




Requisition #: EZ113-150539/A

SPECIFICATIONS: Coldstream Ranch Well Project – Plugging
of Flowing Wells

PROJECT #: R.043433.005

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**DETAILED DESIGN TENDER SPECIFICATIONS
COLDSTREAM RANCH WELL REMEDIATION PROJECT-
PLUGGING OF FLOWING WELLS
COLDSTREAM, BC**

June 30, 2014

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Section Number Section Title Page

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01 GENERAL REQUIREMENTS

01 11 00 Summary of Work

2.1 Project Description

- .1 Public Works and Government Services Canada (PWGSC), on behalf of Natural Resources Canada (NRCan) will be remediating (closing; killing) the Coldstream Ranch Well (CRW) (the Project), located in the District of Coldstream, in the Southern Interior of BC (Figure 1). The Project property is registered to Coldstream Ranch (2002) Ltd. and is primarily agricultural in nature. The Project location (referred to as the Site) is bounded by Kalamalka Road to the south, Coldstream Ranch buildings to the east, Skobalski Brook and a Canadian National (CN) railway to the north. Cultivated fields owned by Coldstream Ranch are located immediately to the west (Figure 2) of the Site and immediately south of Kalamalka Road. As indicated in the following specification, these fields have been identified for potential disposal of groundwater. Coldstream Creek is located approximately 230 m south of the Site.
- .2 In June of 1965, while the Geological Survey of Canada (GSC) was drilling an uncased investigative borehole, a previously undiscovered strongly flowing artesian aquifer was encountered on the Coldstream Ranch lands at a depth of approximately 200 ft (61 m). Drilling into this aquifer (subsequently referred to as the "Lower Aquifer") resulted in large and uncontrollable surface flows. In 1965, a variety of options were pursued to stem or draw down the flow so that the borehole could be plugged, including drilling two undersized relief wells (RW1 and RW2). None of the options pursued resulted in completely stemming the flow; however, surface flows were ultimately mostly contained within a nominal 30 inch casing installed in 1966. In 1980, the nominal 30 inch casing had a nominal 16 inch casing and well screen placed in it. The nominal 16 inch casing was not set in the Lower Aquifer, but rather in the overlying aquitard with the connection with the Lower Aquifer assessed to be sand and gravel infilling an eroded hole through the Lower Aquitard. None of the casings were cemented into the formation. The lithology, aquifers and aquitards identified at the Site, as well as a present day completion drawing of the CRW nominal 16 inch and 30 inch casing is provided in Figure 3.
- .3 To this day, the CRW flows at approximately 300 to 500 US gallons per minute (USgpm). Any attempt to reduce flow, by shutting the CRW in, results in groundwater breaking out at surface as a result of flow from the Lower Aquifer short-circuiting up around the well casings. Historical photographs of flow from the nominal 16 inch and 30 inch casings indicate the Lower Aquifer may be capable of flow at ground surface from 1,000 to potentially 2,000 USgpm. The properties of the Lower Aquifer are not accurately known but it has been assessed that the static piezometric level of the aquifer may stand up to approximately 118 ft (36 m) above ground surface. This is based on an estimated and potential shut-in pressure at ground surface in a properly constructed well, and with breaches in the aquifer at and around the CRW fully plugged, of approximately 50.6 psi (349 kPa). This equates to a mud density of 1,585 kg/m³ (13.2 pounds per gallon) to balance the formation and somewhat higher to allow safe drilling and tripping of drilling tubulars. The best estimate of the transmissivity of the Lower Aquifer is between 250 m²/day and 550 m²/day, but with the potential to be higher.
- .4 A 100 mm (4 inch) monitoring well (MW11-01) was completed in the Middle Aquifer in 2011 .
- .5 Four monitoring wells MW13-01 to 04 were completed in the Upper Aquifer in 2013.

- .6 The orientation of the CRW and the existing RW1 were assessed using a gyroscopic survey.
- .7 In 2013 a relief well (RW3) was successfully completed in the Lower Aquifer approximately 5 m from the CRW. The top of the Lower Aquifer at RW3 was encountered at 64 mbg (210 ft bg) and a basal clay was encountered at 70 mbg (230 ft bg). The relief well was completed using two casings pressure grouted into the ground and a nominal 12 inch liner grouted to overlap the lower part of the second and inner nominal 16 inch casing. A 15 ft telescopic well screen was set in the Lower Aquifer (Figure 4) and fixed in place using an inflatable packer system. Grain size distribution curves for the soils encountered in the Lower Aquifer are provided in Appendix A. With the adjacent CRW still flowing, artesian flow from RW3, was approximately (600 USgpm) and the shut-in pressure of RW3 was 124 kPa or 12.65 m head of water (18 psi/ 42 ft)
- .8 Pumping testing of RW3 in conjunction with flow from RW1 and MW11-01 was conducted following completion of RW3 with flows up to approximately 1200 USgpm achieved at RW3 and the potential, using a pump set within the 12 inch liner, of achieving flow rates up to ~1400 USgpm. With RW3 being pumped at 1200 USgpm the flow from the CRW was stopped. Subsequently a pumping test was conducted at 37.5 L/s (600 USgpm) on the nearby Regional District of North Okanagan (RDNO) Well No.1 and it was assessed that it would provide useful additional drawdown in the CRW resulting from flow from both the Middle and Lower Aquifers.
- .9 Sufficient power is available at the Site to operate 3 x 75 hp well pumps. This will be the duty power for all pumps at the Site with additional emergency back-up power to be provided.
- .10 The RDNO Well No.1 is an operating well connected to municipal power, which can be used once emergency back-up power has been connected, as is.
- .11 The CRW represents an uncontrolled risk for the Government of Canada and potentially to local watercourses (Coldstream Creek and Skobalski Brook) for the Province of BC. Erratic flow from the CRW in recent years, associated with some incidents of high turbidity, has caused concern for the BC Ministry of Forest, Lands and Natural Resource Operations (MFLNRO) and Coldstream Ranch. Despite its potential instability, however, the CRW also provides a benefit to surrounding water bodies and water users.

2.2 Project Objective and Scope of Work

- .1 PWGSC, on behalf of NRCan is remediating the CRW to meet the following objectives:
 - .1 to stabilize an uncontrolled and possibly deteriorating risk while safely providing groundwater flows that have been available since circa 1965 to users and receiving environments; and
 - .2 to meet the BC Ministry of Forests, Lands and Natural Resources Operations requirement that when the CRW is closed, groundwater seepage at ground surface does not occur.
- .2 This phase of work (referred to as Phase 2 and which continues from installation of RW3 and associated monitoring wells; known as Phase 1) relates to closure of the CRW and will include:
 - .1 The plugging of the CRW and RW1 and optionally MW11-01 while operating pumps and relief wells as specified;
 - .2 setting pumps with appropriately sized drop pipes and power supply using both the on-site power, and for all pumps an additional emergency power supply;

- .3 where required, drilling fluid and groundwater control;
- .4 removal of all demolished surface structures or subsurface steel for recycling;
- .5 operating all pumps at the flows and intervals specified for the duration of the Project to effect drawdown in the wells that are to be plugged and abandoned; namely, CRW, RW1 and MW11-01;
- .6 maintenance of minimum nominal 8 inch tubing from ground surface to the lowest open part of the CRW at all stages of the operation when there is open, uncased and unplugged hole;
- .7 removal of well screen and nominal 16 inch casing from the CRW;
- .8 removal of all aquifer material across the breach in the Lower Aquitard;
- .9 plugging using Low Mobility Grout (LMG) the Lower Aquitard across its entire section in the CRW;
- .10 removal of the nominal 30 inch casing and plugging of the Upper Aquitard across its entire section in the CRW using LMG;
- .11 optionally: if the nominal 30 inch casing cannot be removed, ripping and or perforating the nominal 30 inch casing in the CRW across the section from approximately its shoe to the base of the Upper Aquifer and plugging the same section using permeation grouting with high solids bentonite grout;
- .12 removal of the nominal 30 inch casing from the Upper Aquifer while backfilling the hole with clean sand and gravel;
- .13 the possible removal of all remaining surface structures (primarily a concrete cistern) at and around the CRW;
- .14 cutting off the well screen at RW1 and pulling back the nominal 4½ inch liner from the well while grouting using LMG the Lower Aquitard across its entire section at RW1.
- .15 removal of the liner from RW1 and continued LMG grouting of RW1 to approximately 4 mbg, placing a 1 m concrete plug, cutting casing off at 3 mbg and backfilling the hole to surface;
- .16 optional plugging of MW11-01 primarily with a cement/bentonite mixture without recourse to cutting casing or well screens;
- .17 Contractor will also provide a contingency cost to drill, dewater from and subsequently abandon an additional relief well (RW4) to be completed in the Middle Aquifer (Option 1) or Lower Aquifer (Option 2), if required; and
- .18 rehabilitation of the Site to pre-Project surface elevations and general condition.

2.3 Location

- .1 The Site is located at 8755 Kalamalka Road, in the District of Coldstream BC, as indicated on the Drawings.
- .2 The legal address for the Site is Plan B1299 and Parcel B except Plan 25366, Osoyoos Division Yale District (ODYD).

- .3 Parcel Identification Number is 011-232-463.
- .4 The surveyed well locations and elevations are summarized on Table 1.

