native grasses, shrubs and trees be developed to mitigate for the impacts to native habitats and to restore the riparian ecosystem at this site.

5.2 Fish Populations and Habitats

5.2.1 Baseline Information and Consultations

The Englishman River supports significant populations of salmon. Chum is the dominant species followed by coho. Steelhead, cutthroat, Chinook, pink and sockeye are also present. The anadromous[1] section extends up to Englishman River falls, a distance of about 16 km from the mouth. Resident game species include Dolly Varden and rainbow trout.

Table 1 shows when the various life stages for each anadromous salmonid species are present within the Englishman River and estuary. The mainstem reach that extends from downstream of Highway 19A to Morison Creek is an important spawning area for all species of anadromous fish within the Englishman River, including chum, coho, Chinook and pink salmon, steelhead and rainbow trout (Figure 8). Some salmon and steelhead spawning has also been observed as far upstream as the anadromous barrier (Lough and Morley 2002; J. Craig, BCCF pers. comm.).

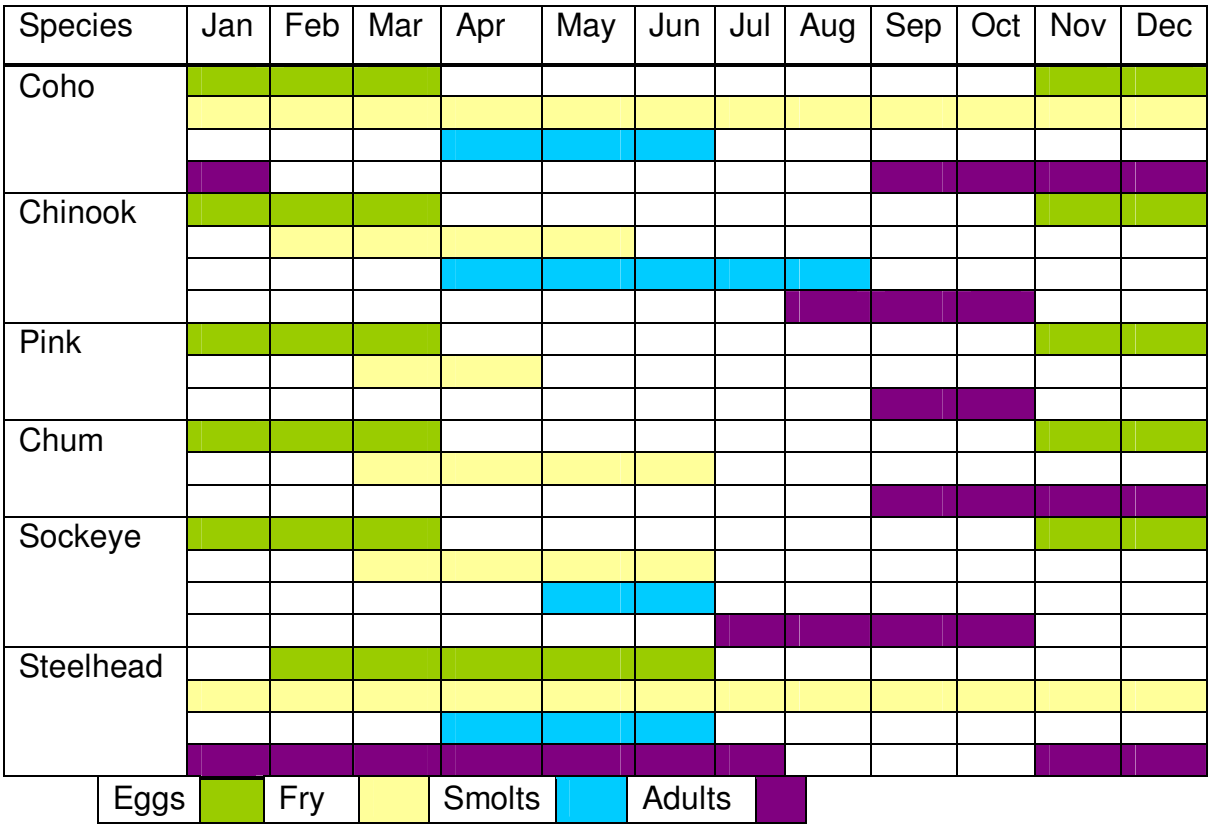
The C.W. Young Side Channel on the left bank of the river, downstream of Morison Creek, is used for spawning by the same species as found in the mainstem as well as cutthroat trout. Coho and chum salmon and cutthroat trout spawn in the MacMillan Bloedel side channel, on the right bank of the river just downstream of the BC Hydro transmission corridor. Both channels extract water from the mainstem and then discharge flow back to the mainstem at the side channel outlets.

The mainstem provides good quality rearing habitat for coho, Chinook, steelhead and resident rainbow trout, while the side channels provide good to excellent rearing habitat for coho, steelhead and cutthroat trout.

Key concerns voiced by DFO, MoE and key stakeholders in discussions held with the project team on the selection of a new river intake site related primarily to the potential loss of flow downstream of the new intake. The specific concern relative to fish habitat is how water withdrawals at the proposed intake location may reduce flows in the mainstem, and thereby negatively impact wetted aquatic area and quality of aquatic habitats downstream of the new water intake. Under existing conditions, summer rearing habitat in the Englishman River is considered one of the primary limiting factors of coho, steelhead, Chinook and rainbow trout production within the watershed (Bocking and Gaboury 2001; Lough and Morley 2002). Rearing habitat is limited by low summer flows that typically occur between July and October (Table 2).

[1] Anadromous defined as fish that breed in freshwater but live their adult life in the sea

Table 1. Life history timing for anadromous salmonids within the Englishman River and estuary.



In the mainstem of the Englishman River, the impacts of low summer flows have been alleviated to some degree by the relatively recent (since 2001) ability to augment low summer flows with the release of storage water from the headwater reservoir at Arrowsmith Lake. A Provisional Operation Rule for Arrowsmith Lake Reservoir was issued by Order under s. 18, *Water Act* which requires a minimum flow release to maintain a discharge of 1.6 m^3/s at the Water Survey of Canada (WSC) gauge located at the Highway 19A bridge crossing. The supplemental summer flow release target from Arrowsmith Dam was proposed to prevent flows from dropping below 10% MAD (mean annual discharge 13.5 cms), which would provide a significant benefit to juvenile salmonid production in the mainstem river (Lough and Morley 2002). However, due to the relatively small storage volume of Arrowsmith Reservoir coupled with years of low precipitation and the naturally low summer discharges in the Englishman River, annual minimum discharges have been below 1.6 cms between 2001 and 2009, albeit for short durations. Nevertheless, the release of water from Arrowsmith Dam has greatly improved summer discharges. For example, the median annual minimum flow prior to the Arrowsmith Dam was 0.3 cms but improved to 1.0 cms with the dam releases.