2.4 Site Setting

- .1 The Site is bounded by Kalamalka Road to the south, Coldstream Ranch buildings to the east, Skobalski Brook and a Canadian National (CN) railway to the north. To the west of the site and south of Kalamalka Road are cultivated fields owned and operated by Coldstream Ranch,
- .2 The Site is located on Coldstream Ranch lands, an active, operational cattle ranch.
- .3 The Site currently contains the following wells:
 - .1 CRW - a nominal 16 inch casing inside a nominal 30 inch casing;
 - .2 RW1 - an undersized relief well consisting of a nominal 4 ½ inch liner and screen, completed in the Lower Aquifer;
 - .3 RW3 – a nominal 12 inch relief well completed in the Lower Aquifer;
 - .4 MW11-01 – a nominal 4 inch steel monitoring well completed in the Middle Aquifer;
 - .5 MW13-01, MW13-02, MW13-03 and MW13-04 – four two-inch PVC monitoring wells completed in the Upper Aquifer.
- .4 A drill pad has been constructed around the CRW, RW1 and RW3 to provide a stable platform for the drilling equipment. The drill pad is constructed of approximately 1 m of compacted 25 mm minus crush gravel and covers an area of approximately 36 m x 18 m. Access to the drilling pad is gained from a road in the northwest corner of the drilling pad area, and a second access road along the eastern end of the drilling pad.
- .5 The CRW is currently housed in a 2 x 4 wood frame construction building set on top of a concrete foundation. Dimensions of the well house are approximately 2.5 m x 4 m.
- .6 The Coldstream Ranch pump house is located immediately to the west of the CRW well house and pumps water from the CRW concrete cistern (discussed below) for irrigation purposes.
- .7 Currently, the CRW discharges groundwater into an above ground concrete cistern that then discharges the water to Coldstream Creek via an 8 inch diameter buried asbestos cement pipe. The buried cement asbestos pipe extends under Kalamalka Road and under the agricultural fields to the south of the Site and daylights approximately 230 m to the south of the Site along Coldstream Creek.
- .8 The CRW also discharges groundwater to a drainage ditch located immediately to the north of the CRW. The drainage ditch extends northward eventually discharging into Skobalski Brook located approximately 150 m to the north of the CRW. Skobalski Brook flows in a westerly direction away from the Site, eventually draining into Coldstream Creek.
- .9 Although a settling pond system (geo-membrane lined straw bales) exists at the Site approximately 40 m to the west of the CRW, it's performance has been lacking in the past.
- .10 A 400 amp, 600 volt, 3 phase power drop is available at the Site directly to the southeast of the CRW, with a single phase transformer and panel for lighting and accessory outlets. The location of the Power Service is identified in Figure 5. The service is designed to operate up to 3 x 75 HP pumps. As pump sizing is unknown to this point, a properly sized

switch and starter will be required for each pump installed and be hard wired into the splitter.

2.5 Off Site Well

- .1 The Regional District of North Okanagan (RDNO) operates the RDNO Well No. 1, which is located on the Coldstream Ranch property, approximately 200 m to the northeast of the CRW.
- .2 The well is of nominal 16 inch diameter completed in the Middle Aquifer at a depth of 162 ft (49.4 m).
- .3 RDNO Well No.1 is a flowing artesian well, with a reported flow rate of approximately 100 USgpm (6.3 L/s).
- .4 A buried overflow pipe between RDNO Well No.1 and Coldstream Creek allows flowing artesian water to discharge to Coldstream Creek, this pipe will also act as the discharge pipe when the well is used for dewatering. The pipe discharges into Coldstream Creek approximately 180 m to the south/southeast of RDNO Well No.1.

2.6 Contractor Qualifications

- .1 The tender is primarily for the plugging of the CRW, RW1 and MW11-01 and potentially control of flowing groundwater using weighted mud systems. Contractors bidding should have demonstrable experience in Low Mobility Grouting and permeation grouting for the plugging of strongly flowing artesian boreholes.
- .2 The Bidder must demonstrate that all key supervisory personnel dedicated to the Contract have adequate experience and proven qualifications in conducting water well and/or geotechnical drilling. The documentation provided must identify by name essential front line personnel including site supervisors and crew leads. The Well Drilling Team must include:
 - .1 Qualified Well Drillers registered as specified under the BC Water Act or Qualified Professionals licensed or registered under the BC Engineers and Geoscientists Act to supervise all drilling operations that individually have minimum 15 years of well drilling experience.
 - .2 Qualified Well Pump Installers as specified under the BC Water Act currently Registered to install well pumps in BC as per BC Water Act and that individually have minimum of 10 years of well pump installation experience with demonstrable, relevant experience in installing well pumps in artesian flowing wells.
 - .3 Qualified Welder, holding
 - .1 Welder Level B certificate
 - .2 Individually have minimum of 10 years of experience in welding
 - .3 Demonstrable relevant experience welding well casings under flowing artesian conditions or welding under wet conditions
 - .4 Qualified "Mud Engineer(s)" that individually have minimum of 10 years of experience designing and maintaining drilling fluid circulating systems

- .3 As discussed in Section 2113 TECHNICAL SPECIFICATIONS, bidders must provide a detailed methodology for completion of the work. Selection of the approved methodology is entirely at the discretion of PWGSC and is not price dependant.
- .4 Experience of the Bidder to undertake and successfully perform contracts of a similar nature to the scope of works set out in this tender including
 - .1 Demonstrated experience within the past three years in completing artesian flowing wells of at least 24" in diameter surface casing to a depth of at least 150 feet and successfully pressure cementing those wells in formations that deliver flow to surface of greater than 500 USgpm and with shut-in pressures in excess of 15 PSI.
 - .2 Demonstrated experience in well drilling using circulated barite-weighted drilling mud and either:
 - .1 Experience using oilfield annular cementing techniques, or
 - .2 Experience using methods employed in the Australian Great Artesian Basin
 - .3 Demonstrated experience using pressure grouting techniques to seal underground formations
- .5 Demonstrated ability to provide and maintain in field conditions necessary rigs, tubulars and equipment and a contained (tanks) drilling-mud mixing and circulation system with appropriate cuttings removal (shale shaker), centrifuges etc.
- .6 Demonstrated ability to operate 24 hours a day for a period of up to six weeks once well kill and closure and drilling operations commence.
- .7 Ability to supply and maintain backup generator capacity for all operations.
- .8 Proposed work program must be described in sufficient detail to demonstrate the adequacy of the bidder's proposals to meet the contract requirements within the completion period.
- .9 Sufficient resources to secure the materials and equipment to execute a well kill and closure and drilling program. The Bidder is required to demonstrate that it has the financial capability to secure the materials and equipment to execute a well kill and closure and drilling program in the order of four million dollars to perform the Contract. To this end the Bidder or if applicable, a joint venture partnership, must provide such financial information as may reasonably be required by the Contracting Authority to establish the Bidder's financial ability to undertake and perform the Contract if awarded.
- .10 Contractor will provide in their bid a Health and Safety plan for the work. Bidders with inadequate Health and Safety plans, and unsatisfactory Health and Safety record or without proof of insurance will be rejected.

2.7 **Schedule**

- .1 Allowing for specified times provided in this document, bidder will provide a schedule for the work which is must be started by September 17th 2014 and then follow the schedule to completion. Note that schedules that indicate the bidder will occupy the Site and are followed by a duration of more than a few days until drilling is started will not be accepted.

2.8 Priority List

- .1 In order to carry out the Project, the Contractor will be required to complete several preliminary tasks. These tasks must be completed prior to commencing the Project on the Site, and the Work reviewed and approved by PWGSC. The following list indicates the tasks in a proposed priority for the Contractor to follow and provide general descriptions of what is required in each task. The descriptions are not absolutely comprehensive and the Contractor should refer to the Project specifications, plans and figures to fully understand the requirements and components of each task.
- .2 Priority Tasks:
 - .1 *Design for staging/work area:* A design of the staging/work area will need to be prepared showing the locations of all proposed constructed works, equipment storage, material holding, staging areas, temporary offices, parking and other components proposed by the Contractor. Note the general location of the staging/work area is provided in Figure 5.
 - .2 *Confirmation of groundwater transfer to the provided temporary settling system and management of the system:* A temporary settling facility has been designed and constructed by PWGSC's Representative (Golder Associates Ltd.) to collect, store and discharge water originating from the closure operations. The system is designed to allow the controlled release of sediment free water, by gravity to Skobalski Brook and or Coldstream Creek. Contractor's system for transferring groundwater from any wells or boreholes included in this project to the settling facility and for management of the settling facility is required.
 - .3 *Environmental Management Plan:* The Environmental Management Plan (EMP) will provide an overall plan for quality control on the Site and address issues such as discharge of collected water and drilling cuttings, protection of air and water quality, on-Site methods to provide for a clean work Site, emergency procedures in the event of leaks, spills, etc.
 - .4 *Materials Management Plan:* This plan will deal with materials movement on the Site, and methods the Contractor will use to ensure materials meet specifications and are moved/used in an efficient manner.
 - .5 *Health and Safety Plan:* Health and safety plan will cover all activities by the Contractor, their employees, other contractors on Site including consultants working for PWGSC and other parties authorized to visit the Site by PWGSC. The health and safety plan will provide for safe working conditions on a day-to-day basis and provide for emergency situations.
 - .6 *Transport and Disposal of Soils and Groundwater Plan:* The Contractor must supply a transport and disposal plan identifying the methods for transport and disposal of drilling cuttings and stored groundwater/drilling water, if required. This will include all safety precautions and contractual arrangements if transport is sub-contracted.
 - .7 *Quality Management Plan:* A quality management plan will be prepared by the Contractor detailing their quality management plan.