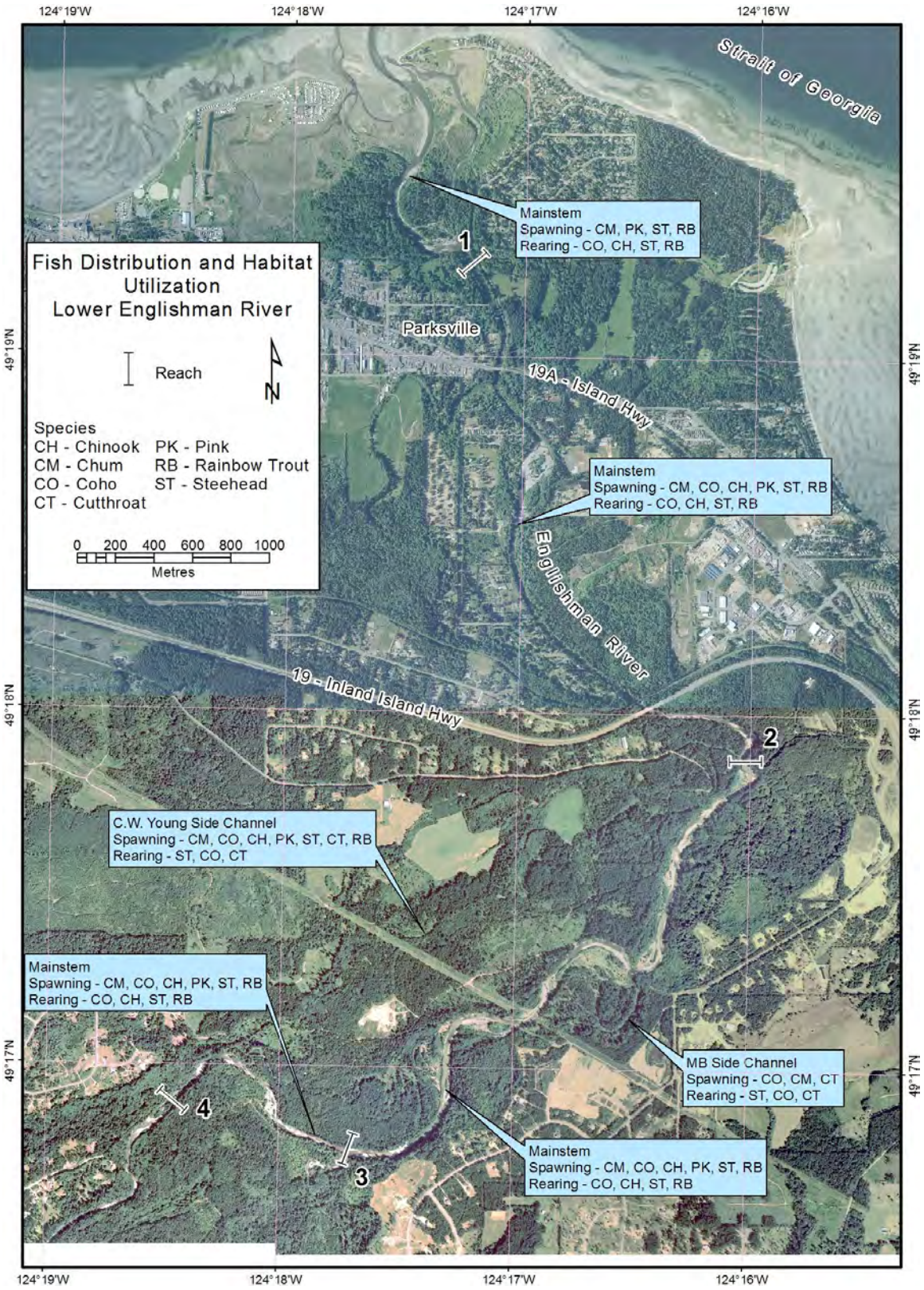


Figure 8. Map of lower Englishman River showing distribution of salmon and trout species that use mainstem and side channel habitats for spawning and rearing.

Table 2. Annual minimum discharges in Englishman River, WSC gauge 08HB002, over period of record, 1913-2009. Note: 2009 datum is provisional.

Year	Minumum Discharge (cms)	Date (Month--Day)	Period Summaries	
1913	0.283	9--1		
1914	0.085	9--4		
1915	0.651	9--20		
1916	0.425	10--17		
1917	1.1	8--11		
1970	0.17	9--1		
1971	1.16	8--29		
1980	0.633	9--19		
1981	0.464	8--23		
1982	0.494	9--3		
1983	0.476	10--12		
1984	0.418	8--31		
1985	0.269	8--28		
1986	0.292	9--19		
1987	0.265	10--19		
1988	0.268	9--14		
1989	0.31	10--3		
1990	0.216	8--29		
1991	0.29	8--5		
1992	0.252	8--16		
1993	0.144	9--30		
1994	0.338	9--2		
1995	0.249	9--25		
1996	0.208	8--28		
1997	0.831	8--19		
1998	0.17	9--7	1913~2000	Discharge
1999	0.891	10--12	Minimum	0.085
2000	0.665	9--28	Median	0.301
2001	1.12	7--24		
2002	0.973	11--5		
2003	1.02	7--21		
2004	1.15	9--7		
2005	1.22	9--28		
2006	0.737	10--13		
2007	1.56	9--14	2001-2009	Discharge
2008	0.942	8--17	Minimum	0.737
2009	0.764	10--12	Median	1.02

J. Craig (BCCF) indicated that the most critical fish habitat in the mainstem is located in Reach 3 (from confluence of the South Englishman downstream to Top Ridge Park) and Reach 4 (from below the confluence of Morison Creek downstream to the South Englishman confluence) (Figure 8). As identified above, the habitat in this reach is most important for salmon, steelhead and rainbow trout spawning, and coho, Chinook, steelhead and rainbow trout rearing and overwintering.

In addition, two side channels currently extract water from the mainstem at two separate locations. For the C.W. Young Channel, the intake is located near Morison Creek confluence (Reach 4) and for the MacMillan Bloedel Channel the intake is located just below the BC Hydro transmission corridor crossing (Reach 3). Both side channels discharge flows back to the mainstem upstream of Allsbrook Canyon.

Based on these concerns, representatives from DFO, MoE, BCCF and MVIHES indicated that their preferred intake location would be as far downstream as possible. Consequently, an intake location downstream of Allsbrook Canyon would be considered more favourable to agency staff and key stakeholders than an intake location upstream of Allsbroook Canyon.

5.2.2 Site 1

5.2.2.1 Fish Habitat Assessments

Site 1 is located on the left bank (facing downstream) at a shallow curve meander bend of the river. Large boulders and bedrock are the predominant channel substrates present along the left bank at the candidate water intake site. The bank itself is comprised primarily of bedrock throughout the length of the potential site. Water depth near the bank is ~1.5-2 m adjacent to the bank. The habitat immediately adjacent to Site 1 is characterized as deep pool. At low discharges the pool site would be adjacent to a large cobble and boulder / bedrock riffle and a section of glide habitat. The pool habitat and backeddies created by the emergent boulders and bedrock features would be suitable as rearing and holding habitat for steelhead and rainbow trout parr and adults at moderate and high flows and for trout, coho and Chinook juveniles at low flows. This location does not have suitably-sized gravels for salmonid spawning. Although the bank vegetation near the Highway 19 and railway crossings has been disturbed, large mature Douglas fir and red cedar are the dominant tree species found on the left bank at the potential intake Site 1.

Development of a water intake at Site 1 would result in a pipeline crossing of the river, likely within the right-of-ways (ROWs) of either the Highway 19 or railway crossings. Fish habitat further downstream near the Highway 19 and railway crossings is composed of both glide and riffle habitats, with substrates of bedrock, large cobble and boulder. Suitable gravel substrate or habitat for

salmonid spawning was not found. Similar to the habitat at the intake site, the habitat within the ROWs would be suitable as rearing habitat for steelhead and rainbow trout parr and adults at moderate and high flows, and as rearing habitat for trout, coho and Chinook juveniles at low flows.

5.2.2.2 Potential Harmful Effects

Site 1 is located ~2.6 km upstream of the existing water intake and ~4.4 km upstream of the river mouth. Fish habitat within this 4.4 km section of channel is characterized as predominantly glide with current utilization by salmon and steelhead for spawning, and by coho, Chinook, steelhead and resident rainbow trout for rearing (Figure 8). Timing of use of this habitat by these species would be as described in Table 1.

Potential harmful effects on fish and fish habitats during construction within the specified fisheries work window would include:

1. Short term disturbance to juvenile coho, Chinook, steelhead and resident trout that would be rearing in the glide adjacent to the proposed water intake;
2. Short term disturbance to juvenile coho, Chinook, steelhead and resident trout that would be rearing in the glide and riffle habitats near the Highway 19 and railway crossings during installation of the pipe along the left bank and across the mainstem.

Depending on the maintenance activities involved and the timing of these activities at the water intake site, there could be some short term disturbance to either spawning or rearing fishes that are proximal to the intake.

Potential harmful effects of water withdrawal at this intake site during the operational phase would include a reduction in wetted habitat area reducing the amount of spawning, incubation and rearing habitat area downstream of this intake site. The reduction in wetted habitat area could also potentially affect the quality of these habitats. Lower water flows could also contribute to higher water temperatures that exceed optimal conditions for fish growth and survival.

Entrainment or impingement of particularly juvenile fish may occur with inappropriate or inadequate screening of the water intake or if the screen is not regularly maintained. Approach velocities (i.e., the water velocity into or perpendicular to the face of an intake screen) that exceed 0.11 m/s may to be too great for salmon or trout juveniles to avoid, causing impingement and potential fish losses.

5.2.2.3 Opportunities for Mitigation

Short term disturbance to fish populations and potential impacts on river water quality (i.e., riparian clearing, bank erosion, sediment mobilization, etc.) as a result of intake construction and/or maintenance can be effectively mitigated through established environmental protection procedures that have been

endorsed by the regulatory agencies and by site-specific environmental management plans developed by AWS for construction and maintenance operations. In addition, timing of construction and maintenance should conform to least sensitive fisheries instream work windows to ensure work does not occur during egg incubation and fry emergence periods.