2.9 Definitions

- .1 The following Definitions shall apply to all Contract Documents.
 - .1 Change Directive: A Change Directive is a written instruction signed by PWGSC directing a change in the Work within the general scope of the Contract Documents
 - .2 Change Order: A Change Order is a written amendment to the Contract signed by PWGSC and the Contractor stating their agreement upon:
 - .1 a change in the Work;
 - .2 an amendment to PWGSC's Statement of requirements, if any;
 - .3 the method of adjustment or the amount of the adjustment in the Contract Price, if any; and
 - .4 the extent of the adjustment in the Contract Time, if any.
 - .3 Contractor: means the person, entity or entities named in the Contract to supply goods, services or both to Canada.
 - .4 Mud "Engineer" – An individual that primarily by experience monitors and maintains circulating barite weighted drilling fluid systems, typically on oil well drilling rigs. The term "Engineer" is a term of art and is not as specified under various provincial engineering acts.
 - .5 Owner: PWGSC is the person or entity identified as such in the Agreement. The term Owner means PWGSC or PWGSC's Representative as designated by PWGSC to the Contractor in writing. The PWGSC may also be defined as "Canada" or the "Contracting Authority" within this document.
 - .6 Project: The Project means PWGSC's enterprise of which the Work may be the whole or a part.
 - .7 Site: Defined as the Coldstream Ranch lands on which the Project occurs, generally bounded by Kalamalka Road to the south, Ranch lands to the east and west and a CN Rail line and Skobalski Brook to the north.

2.10 Dimensions

- .1 As far as possible, metric units are used in this tender; however, water well drilling equipment and tubulars are typically sized in nominal inches and nominal inches are used in this document for specifying tubing and well screen sizing consistent with major manufacturers of well screen, steel and PVC casing and pipe, pipe fittings and pump suppliers for the water well industry.

2.11 PWGSC Work

- .1 The following are some of the activities related to the Work that will be performed by PWGSC or PWGSC's Representative:

- .1 Provision of a legal survey plan.
- .2 Provision of a Site topographical survey and plan.
- .3 Designation of soil cuttings storage and provision of discharge water control at the Site.
- .4 Provision of Quality Assurance for water discharged from temporary settling system into any local water courses.
- .5 Collection of QA samples and testing and approval of samples during well plugging operations
- .6 Camera surveys of holes as required
- .7 Provision of QA report for PWGSC and Contractor review by PWGSC Representative.
- .8 Monitoring of discharge rates/ amounts to evaluate carrying/ absorption capacity of the surrounding landscape and water courses and to determine appropriate discharge rates and locations.

2.12 Permits and Approvals

- .1 The Contractor is required to meet or exceed the requirements of applicable regulations, standards, guidelines and codes.
- .2 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, supervision, materials, quality control, and other incidentals required to obtain all required permits and approvals to complete the Work.
- .3 All Work is to be carried out to a professional standard of care that meets or exceeds the requirements of specified standard, codes and referenced documents.
- .4 The Contractor is responsible for obtaining and paying for any permits and licenses required for the Work.
- .5 The Contractor must obtain and maintain at its own costs all permits, licenses and certificates required for the performance of the Work (including transportation, water disposal, and other permits, as necessary).
- .6 Upon request from PWGSC Representative, the Contractor must provide a copy of any required permit, license or certificate to PWGSC.
- .7 The Contractor must comply with all laws and regulations applicable to the performance of the Work.
- .8 The Contractor must provide evidence of compliance to PWGSC at such times as PWGSC may reasonably request it.

END OF SECTION

01 33 00 Submittals Procedure

2.1 Submittals List

- .1 Quality Management Plan
- .2 Daily, weekly, monthly summary reports on works associated with Project
- .3 Environmental Management Plan
- .4 Environmental Procedures
- .5 Project Schedule
- .6 Proof of Insurance
- .7 Bid Bond
- .8 Performance Bond
- .9 Mobilization Plan
- .10 Demobilization Plan
- .11 Contractor's Declaration
- .12 Work Completion Declaration
- .13 Manufacturer Certification or certified testing results for any materials used for the Work
- .14 Health and Safety Plan
- .15 Field Reports: submit to PWGSC or PWGSC Representative on Site, within three days of review, verifying compliance of Work
- .16 The Contractor is responsible for ensuring reporting requirements are fulfilled to satisfaction of PWGSC or PWGSC Representative
- .17 Examples of:
 - .1 Daily reporting templates for (but not limited to) drilling, casing, LMG installation, casing grout fracturing, water pressure testing, grouting, et. al.;
 - .2 Real-time monitoring (screen-dump of display to be used);
 - .3 Electronic data (file format to be provided);
 - .4 Equipment calibration data collection template; and
- .18 Drawings: Submit in accordance with Contract requirements
- .19 Design of Staging/Work Area
- .20 Equipment Specifications (including serial numbers where available) for all proposed equipment
- .21 Material specifications for all proposed fluid, cement, grout and admixtures
- .22 Provisional grout mix designs as per Specifications (where cement or bentonite is included in the mix by weight of cement or bentonite) including QC results from mix testing carried out prior to submittal;

- .23 Plan for pump installation and back-up power systems
- .24 Individual plans for plugging CRW, RW1 and MW11-01 (Optional Item) including:
 - .1 Materials storage;
 - .2 Removal of well screens and casing from ground, cutting of wells screens and casing;
 - .3 drilling, casing, installation and removal;
 - .4 grout mix design for both low mobility grout and permeation grout, strength, and placement as specified in 1.17;
 - .5 Bentonite pre-hydration (if proposed to be used);
 - .6 Drill cuttings / water / spoiled grout management plans;
- .25 Optional Item: Contingency plan for drilling and completing in the Middle Aquifer (Option 1) or Lower Aquifer (Option 2) the contingency well RW4 and for dewatering from the well and abandoning the well.
- .26 Quality control documentation, confirming any supplied backfill material meets Contract requirements
- .27 Commissioning
 - .1 As part of mobilization, and prior to the initiation of the Works, to the satisfaction of PWGSC and PWGSC's Representative, the Contractor shall prove that all equipment mobilized to site is fully functional and calibrated according to the specifications provided herein. Such proof of functionality shall include:
 - .1 general site setup and site safety (generators, light plants, material storage, office trailers, waste management etc.);
 - .2 drill rig condition, sufficient spare parts, drill rod and grout pipe handling capabilities, drill bit condition, proof of ability to drill in overburden material and bedrock;
 - .3 grout mixing plant condition, setup, containment of cement dust, grout pump condition, batching capability, cleaning / maintenance demonstration;
 - .4 grout header condition, flow control setup, grout hose lengths and diameters, initial calibration checks on all flow meters and pressure transducers, condition and adequacy of valves and connections, whip checks for high pressure lines, test run of water through system, cleaning and maintenance demonstration;
 - .5 adequacy of the real-time data acquisition system for monitoring pressure grouting operations (i.e., programming aspects of head loss calibrations, frequency of data collection, data averaging, file format, screen display);
 - .6 where applicable: packer inflation / deflation methods as well as leakage allowance past the packer; double packer setup for water pressure testing;
 - .7 adequacy of grout mix testing equipment;

- .8 acceptance of the full suite of grout mix designs as per Specifications including line loss testing and incorporation of derived line loss coefficients into the real-time monitoring system for each mix.
- .9 acceptance of casing grout mix design and where applicable strength performance with time.
- .28 Plan for Environmental Control of Imported Materials
- .29 Construction Management Plan
- .30 Infrastructure Monitoring Plan
- .31 Site Layout
- .32 Design for Site Restoration

END OF SECTION

01 42 00 References

2.1 Mandatory References

- .1 Golder Associates Ltd. December 6, 2010. PAC 3612 – Ci22N42 Coldstream Ranch Flowing Well, Coldstream BC, Remedial Options Assessment for Flowing Well Control.
- .2 Golder Associates Ltd. December 30, 2013. Coldstream Ranch Well Remediation Project; Drilling, Construction and Testing of RW3, Coldstream, BC.
- .3 Golder Associates Ltd. March 24, 2014. Drilling, Construction and Testing of Shallow Monitoring Wells, Coldstream Ranch Well Remediation Project.
- .4 Golder Associates Ltd. March 27, 2014. . Coldstream Ranch Well Remediation Project. Pumping Test of North Okanagan Coldstream Ranch Well No. 1.

2.2 General References

- .1 British Columbia Fire Code
- .2 British Columbia Ministry of the Environment, “Environmental Standards & Guidelines for fuel Handling, Transportation and Storage”, 1995
- .3 British Columbia Workers Compensation Act and Regulation
- .4 British Columbia Master Municipal Construction Document (2000)
- .5 British Columbia Ministry of Waste Land and Air Protection - Technical Guidance on Contaminated Sites, “#1 Site Characterization and Confirmation Testing (GDI)”
- .6 British Columbia Ministry of Transportation and Infrastructure
 - .1 “2009 Standard Specifications for Highway Construction” (October 1, 2008).
 - .2 Technical Circular 04-10.
- .7 Canadian Federal Legislation
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
 - .2 Canadian Environmental Assessment Act (CEAA), 1995.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992.
 - .4 Motor Vehicle Safety Act (MVSA), 1995.
 - .5 Canada Labour Code: Part 11-Occupational Health and Safety (R.S. 1985, c.L-2).
 - .6 Canada Occupation Health and Safety Regulations.
 - .7 Canada Water Act.
 - .8 Canadian Fisheries Act.
- .8 Canadian Foundation Engineering Manual, 4th Edition, Canadian Geotechnical Society, 2006.
- .9 British Columbia Contaminated Sites Regulation (Reg. 375/96 as amended).
- .10 British Columbia Environmental Management Act (SBC 2003) (BC Reg. 201/2007, as amended).

- .11 BC Environmental Management Act – Hazardous Waste Regulation, BC Reg 63/88 (amended April 1, 2009).
- .12 British Columbia Electrical Safety Regulation (Reg. 100/2004, as amended).
- .13 British Columbia Groundwater Protection Regulation (Reg. 299/2004, as amended).
- .14 British Columbia Hazardous Waste Regulation (Reg. 63/88 as amended).
- .15 British Columbia Occupational Health and Safety (OHS) Regulation.
- .16 British Columbia Occupational Health and Safety Regulation, including Part 18 - Traffic Control (BC Reg. 242/2006 as amended).
- .17 Canadian Council of Ministers of the Environment Canadian Environmental Quality Guidelines.
- .18 Controlled Products Regulations (SOR/88-66).
- .19 Driscoll, F.G. 1986. Groundwater and Wells. Johnson Filtration Systems. 1089 p.
- .20 Inter-provincial Movement of Hazardous Waste Regulations (SOR/2002-301).
- .21 Manual of Uniform Traffic Control Devices for Streets and Highways, US FHWA, Part IV, - 1988.
- .22 National Fire Code of Canada.
- .23 Transportation of Dangerous Goods Act.
- .24 Transportation of Dangerous Goods Regulations (SOR/2001-286).
- .25 Work Safe BC Regulations.
- .26 Canadian Payments Act.
- .27 The Income Tax Act.
- .28 Domestic Bonds of Canada Regulations.
- .29 International Chamber of Commerce (ICC) Uniform Customs and Practice for Documentary Credits, 1993 Revision, ICC Publication No. 500.
- .30 Applicable Canadian Standards Association (CSA) standards.
- .31 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .32 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .33 U.S. Environmental Protection Agency (EPA) / Office of Water.
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

END OF SECTION

01 45 00 Quality Control

1.0 Summary

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, supervision, materials required to meet the quality management requirements to complete the Work according to the Contract documents.

1.1 General

- .1 All work shall be undertaken through a total quality management process utilizing PWGSC, Contractor and third-party resources as necessary.

1.2 Definitions

- .1 Quality Control (QC): The process of checking specific product or service results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory product or service performance.
- .2 Quality Assurance (QA): The process of evaluating overall product or service, by persons or companies independent of those doing the Work, on a regular basis to provide confidence that the product or service satisfies the relevant quality standards.
- .3 Quality Audit (Q Audit): Review by a party independent of QC and QA, to provide confidence that QC and QA processes and resulting products satisfy the contractual requirements.
- .4 Quality Management (QM): The compendium of quality control, assurance, and audit provided by a party.
- .5 Quality Manager: The Quality Manger shall be appointed by the Contractor to oversee the Quality Control Plan.

1.3 Responsibilities

- .1 Contractor shall provide unrestricted access to all Quality Management operations and documentation produced by or on behalf of the Contractor and shall allow PWGSC full access at any time during working hours.
- .2 The PWGSC Representative will review the Contractor's performance of the Work and determine the acceptability of the Work based on the Quality Control, Quality Assurance and Quality Audit results and, where deemed appropriate by the PWGSC Representative, supplemented by the Contractor's Quality Management results.

1.4 Acceptance

- .1 Work failing to meet the conditions of the Contract shall be considered Unacceptable Work.
- .2 The PWGSC Representative may consider all Work from the last acceptable Quality Control testing or review as Unacceptable Work. The Contractor shall not be entitled to payment for Work that lacks the appropriate Quality Management Documentation, verified by the Quality Manager, as required by the Contract.

1.5 Quality Management Plan (QM Plan)

- .1 The Contractor shall be responsible for all Quality Control during the performance of the Work unless otherwise specified by PWGSC. QC work includes monitoring, inspecting, and testing the means, methods, materials, workmanship, processes, and products of all aspects of the Work, including design, construction, and management, as necessary to ensure conformance with the Contract.
- .2 The Contractor shall prepare a Quality Management Plan (QM Plan) in accordance with the Contract provisions.
- .3 No work shall be undertaken on any element of Work (including payment Items and incidental Work, or submittals for review) for which there are QM Plan submission requirements until the Quality Manager and PWGSC have accepted the base portion of the QM Plan and the specific details for that element of the Work.
- .4 Subject to the submission requirements of the Contract, the QM Plan is required to cover the Work in its entirety, including without limitation all materials the Contractor and Subcontractors are supplying and all items and phases of the design and construction on the Project.
- .5 The plan may be operated wholly or in part by a qualified Subcontractor or an independent agency/organization. However, the plan's administration (including conformance with the plan and its modifications) and the quality of the Work remain the responsibility of the Contractor.
- .6 The Contractor's QC program and the Work shall be undertaken in accordance with the QM Plan. Testing results must represent actual operations. Results will be reported accurately and in a timely manner.
- .7 Ensure that workers are familiar with the Quality Management Plans, its goals and their role under it, as well as with the Contract specifications associated with the Work they are to undertake.

1.6 QM Plan Quality Control Staff and Equipment Submission Requirements

- .1 The Contractor will provide all resources and take all actions necessary to ensure
 - .1 Provision of sufficient review, inspection and testing staff, with adequate equipment and technical support to perform all Quality Control functions in an accurate and timely manner.
 - .2 The QC staff performs only reviews, inspections, and tests for which they are qualified.
 - .3 All testing equipment is calibrated, properly maintained, and in good operating condition.
 - .4 All testing and inspection is performed in accordance with applicable industry standards and the appropriate standards of the Contract.
 - .5 Submission to the PWGSC, within twenty-four (24) hours, of daily reports for all tests and inspections that indicate non-conformance of the material being tested.
 - .6 Production, within forty-eight (48) hours, of daily reports for all tests and inspections that indicate conformance of the material being tested and the availability of back-up documentation to substantiate test results when required.

- .7 Organization, compilation and submission of all project QC documentation within 14 days of "issuance of the Completion Certificate.
- .2 The Contractor shall designate one person as the Quality Manager (Quality Manager) who shall be responsible for the implementation of the QM Plan. The Quality Manager shall be a qualified Professional, Certified Engineering Technician, or Applied Science Technologist, or other person subject to professional liability for their certifications and with knowledge, skills and abilities acceptable to the PWGSC. The Quality Manager shall be at arm's length from the productivity part of the Contractor's organization and specifically shall not be the Project Manager or the Project Superintendent.
- .3 PWGSC recognizes the Contractor's Project Manager, Superintendent and Designer as the personnel responsible for making the product meet the contractual requirements, but the Quality Manager's duties include being responsible to measure conformance and to ensure that quality is not compromised by production pressures.
- .4 The Quality Manager, or a designated replacement acceptable to the PWGSC empowered and able to perform all of the Quality Manager's relevant duties, shall remain on Site at all times the Contractor is performing Work which, must be tested or inspected in-process, and must be readily accessible and able to return when off-Site.
- .5 The QM Plan prepared by the Contractor will include the following information:
 - .1 The name of the Quality Manager and qualifications establishing a proven capability to provide the specific services required for the Project;
 - .2 The name of QC testing agencies and their proven capability to provide the specific services required for the Project;
 - .3 A listing of QC staff (including names, qualifications and relevant experience) and their assigned roles and work scheduling in performing QC duties; and
 - .4 A list of testing equipment to be used for the Work.
- .6 The QM Plan must include an organizational chart showing details of the flow of information, "hold" points, rectification of deficiencies and other relationships and responsibilities necessary to assure Project quality requirements are met.
- .7 The QM Plan should describe how the QC staff are allocated to Project requirements, the tasks assigned to each, and how their work will be coordinated.
- .8 Without limitation, the Contractor's Quality Manager shall:
 - .1 Implement the Contractor's QM Plan.
 - .2 Be responsible for measuring conformance with all aspects of the contract quality.
 - .3 Stop work when materials, product, processes or submittals are deficient.
 - .4 Develop inspection and testing plans for each element of Work.
 - .5 Develop acceptance/non-acceptance reports and quality control checklists for each element of Work in sufficient detail to gauge conformance with all contractual requirements.
 - .6 Ensure the requirements for quality management (including an overview of how the QM Plan operates, the worker's role in it,

- contractual specifications for the Work, and work procedures) are known to, understood by, and adhered to by all workers on the Site.
- .7 Ensure that all QC checklists are signed-off by competent and responsible parties as close to the actual work as appropriate to the nature of the Work (e.g., by the Designer for engineering drawings; by the actual worker or a foreman for most work; by a Professional Engineer for falsework erection; etc.).
 - .8 Review, sign, and be responsible for all reports (materials and testing results).
 - .9 Consult with field inspectors regarding materials and testing issues.
 - .10 Receive notification by the inspectors regarding deficiencies and ensure re-testing or rejection.
 - .11 Provide daily, weekly and monthly summary reports on testing and inspection results.
 - .12 Initiate the non-conformance process when materials or product do not meet the required specifications and, inform the PWGSC and the Contractor of such non-conformance.
 - .13 Consult with the PWGSC Representative and initiate corrective action on non-conformance.
 - .14 Respond to each Non-Conformance Report (NCR) issued by the Contractor or PWGSC within the time specified in the NCR.
 - .15 Schedule testing and inspection services in coordination with the Contractor's superintendent and foremen.
 - .16 Include and monitor QC testing and inspection procedures including those of the Subcontractors.
 - .17 Work directly with the PWGSC and the Contractor on matters related to QC.
 - .18 Ensure required approvals and permits from the PWGSC and others are obtained as and when required.
 - .19 Verify that all testing equipment is properly maintained and kept in good working order.
 - .20 Keep an organized filing system to ensure that quality records are easily accessible so that auditors can obtain necessary information.
 - .21 Review issued for construction drawings, calculations, and shop drawings and ensure that all concerned Contractor staff have current versions of documents applicable to their part of the Work.
 - .22 Notify the PWGSC and the Contractor of any changes in survey layout, location, line, grade, etc., for acceptance; notify the company principals of any issues that compromise the integrity or function of the Quality Management System.
 - .23 Provide an auditable trail for survey computations to the PWGSC.