During the operational phase, potential impacts on spawning, incubation and rearing habitat downstream of alternative intake Site 1 as a result of a decrease in river discharge after raw river water is extracted can be mitigated by ensuring that releases from Arrowsmith Dam meet, where conditions permit, a minimum discharge in the mainstem up to a specific location downstream. Minimum discharge provisions should ensure that all important spawning and rearing sections of the river remain productive and viable for salmon and trout. Currently, a minimum discharge target is set for the WSC gauge at the Highway 19A bridge crossing. A suitable minimum river maintenance flow up to Highway 19A would mitigate potential impacts as a result of water withdrawal and maintain the current capacity and productivity of important spawning and rearing habitats within the majority of the anadromous zone of the river.

In addition, summer and fall operation of the water intake could be managed so water extraction only occurred when flows exceeded a specific river discharge at, for example, Highway 19A. As a precautionary measure, this on-off flow target could be set higher than the minimum river maintenance flow described above. Managing the timing of water extraction would mitigate potential impacts to fish populations and recognize existing limitations to rearing habitat during low flow periods. Also, managing the timing of Arrowsmith Dam releases to consider the predominant low flow period of August 15 to October 15 (81% occurrence of annual minimum flow in period of record; Table 2) could further mitigate potential impacts to rearing habitats during the low flow period.

Intake screens should be designed so that when the pumps are operating there is a low approach velocity through the screen. This will minimize potential fish entrainment or impingement on the screen, particularly for juvenile life stages. Screen type and design should also meet the applicable guidelines set by DFO (1995) in 'Freshwater Intake End-of-Pipe Fish Screen Guideline'. A regular maintenance schedule that includes screen cleaning would reduce the likelihood of fish impingement.

5.2.3 Site 3

5.2.3.1 Fish Habitat Assessments

Site 3 is located on the left bank in a short straight section of channel, ~55 m upstream of the Highway 19A bridge crossing and immediately downstream and on the outside curve of a meander. The bedrock bank projects above the water surface ~1-1.5 m at the moderate flows observed during our survey on 21 April

2010. The habitat at Site 3 is characterized as pool habitat at all flows. Water depth near the bank is ~1.5-2.5 m adjacent to the vertical bedrock bank. The deeper water within the pool habitat would be suitable as holding habitat for pre-spawning salmon, steelhead and rainbow trout. The site is also suitable for juvenile trout, steelhead, coho and Chinook rearing. The pool immediately adjacent to the potential intake location does not have gravel of a suitable size for salmonid spawning. However, suitable spawning substrate for salmon, steelhead and trout is present on the right side of the channel, opposite the potential intake site.

Riparian vegetation is sparse adjacent to Site 3, having been disturbed through historic land use, and highway and commercial developments at this location. However, a narrow riparian strip of mature Douglas fir and red cedar occurs on the left bank at Site 3.

5.2.3.2 Potential Harmful Effects

Site 3 is located ~415 m upstream of the existing water intake and ~2.2 km upstream of the river mouth. Fish habitat adjacent to the intake site and within this 0.4 km section of channel downstream is characterized as glide with current utilization by salmon for spawning and by coho, Chinook, steelhead and resident rainbow trout for rearing. Timing of use of this habitat by these species would be as described in Table 1.

A potential harmful effect on fish and fish habitats during construction within the specified fisheries work window would be a short term disturbance to juvenile coho, Chinook, steelhead, and resident trout that would be rearing in the glide adjacent to the proposed water intake.

Depending on the maintenance activities involved and the timing of these activities at the water intake site, there could be some short term disturbance to either spawning or rearing fishes that are proximal to the intake.

Potential harmful effects of water withdrawal at this intake site during the operational phase would include a reduction in wetted habitat area reducing the amount of spawning, incubation and rearing habitat area downstream of this intake site. The reduction in wetted habitat area could also potentially affect the quality of these habitats. Lower water flows could also contribute to higher water temperatures that exceed optimal conditions for fish growth and survival.

Entrainment or impingement of particularly juvenile fish may occur with inappropriate or inadequate screening of the water intake or if the screen is not regularly maintained. Approach velocities (i.e., the water velocity into or perpendicular to the face of an intake screen) that exceed 0.11 m/s may to be too great for salmon or trout juveniles to avoid, causing impingement and potential fish losses.