1.7 QM Plan Submission Requirements (Contract-Specific)

- .1 The Contractor's QM Plan shall provide details of the means, methods, and frequencies of Quality Control measures for all elements of Work (whether payment Items or incidental or being performed by Subcontractors or Suppliers, including design, construction and management) in the Contract.
- .2 The QM Plan shall be submitted to PWGSC a minimum of three (3) days in advance of the project initiation meeting and must provide details of all elements of Work anticipated to be undertaken.
- .3 The initial submission, as well as any subsequent submission or revision, must be accompanied by the Contractor's checklist for Quality Management, verifying that the submission meets all relevant contractual requirements.
- .4 Improved procedures may be introduced after the start of work as necessary as amendments to the QM Plan. All amendments require the written acceptance of the PWGSC.
- .5 The type and frequency of QC tests shall be established by the Contractor and shall be in conformance with the requirements of the Contract, including the minimum frequencies specified in the Contract and/or Standard Operating Procedures (for those listed items applicable to the Work), and the current acceptable practice of the industry.
- .6 When materials or equipment are specified by standard or performance specifications, the Contractor shall obtain from suppliers or manufacturers independent test reports, or test certificates stating that the materials or equipment meet or exceed specified requirements. The Contractor shall provide documentation of actual testing results upon request by the PWGSC.

1.8 Quality Assurance-Plan (QA Plan)

- .1 The PWGSC Representative will prepare, and the Quality Manager shall implement, a Quality Assurance Plan, based in part on the effectiveness and reliability of the Contractor's Quality Management Plan, to assess the effectiveness of that QM Plan. The PWGSC shall also undertake random and systematic inspections of the Work and the Contractor's QC documentation.
- .2 The purpose of the QA Plan and inspection activities is to ensure that QC procedures are available, are being followed, and that the Contractor will have confidence that the resulting products (transitory or permanent) conform to Contract requirements.
- .3 The operation of the QA Plan shall be fully independent of those performing the QC tasks, except for the Quality Manager.
- .4 Any instances of Unacceptable Work discovered will result in a Non-Conformance Report being issued by the Quality Manager to the Contractor.
- .5 The QA program activities will not relieve the Contractor of Quality Management responsibilities under the terms of the Contract.
- .6 The frequency of QA inspection and testing will generally be approximately five to ten percent (5 - 10%) of the frequencies undertaken by the Contractor in its QM Plan and will initially be set at a level commensurate with the risk that an element will have on final product quality. Elements that have higher risks shall be checked at higher frequencies; lower risk elements may be checked at lower frequencies.

- .7 The Quality Manager may, with the prior acceptance of the PWGSC, decrease the frequency of QA inspection and testing during the course of the Work, based upon the proven effectiveness of the Contractor's QM Plan.

1.9 Quality Audit

- .1 The PWGSC will have one or more auditors on the Project. The PWGSC Audit will provide a systematic and independent assessment of whether or not the design, construction and management comply with the Contract and Contractor's QM Plan and PWGSC's QA Plans. The auditors may or may not be PWGSC employees but will be from resources which have not otherwise been involved with the Work.
- .2 The objective of Quality Auditing is to have an independent opinion on both QC and QA activities and be proactive in avoiding or reducing quality related issues by requiring the process of conformance verification to be systematic.
- .3 The auditor(s) will be allowed unrestricted access to the Site and all activities therein, to all testing and documentation of the work done by the PWGSC, Contractor and their agents and suppliers.
- .4 The PWGSC will monitor the Contractor's operations and the Quality Control program to assure that standards and the terms of the contract regarding quality of materials and processes are being met, and to assess what payments have been earned under the terms of the Contract.

1.10 Non-Conformance Reports (NCRs)

- .1 The Contractor shall and the PWGSC may review the Work to determine conformance with the contractual requirements.
- .2 Non-conformances found shall be dealt with as follows.
 - .1 Contractor's Internal NCR:
 - .1 Should the Contractor's QC reporting indicate that the Work is not in conformance, the Quality Manager shall issue an internal Non-Conformance Report (NCR) to the Contractor, with a copy to the PWGSC, including a response time.
 - .2 The Contractor shall then respond to the Quality Manager, with a copy to the PWGSC, with respect to the NCR, within the specified time, with proposed resolutions and corrective actions. The Contractor and/or the Quality Manager may consult with the PWGSC on the proposed resolutions.
 - .3 Payment for Quality Management (where specified in the Contract) will not be affected by internal NCRs, as long as the issue is diligently pursued and resolved.
 - .4 Payment for the Work itself may be withheld until the NCR issue is resolved.
 - .2 PWGSC Issued NCR
 - .1 Should the PWGSC's Quality Audit reporting indicate that the Work is not in conformance, the PWGSC or PWGSC Representative will issue to the Contractor a NCR, including a response time.

- .2 The Contractor shall then respond to that NCR, within the specified time, with proposed resolutions and corrective actions.
 - .3 The PWGSC will accept or reject the proposed resolution and corrective action proposal.
 - .4 Assurance testing and inspection will be performed to determine if the corrective action has provided an acceptable product. Acceptance and rejection will continue until the PWGSC determines that a quality product has been achieved.
 - .5 A portion of the payment for Quality Management (where specified in the Contract) may be withheld until the NCR issue is resolved or maybe withheld permanently.
 - .6 Payment for the Work itself may be withheld until the NCR issue is resolved.
- .3 Opportunity for Improvement
- .1 Should the Quality Audit review indicate that the Work is not in conformance, but the variance is deemed minor by the PWGSC, the PWGSC may issue an Opportunity for Improvement (OFI) report.
 - .2 The Contractor is encouraged to review the findings and recommend modifications to the QM Plan and/or QA Plan and the work procedures as necessary to address the issue.
 - .3 An OFI will not affect payment for Quality Management (where included in the Contract) or for the Work itself.

1.11 Appeal

- .1 If the Contractor disputes the validity of a finding in an NCR, the Contractor may file an appeal with the PWGSC. The PWGSC and the Contractor will use all reasonable efforts to refine the area of dispute and to resolve the dispute in conformance with the Contract.
- .2 If the PWGSC and the Contractor cannot come to a mutually agreeable resolution, the Work that is the subject of the Non-Conformance Report shall be re-evaluated by an independent third-party, selected by the PWGSC in consultation with the Contractor, at a test frequency equivalent to twice that specified in the Contract or to such other frequencies as may be mutually agreed between the PWGSC and the Contractor.
- .3 If the appeal testing confirms the non-conformance determination, all appeal testing costs will be borne by the Contractor. If the appeal testing shows that the Work did in fact meet the requirements of the Contract, all appeal testing costs will be borne by the PWGSC.

END OF SECTION

01 41 00 Regulatory and Other Requirements

1.0 Summary

- .1 This section covers the general and specific provisions of the environment, in cooperation with any Federal and/or Provincial Environment officers or an Environmental Monitor, as designated in the Contract.
- .2 These Specifications give PWGSC or PWGSC's Representative the right to exercise control over environmental aspects of the work. The Contractor shall adhere to specific instructions if the work may result in an adverse impact on the environment.
- .3 PWGSC or PWGSC's Representative will determine the significance of environmental impacts in consultation with Environmental Agencies.
- .4 PWGSC reserves the right to approve all general methods employed by the Contractor in the performance of the Work, but only insofar as they may affect relations with Environmental Agencies, the protection of aquatic and terrestrial resources, health and safety of the public, and protection of socio-community resources and features.
- .5 These specifications are for the protection of the environment in both the upland and marine areas, and shall be given such interpretation as will secure this intent.
- .6 The Contractor is responsible for environmental monitoring.

1.1 Definitions

- .1 For the purposes of this Section, the following general terms are defined as follows:
 - .1 "Compensation" refers to monetary payment or replacement in kind for environmental losses resulting from project Works, as well as the construction activities for the re-creation of lost or damaged habitat.
 - .2 "Deleterious Substance or Material" is defined as a substance harmful to fish or fish habitat (Canada Fisheries Act, Section 34.1).
 - .3 "Designated" shall mean designated in the Contract or by PWGSC or PWGSC Representative.
 - .4 "Environment" refers to the physical, biological, social, spiritual and cultural components that are interrelated and affect the growth and development of living organisms. The term "environment" in these specifications shall include the socio-community issues and resources.
 - .5 "Environmental Agencies" shall mean the appropriate regulating branches of the Federal and Provincial agencies responsible for the management and protection of the Environment and human resources. A partial listing of these Environmental Agencies and their areas of authority is given in the joint publication "Land Development Guidelines for the Protection of Aquatic Habitat", Fisheries and Oceans Canada and Ministry of Environment, Lands and Parks (1992), hereafter referred to as the Land Development Guidelines, and associated updates.

- .6 The “Environmental Monitor” shall mean an agent hired by the Contractor in compliance with the environmental protection aspects of the Specifications, the Contract, permits and approvals, and to advise the Contractor and the PWGSC or PWGSC Representative on environmental problems. An Environmental Monitor will be used when and where required, and will report to the Contractor.
- .7 “Environmental Approval” is defined as the written authorization issued to a person or company by a government agency that allows the person or company to do something that otherwise may not be permitted by law, or which is not defined in law. An environmental approval is a broad, generic term referring to informal or formal authorization for actions that may have an adverse effect on the environment, such as (i) undertaking an activity (e.g., authorization from fishery agencies to proceed with work within the wetted perimeter of a fish-bearing stream); or (ii) discharging some form of material (e.g., approval under the British Columbia Environmental Assessment Act to introduce waste into the environment or the storage of hazardous waste for a period of 12 months or less). The term “approval” can include related forms of authorization such as permits and licenses.
- .8 “Environmentally Sensitive Areas” shall mean areas requiring special management and attention to protect resources, habitat or species (which includes and is not limited to water quality, identified sensitive areas, fish and fish habitat, vegetation, rare and endangered flora/fauna, landscaping and visual aesthetics, soil conservation (including dust control), air quality and archaeological, heritage and cultural resources).
- .9 “Environmental Timing Window” shall mean any period suitable for environmentally sensitive construction work as designated by an Environmental Agency or other federal, provincial, municipal or local agency. This window represents the period that the natural or human environment is likely less susceptible to adverse impacts.
- .10 “Fishery Timing Window” refers to the time period(s) of reduced risk for important commercial, sport, and resident fish species, based on their life histories. The Fishery Timing Window is the time of year during which there are no fish eggs or alevins present in the substrates of local watercourses, and the period when fish migration (juvenile out-migration and adult spawning in-migration) is not occurring. This is generally the preferred period for (i) instream work; or (ii) work adjacent to or over top of fish-bearing streams with the potential to create adverse impacts on fish or fish habitat.
- .11 “Habitats” are defined as those parts of the environment on which terrestrial and/or aquatic species depend, directly or indirectly, in order to carry out their life processes.
- .12 “Fisheries Sensitive Zone: is defined as the instream aquatic habitats, as well as out-of-stream supporting habitat features such

- as side channels, wetlands, and vegetated riparian areas adjacent to these features.
- .13 “Impact” is defined as an alteration, either positive or negative, to the environment brought about as a direct or indirect result of the Work.
- .14 “Mitigation” refers to a procedure or an action designed to avoid, reduce or control the severity, magnitude, duration and/or frequency of environmental impacts of a project through design alternatives, scheduling or other means.
- .15 “Permit” refers to a formal authorization, typically granted to proponents by an Environmental Agency, for discharging agreed upon quantities and types of regulated substances such as pollutants or waste. For example, under Section 8 of the British Columbia Waste Management Act, a permit may be issued to introduce waste into the environment or to store special waste subject to environmental protection requirements which are deemed advisable. The permit can specify the procedures or requirements respecting the handling, treatment, transportation, discharge or storage of waste that the holder of the permit must fulfill. The term “permit” can be defined by applicable legislation. The term “permit” is synonymous with the term “licence”, and the two terms are often used interchangeably.
- .16 “Riparian Area” is defined as the land adjacent to the normal high water level in a stream, river, lake or pond and extending to the portion of land that is directly influenced by the presence of adjacent ponded or channelled water or a groundwater zone fed by surface water bodies (e.g., zone in which rooted vegetation is influenced). Riparian areas typically contain important vegetation resources which provide several critical functions for the survival of fish (e.g., protection from predators, shade for temperature regulation of the watercourse, and sources of food).
- .17 “Sedimentation” is defined as the deposition of material carried in water, usually as a result of a reduction in water velocity below the point at which material can be transported.
- .18 “Watercourses” shall apply to all bodies of water including streams, rivers, canals, ditches, lakes, ponds, and wetlands.
- .19 “Wetted Perimeter” is defined by Station number and/or as highlighted on the plan drawings.

1.2 General Restraints for Watercourses and Groundwater

- .1 The following general restraints in regard to the protection of any watercourse shall apply:
- .1 All organic material, refuse, ash, petroleum products and other deleterious materials shall be placed so as not to directly or indirectly pollute any watercourse or groundwater. The placement and disposal of all such products and materials shall be done in an environmentally acceptable manner.
- .2 Except as required by the Contract, all inorganic material shall be placed and/or disposed of in a manner that does not obstruct or unduly disturb any permanent or seasonal watercourse. Any such

obstruction or disturbance shall be restored to the original drainage pattern. Any removal of inorganic material from a watercourse shall be done in a manner that minimizes adverse impacts.

- .3 All activities within the wetted perimeter of any watercourse shall be kept to an absolute minimum. Machinery and equipment shall not be operated within the wetted perimeter of any watercourse other than under the terms of the Authorization and permits issued by the Environmental Agencies. An Environmental Monitor shall be present during any work within the wetted perimeter of any watercourse on the Project.

1.3 **Planning and Scheduling**

- .1 Construction activities shall be carefully planned and scheduled in a manner that ensures the avoidance or absolute minimization of environmental damage.
- .2 The Contractor shall be familiar with and be able to identify those areas and times which present environmental problems and shall prepare schedules and work methods accordingly.
- .3 The contractor shall forward a copy of each of the schedules to the PWGSC Representative at least two weeks in advance of commencement of each of these operations, unless otherwise specified in the contract.
- .4 The Contractor shall provide an Environmental Management Plan (EMP), which describes in detail the approach to be taken in addressing environmental issues associated with the Project and the correlation of the EMP to the project schedule. The EMP will be structured according to the following format and will include, but not be limited to the following:
 - .1 Demonstrate understanding of the specific environmental issues involved with the Project.
 - .2 Indicate an understanding of PWGSC/Contractor responsibilities.
 - .3 Include a sediment and drainage management plan.
 - .4 Identify all the tasks required and clearly identify the duration and sequence of each task leading to the receipt of agency approvals.
 - .5 Indicate the linkage of the tasks required to the project schedule.
- .5 The EMP will clearly indicate how the Project will be undertaken to avoid negative impacts pertaining to, but not limited to:
 - .1 Water quality (including all surface and sub-surface sources).
 - .2 Identified sensitive areas.
 - .3 Fish and fish habitat.
 - .4 Wildlife.
 - .5 Vegetation (including riparian plant communities).
 - .6 Rare and endangered flora/fauna.
 - .7 Landscaping and visual aesthetics.
 - .8 Soil conservation (including Site stability, dust control).
 - .9 Air Quality.

.10 Archaeological, heritage and cultural resources.

- .6 The Contractor, in consultation with the PWGSC Representative, Environmental Monitor and the Environmental Agencies, shall be responsible for determining the conditions under which the work must be carried out in Environmentally Sensitive Areas, and for making all required on-Site examinations and examinations of documents supplied and referenced by the Ministry in order to fully comprehend the environmental aspects of the work required.

1.4 Environmental Legislation and Regulatory Requirements

- .1 The Contractor shall observe and comply with all federal, provincial, municipal and local laws and regulations which seek to ensure that construction work does not adversely affect the environment or social-community resources.
- .2 In the event of a conflict between the requirements set out in these specifications and quality control laws, statutes, regulations and ordinances of federal, provincial, municipal or local agencies, the more restrictive requirements or regulations shall apply.
- .3 A violation of the environmental laws and regulations reported to the PWGSC by the responsible agencies may result in the issuance of a non-conformance report.
- .1 Should the situation warrant more stringent measures, it may also result in the issuance of a stop work order until the violation is corrected.
- .4 The Contractor shall have no recourse for reimbursement due to delays or alterations to construction.

1.5 Environmental Procedures

- .1 The Environmental Agencies or the PWGSC Representative may require one or more detailed sets of environmental procedures for any work in and around Environmentally Sensitive Areas, such as critical fish habitat. When a set of environmental procedures is required, the Contractor shall prepare and submit the procedures to the PWGSC Representative and the Environmental Agencies prior to undertaking work in these areas. These detailed procedures shall supplement the EMP. The Contractor shall forward a copy of the approved set of procedures to the Environmental Agencies and the PWGSC Representative, prior to undertaking the work. The environmental procedures shall contain the following items:
- .1 Existing environmental conditions. Identification of the environmental resources (e.g. fish species and habitat) in the area of the proposed work.
- .2 Description of work proposed in the Environmentally Sensitive Area. Summary of the proposed work, equipment to be used, schedule of activities, and location.
- .3 Environmental protection measures. Statement concerning the protective measures that will be used to protect environmental resources (e.g., species and habitat) from each anticipated adverse impact.
- .4 Contingency plan. Description of alternative or backup plan in the event of an environmental emergency or failure of any of the protective measures.

- .5 Environmental monitoring requirements. Indication of any specific or unique environmental monitoring requirements to ensure compliance with environmental specifications and proper implementation of the environmental procedures.
- .2 The Contractor's Environmental Monitor shall contact the - Fisheries and Oceans Canada (F&OC) and the Ministry of Environment for specific recommendations about the preparation of the environmental procedures. The environmental procedures must be approved by the PWGSC Representative and the Environmental Agencies prior to commencement of work in Environmentally Sensitive Areas.