5.2.3.3 Opportunities for Mitigation

Short term disturbance to fish populations and potential impacts on river water quality (i.e., riparian clearing, bank erosion, sediment mobilization, etc.) as a result of intake construction and/or maintenance can be effectively mitigated through established environmental protection procedures that have been endorsed by the regulatory agencies and by site-specific environmental management plans developed by AWS for construction and maintenance operations. In addition, timing of construction and maintenance should conform to least sensitive fisheries instream work windows to ensure work does not occur during egg incubation and fry emergence periods.

During the operational phase, no significant change from the existing condition would occur to the quality of spawning, incubation and rearing habitat downstream of alternative intake Site 3 if the current minimum discharge provisions in the Arrowsmith Dam license were maintained. Under this alternative the minimum discharge reference location could move to a river discharge point immediately upstream of Site 3, as the WSC gauge at the Highway 19A bridge crossing is only ~30 m downstream. Potential impacts to important spawning and rearing sections of the river would be mitigated by ensuring a minimum river maintenance discharge that maintained productive and viable habitat for salmon and trout.

In addition, summer and fall operation of the water intake could be managed so water extraction only occurred when flows exceeded a specific river discharge at the reference location. As a precautionary measure, this on-off flow target could be set higher than the minimum river maintenance flow described above. Managing the timing of water extraction would mitigate potential impacts to fish populations as a consequence of existing limitations to rearing habitat during low flow periods. Also, managing the timing of Arrowsmith Dam releases to consider the predominant low flow period of August 15 to October 15 (81% occurrence of annual minimum flow in period of record; Table 2) could further mitigate potential impacts to rearing habitats during the low flow period.

Intake screens should be designed so that when the pumps are operating there is a low approach velocity through the screen. This will minimize potential fish entrainment or impingement on the screen, particularly for juvenile life stages. Screen type and design should also meet the applicable guidelines set by DFO (1995) in 'Freshwater Intake End-of-Pipe Fish Screen Guideline'. A regular maintenance schedule that includes screen cleaning would reduce the likelihood of fish impingement.

5.2.4 Site 5

5.2.4.1 Fish Habitat Assessments

Site 5 is located on the left bank in a short straight section of channel, ~380 m downstream of the Highway 19A bridge crossing. The streambank is composed primarily of sand and silt. The habitat at Site 5 is characterized as glide habitat. Channel substrate consists of ~60% cobble and ~40% gravel. Water depth near the bank is relatively shallow at ~0.3-0.5 m approximately 2-3 m from the bank toe. The glide habitat adjacent to the intake site is suitable as spawning habitat for salmon, steelhead and rainbow trout. The site is also suitable for juvenile trout, steelhead, coho and Chinook rearing.

5.2.4.2 Potential Harmful Effects

Site 5 is located ~30 m downstream of the existing water intake and ~1.8 km upstream of the river mouth. Fish habitat adjacent to the intake site is characterized as glide with current utilization by salmon for spawning and capability for rearing by coho, Chinook, steelhead and resident rainbow trout. Timing of use of this habitat by these species would be as described in Table 1.

A potential harmful effect on fish and fish habitats during construction within the specified fisheries work window would be a short term disturbance to juvenile coho, Chinook, steelhead, and resident trout that rear in the glide adjacent to the proposed water intake. Disturbance during spawning would not occur as construction would be scheduled outside of the spawning period, during the fisheries work window.

Depending on the maintenance activities involved and the timing of these activities at the water intake site, there could be some short term disturbance to either spawning or rearing fishes or incubating salmonid eggs that are proximal to the intake. Back-flushing of the filtration gallery could cause localized disturbance of the gravel substrate and could dislodge benthic macroinvertebrates or incubating eggs, or disturb salmonids during spawning.

Potential harmful effects of water withdrawal at this intake site during the operational phase would include a reduction in wetted habitat area reducing the amount of spawning, incubation and rearing habitat area downstream of this intake site. The reduction in wetted habitat area could also potentially affect the quality of these habitats. Lower water flows could also contribute to higher water temperatures that exceed optimal conditions for fish growth and survival.

5.2.4.3 Opportunities for Mitigation

Short term disturbance to fish populations and potential impacts on river water quality (i.e., riparian clearing, bank erosion, sediment mobilization, etc.) as a result of intake construction and/or maintenance can be effectively mitigated through established environmental protection procedures that have been

endorsed by the regulatory agencies and by site-specific environmental management plans developed by AWS for construction and maintenance operations. In addition, timing of construction and maintenance should conform to least sensitive fisheries instream work windows to ensure work does not occur during egg incubation and fry emergence periods.