1.6 Project Orientation

- .1 The Contractor and the Environmental Monitor shall arrange regular meetings with the PWGSC Representative. Other interested parties may be asked to attend (e.g., Agency Representatives), whose representation is necessary because of the specific type or location of work being undertaken. The purpose of such regular meetings will be to outline the schedule of upcoming construction and proposed activities, and to review the activities of the previous week. Such regular meetings do not relieve the Contractor from attending or arranging other types of meetings as required due to the nature or extent of the work being done.
- .2 The Contractor shall arrange and conduct such regular meetings during construction, subject to the following conditions:
 - .1 Meetings shall be held on a weekly basis when construction activities are to proceed during an Environmental Timing Window, during a period when work is to proceed in an Environmentally Sensitive Area, or during a period when the proposed construction activity elsewhere one project is to proceed for a duration greater than two weeks and has the potential to cause adverse environmental impacts.
 - .2 During periods other than that specified above, regular environmental meetings shall be held every two weeks, or as otherwise agreed to by the PWGSC Representative.
 - .3 In the event that the Environmental Monitor or the PWGSC Representative deem the Contractor's compliance regarding environmental requirements to be inadequate at any time during the Project, the frequency of the weekly or biweekly regular meetings shall be increased accordingly until the Contractor's Environmental Monitor and the PWGSC Representative are satisfied with the compliance rate.
 - .4 The Contractor's Environmental Monitor will record highlights from the meetings (e.g., summary of major discussion items and key action items) and forward a copy to the Contractor, as well as include this material in the Project Environmental Progress Reports.
 - .5 During the maintenance phase of the Project, the Contractor shall conduct regular environmental meetings on a quarterly basis, unless operations are to be conducted within Environmentally Sensitive Areas that pose potential environmental concerns. In the event that operations are to be conducted within such areas, the Contractor and Environmental Monitor shall conduct weekly

environmental meetings for the duration of the maintenance work in such areas.

- .3 The Contractor is responsible for ensuring that the foreman, operators, and work crews (including any subcontractors) understand the specific environmental issues on the work Site and their responsibilities under this Section. The Contractor's Environmental Monitor will give all construction personnel a brief environmental orientation prior to such personnel commencing work in any Environmentally Sensitive Area on the Project. The Contractor's Environmental Monitor will ensure that construction personnel are familiar with the environmental requirements and acceptable construction practices on the Project. The Contractor shall support the Contractor's Environmental Monitor's role in this regard.

1.7 Activity Within Designated Watercourses and Environmentally Sensitive Areas

- .1 All activities that are conducted within the wetted perimeter of any designated watercourse or within other designated Environmentally Sensitive Areas must conform to the timing restrictions stated in the Contract, and to the Environmental Timing Windows given in the authorizations/approvals of the Environmental Agencies. Construction work must be scheduled so that all operations affecting the Fisheries Sensitive Zone or other designated Environmentally Sensitive Areas can be completed within these time periods. Prior to the commencement of any construction activities, all work in these areas must be approved by the Environmental Agencies.
- .2 The Contractor must advise the PWGSC Representative in advance of any construction-related activity in designated areas. Construction activities within designated watercourses or other Environmentally Sensitive Areas shall not commence without the attendance and support of the Environmental Monitor.

1.8 Inclement Weather

- .1 The Contractor shall cease operations, modify construction methods, or relocate to an alternative Site within the project area during periods of inclement weather to avoid siltation of designated watercourses.

1.9 Work Stoppage

- .1 Prior to initiating work stoppages, the Contractor shall initiate and complete any mitigative and environmental protection measures required to safeguard the environment and the Project during work stoppages.
- .2 The Contractor shall consult with the PWGSC Representative of impending shutdowns to enable the PWGSC Representative, Contractor, and the Environmental Monitor to examine the project. This notice shall be sufficient to permit the Contractor adequate time to install all necessary additional environmental mitigation measures.
- .3 The Contractor shall ensure that the Environmental Monitor and construction personnel inspect Environmentally Sensitive Areas on the Project on a regular basis during any extended work stoppages (e.g., weekends, statutory holidays, Christmas vacation periods) to prevent environmental problems. If potential adverse environmental impacts are observed during work stoppage periods, the Contractor shall initiate and undertake any required environmental measures to avoid or minimize impacts.

1.10 Compliance and Enforcement

- .1 Temporary Pollution Control:

- .1 The Contractor shall be responsible for implementation of any temporary environmental protection measures, such as pollution control measures. If the Contractor fails to respond, the PWGSC may take whatever action is necessary to provide the proper corrective measures. In the event the Contractor fails to take reasonable action to implement temporary environmental control measures, the PWGSC Representative or the Environmental Agencies shall determine the need for additional corrective action. The PWGSC Representative may deduct incurred costs from any money due or to become due to the Contractor for any corrective action taken in this regard.
- .2 Responsibility for Damage to Environment
 - .1 The Contractor shall bear sole responsibility for any direct or indirect damage to the environment which occurs as a result of failure to comply with these Specifications, the Contract and the directions of the PWGSC Representative or recommendations of the Environmental Monitor.
- .3 Stop Work Orders
 - .1 In the event that the PWGSC Representative determines that some aspect of the construction is creating or will result in a substantial adverse effect on environmental values or resources on or adjacent to the project Site, the PWGSC Representative may issue a "stop work order". The Contractor shall subsequently be responsible for advising the PWGSC Representative of the intended remedial action. The PWGSC Representative may direct the Contractor to cease construction work on an unaffected portion of the Site so that any necessary equipment can be immediately diverted to address the environmental emergency. In such an event the Contractor will not be entitled to any claim for compensation from the PWGSC.
 - .2 The Contractor shall be required to modify or halt any aspect of construction or maintenance that the Environmental Agencies determine poses or will pose an environmental concern. The Environmental Agencies may verbally direct the Contractor to modify or halt any such activity or submit formal written instructions to that effect. In either case, the Contractor's immediate compliance with their instructions will be mandatory. The Contractor shall document any such requests by the Environmental Agencies and forward a copy of this documentation to the PWGSC Representative within five working days of the initial notification by the Environmental Agencies.
- .4 Compliance with Specifications
 - .1 The Contractor is responsible for ensuring that all subcontractors and employees are in compliance with these Specifications and all applicable environmental legislation and regulatory requirements at all times, and shall take immediate action to rectify problems in this regard. The Contractor shall initiate

action to rectify environmental problems. The Contractor shall have available such additional safeguards, safety devices and protective equipment as are necessary to protect the environment. The Contractor shall be responsible for ensuring sufficient safety devices and protective equipment (e.g., pumps, silt fence, armoring, tarps, fuel spill cleanup kits, etc.) are readily available at all times during construction of the Project. The location and inventory of safety devices and protective equipment shall be documented and placed in a prominent location in the Contractor's field office. A copy of this information shall be updated as necessary and provided to the PWGSC Representative.

- .2 The Environmental Monitor will inspect and monitor conditions at, and in the vicinity of, the project to ensure acceptable levels of pollution and disturbance are not exceeded, and to ensure compliance with the environmental specifications contained herein and in the Contract.
- .3 The frequency of such inspection and monitoring efforts shall correspond to the sensitivity and location of construction activities, as well as to the environmental conditions (e.g., increased monitoring and inspection will be conducted during periods of inclement weather). In the event that the PWGSC Representative is not satisfied with the frequency and duration of such inspection and monitoring, the Contractor's Environmental Monitor will be required to increase their efforts in this regard to a level satisfactory to the PWGSC Representative.

1.11 Erosion, Sediment and Drainage Control

- .1 All works shall be undertaken in a manner that avoids or absolutely minimizes erosion problems and the discharge of siltation or other deleterious substances into any watercourse. The Contractor shall not disturb designated watercourses, unless the express written consent of the Environmental Agencies is obtained prior to initiating construction activities in such areas. No obstruction or debris shall be placed in any watercourse during any operations, unless specified in the Contract or by the PWGSC Representative, or for designated watercourses approved by the Environmental Agencies. Should any material be inadvertently placed within the normal high water wetted perimeter of a watercourse, the PWGSC Representative shall be notified immediately and the Contractor shall remove the material immediately, using environmentally acceptable construction procedures and under the direction of the Environmental Monitor.
- .2 Sediment and Erosion Control
 - .1 The Contractor shall incorporate all permanent soil erosion control features into the project at the earliest practicable time, as outlined in the accepted work schedule, and shall be responsible for temporary erosion and sediment control measures, including daily inspection of the integrity of such measures during adverse weather conditions or when construction operations are proceeding in Environmentally Sensitive Areas. Control measures shall be capable of continuous operation during working and non-working hours. Any deficiencies which are