During the operational phase, no significant change from the existing condition would occur to the quality of spawning, incubation and rearing habitat downstream of alternative intake Site 5 if the current minimum discharge provisions in the Arrowsmith Dam license were maintained. Potential impacts to important spawning and rearing sections of the river would be mitigated by ensuring a minimum river maintenance discharge that maintained productive and viable habitat for salmon and trout.

In addition, summer and fall operation of the water intake could be managed so water extraction only occurred when flows exceeded a specific river discharge at a reference location, i.e., WSC gauge at Highway 19A. As a precautionary measure, this on-off flow target could be set higher than the minimum river maintenance flow described above. Managing the timing of water extraction would mitigate potential impacts to fish populations as a consequence of existing limitations to rearing habitat during low flow periods. Also, managing the timing of Arrowsmith Dam releases to consider the predominant low flow period of August 15 to October 15 (81% occurrence of annual minimum flow in period of record; Table 2) could further mitigate potential impacts to rearing habitats during the low flow period.

6.0 Recommendations on Site Selection

From a wildlife and terrestrial vegetation perspective, Site 3 is heavily impacted in its current state and the development of an intake structure and WTP is expected to have minimal impacts to key indicators. Consequently, Site 3 is the preferred option from this perspective. Development of Sites 1 and 5 would have higher potential impacts. Potential impacts at Site 1 are considered moderately significant because of the reduction in second-growth Douglas-fir forest. Of the three sites, Site 5 is the least-preferred option because of the potential impacts to riparian mixed forest and associated habitats, and the greatest potential to impact species-at-risk.

Although only one species with conservation designation (Band-tailed pigeon) was documented during our site assessment, it is likely that at least several others occur in the riparian mixed forest associated with Site 5 (e.g., Pacific Sideband and Red-legged Frog). The timing of our site visits may have precluded documenting other species-at-risk and because of this we have taken a conservative approach when assessing the potential impacts to key indicators. This means that our assessment was based on the assumption that species-at-risk were considered to be potentially present where specific habitat features or sensitive ecosystems (such as maturing second-growth forest) were found that

are characteristic habitats for these species. This permitted a qualitative yet consistent approach to assessing the impacts to the key indicators for each site assessed.

Overall, all three site locations have lower impact on fish and fish habitats than a potential intake location in Reaches 3 and 4 upstream of Allsbrook Canyon. If any of the three candidate sites are selected, flows within these critical spawning, rearing and overwintering reaches will be maintained. For all three candidate sites, the proposed locations for the WTPs does not impact fish habitat and is therefore not germane to the recommendations on site preferences from a fish habitat perspective.

A Site 5 water intake would have the least impact on fish populations and their habitats because the location is the furthest downstream in the mainstem and below critical spawning, incubation, rearing and overwintering habitats that require and are sustained by adequate river flows. The riverbank filtration gallery type of intake proposed for Site 5 will not cause fish impingement but back-flushing of the gravels could cause localized disturbance and could dislodge benthic macroinvertebrates or incubating eggs and could disturb spawning salmonids. Nevertheless, water withdrawal at Site 5 would have the least impact on habitat area or quality as only 1.8 km of channel downstream of the intake is potentially affected, and most of the affected channel is backwatered at high tide. Site 5 is therefore the most favourable site from a fish habitat perspective.

In comparison, Site 3 would be quite similar to Site 5 in its relatively low potential impact on fish and fish habitat. The impact on habitat area would be only slightly greater than Site 5 as it is located ~445 m upstream of Site 5. The bank type intake structure would have some potential to impinge fish during its operation but current technology should limit the effect to insignificant mortality levels. Site 3 would be considered as favourable as Site 5 as a water intake location.

Site 1 would have the greatest potential impact on fish and fish habitat because of the greater distance of habitat affected (4.4 km) with potentially lower river discharge downstream of this water extraction point. Consequently, Site 1 is the least favourable from a fish habitat standpoint. Implementation of mitigation measures that ensure a minimum river maintenance flow target similar to current Water License provisions would mitigate the potential impact, making this site a more acceptable alternative.

7.0 References

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