- observed in erosion control measures shall be immediately corrected.
- .2 The Environmental Agencies and the PWGSC Representative have the authority to define environmentally sensitive areas or conditions, such as areas of erodible soil, and to direct the Contractor to provide temporary erosion and sediment control measures. These measures may include, but may not be limited to:
 - .1 Interceptor ditches or berms to direct runoff away from erodible areas.
 - .2 Slope protection measures such as mulches, hydroseeding, erosion mats, geotextiles, filter fabric, polyethylene covers, or riprap.
 - .3 Silt fences.
 - .4 Ditch blocks to reduce flow velocities.
 - .5 Sediment control measures, such as settling ponds.
 - .3 The Contractor shall have sufficient materials, such as clean rock, granular material, and filter fabric available on-Site for emergency protection measures when required.
 - .4 The Contractor shall regularly maintain sediment and drainage control measures, such that they function as designed. Immediate action shall be taken by the Contractor to correct any deficiency observed in the operation of sediment and erosion control measures. In the event that a deficiency in any sediment or drainage control measures is directly or indirectly creating an adverse environmental impact, the Contractor shall initiate the necessary action to correct the problem within one hour of observing or being informed of the situation. In the event that a deficiency in any sediment or drainage control measures poses the potential to create an adverse environmental impact, the Contractor shall take action within two days of observing or being informed of the situation. In the event that environmental conditions or the status of the situation change in regards to a potential deficiency, the Contractor shall accelerate any proposed correction measure(s) by taking immediate action (i.e., within one hour). The judgment of the need and timing for corrective action in regard to sediment or drainage control measures shall be at the discretion of the Contractor and the Environmental Monitor, and shall be to the satisfaction of the PWGSC Representative and the Environmental Agencies.
 - .5 Sediment and debris accumulations which compromise the functioning of the erosion and sediment control measures shall be removed by the Contractor and disposed of in an environmentally acceptable location and manner. At a minimum, silt fence strictures shall be cleaned when sediment accumulation heights exceed 30 cm along any portion of the structure.
 - .6 In the absence of Site-specific requirements from Fisheries and Oceans Canada or the British Columbia Ministry of Environment, the Contractor shall comply with criteria for

suspended solids in runoff water from the Site as agreed upon prior to construction by the Environmental Agencies.

- .3 Sediment and Drainage Management Plans:
 - .1 The Contractor, in consultation with the Contractor's Environmental Monitor, shall be responsible for the preparation and implementation of any Sediment and Drainage Management Plan(s) to form part of the EMP required for the Project. Such plans will form an essential component of the Contractor's environmental protection program, in terms of identifying environmentally acceptable construction practices for sediment and erosion controls at specific Sites. The Sediment and Drainage Management Plan(s) will be subject to, but not limited to the following requirements:
 - .1 Prior to commencement of construction activities on the Project and thereafter when- deemed necessary, the Contractor and the Environmental Monitor will identify areas and major construction activities for which the Contractor will be required to prepare one or more Sediment and Drainage Management Plans. Designation of these areas and activities will be done in consultation with the Environmental Agencies and the PWGSC's Environmental Quality staff.
 - .2 The Contractor shall not commence work in any area so identified until a Sediment and Drainage Management Plan has been submitted and accepted by the PWGSC Representative and involved Environmental Agencies.
 - .3 The acceptance and approval of the Contractor's Sediment and Drainage Management Plan or updated Plan shall be valid only so long as the conditions and anticipated conditions upon which the Plan and its acceptance were based continue to be applicable.
 - .4 The Contractor shall at all times be responsible for ensuring that work is carried out in accordance with a Sediment and Drainage Management Plan or updated Plan, which has been accepted by the PWGSC Representative and Environmental Agencies.
 - .5 The PWGSC Representative or the Environmental Agencies may request the Contractor to update and resubmit its plan(s) at any time, and may require the Contractor to cease work until the update(s) has been submitted and accepted. Whether or not the PWGSC Representative or the Environmental Agencies so request, the responsibility for carrying out the work in accordance with a validly accepted Plan lies entirely with the Contractor.
 - .6 The PWGSC or the Environmental Agencies may order the Contractor to stop work or to take other precautionary or remedial measures whenever the Contractor is carrying out any work that is not in

accordance with a Sediment and Drainage Management Plan or updated Plan which has been accepted by the PWGSC Representative or the Environmental Agencies, and for which that acceptance is still valid.

- .7 At a minimum, a Sediment and Drainage Management Plan will include the following information and will be prepared in a format satisfactory to the PWGSC Representative:
 - .2 A schedule for the proposed activities, as they pertain to the Sediment and Drainage Management Plan and construction staging, including anticipated duration of construction.
 - .3 A description of the construction procedures that will be used to limit the potential for erosion and sediment production, including estimates of work areas where applicable (e.g., volume of material in a proposed stockpile Site), description of construction equipment to be used, and staging of operations.
 - .4 A detailed description of the Site-specific measures for runoff and drainage management.
 - .5 A detailed description of the Site-specific mitigation measures and design information for erosion prevention and control (e.g., sizing of culverts, ditches or sediment/detention ponds, silt fence specifications, and description of ditching and berming).
 - .6 A detailed description of mitigative measures for ensuring acceptable water quality and quantity at points of discharge to watercourses, including sizes and specifications for any proposed water treatment facilities.
 - .7 A key plan and drawings, in suitable scale and detail, of the Site and proposed mitigative measures and applicable construction procedures.
 - .8 A written commitment of on-Site equipment (e.g., water pumps) and materials (e.g., silt fence, hay bales, rock armouring, and ditch breakers) for erosion, sediment and drainage control to deal with emergency situations that may arise.
 - .9 A written commitment of on-Site equipment and staff to handle any fish salvage and transfer operations, if required.
 - .10 Contact names, positions and telephone numbers.
 - .11 A description of the specific monitoring procedures prior to, during and after completion of construction activities at this Site.
- .4 Settling Tank System
 - .1 If during use the function of the settling tank system is compromised by accumulated sediments and is still required for sediment control, accumulated settled sediments shall be removed from sediment control system. Such sediments shall be disposed of in an environmentally acceptable location and manner.

.5 Maintenance of Drainage Patterns

- .1 Except where interceptor ditches or berms are required to divert sediment laden runoff from the Site to a sediment control pond, original drainage patterns shall be maintained throughout construction operations. Interceptor ditches or berms shall be constructed to divert water entering the Site away from erosion prone areas. The Contractor will not rely on drainage courses or conduits being shown on the Drawings, and will make whatever investigation is necessary. Where a natural watercourse traversing the construction Site crosses this interceptor ditch or berm, an armoured or lined ditch or a culvert shall be installed in order to pass accumulated flows through or around the construction Site in a manner that maintains the natural runoff pattern, unless otherwise directed by the Environmental Agencies.
- .2 All Ditches constructed for interception of clean water outside the work Site(s) to divert it around the work Site(s) and for collection of treated water from the work Site(s) shall be designed and constructed to accommodate the 10-year return period storm with a 0.3 m freeboard under developed conditions. Temporary and/or permanent drainage ditches, including those constructed for sediment and erosion control shall be designed to prevent high water velocities and erosion by including measures such as check dams, drop structures or erosion-resistant liners or armoring.

.6 Storm Drainage Systems

- .1 In order to minimize siltation, the Contractor may be required to block storm drain inlets, or to activate inlets by means of sandbags, berms or swales, as circumstances require. Berms shall be constructed of clean, non-erodible granular material. The Contractor shall maintain, on a regular basis, any inlets activated during the course of construction. Any deficiencies noted in these works shall be corrected immediately in the event that the inlet is plugged and within the same day if the Site is relatively dry.
- .2 The Contractor shall ensure adequate inspection and correction of any storm drainage system deficiencies for Sites within the influence of the Project. During periods of inclement weather, the Contractor shall ensure project staff inspect storm drainage systems throughout the day, and if necessary, make arrangements for inspection and maintenance during regular work stoppage periods, such as evenings or weekends. At a minimum, such inspections shall be carried out at the start of the regular workday, at mid-day in the workday, and one hour prior to end of the regular workday. Furthermore, in the event of flooding problems, the Contractor shall be responsible for any damages or compensation resulting from impacts on residences or businesses caused by a failure or deficiency in the Contractor's design and maintenance of the storm drainage system.

1.12 Ditch Maintenance

- .1 To reduce the risk of damage to aquatic habitat and sensitive life stages of fish and other aquatic organisms, the Contractor shall ensure that the excavation and maintenance of ditches is conducted in an environmentally sound manner.
- .2 Excavation for ditch cleaning of any ditch that contains or directly drains into fish-bearing waters shall be performed only within Timing Windows as specified in the Contract.
- .3 The Contractor shall consult local Environmental Agencies for the locations of sensitive areas and local Timing Windows prior to commencement of ditch maintenance. Areas identified as Fisheries Sensitive Zones shall be revegetated by the Contractor prior to the close of the timing window.

1.13 Servicing and Operation of Equipment

- .1 Transport of Materials
 - .1 The Contractor shall use equipment and containers that are capable of safely transporting petroleum products and/or hazardous materials in compliance with Section 7.33.1 of the Federal "Transport of Dangerous Goods Regulations" for bulk containers, and Sections 7.21 and 7.23 of the same regulations for materials in packages-or small containers. These regulations shall apply to both on-road and on-Site transport, In addition to compliance with the Federal Transport of Dangerous Goods Regulations, the transportation of fuel trailers, fuel tanks on skids, and non-commercial fuel trucks shall comply with all the requirements of the Motor Vehicle Act and the British Columbia Fire Code.
 - .2 The Contractor shall take the necessary precautions to prevent the loss of materials during transport on public highways, roads, access roads, and haul routes. Trucks carrying loose materials shall be covered and restraints shall be used to prevent materials from blowing or falling from vehicles. The Contractor shall be responsible for collection and removal of any and all litter deposited by vehicles or equipment along access routes during construction-related activities, including removal of dirt and mud deposited from truck tires on municipal roadways.
- .2 Location and Installation of Fuel Storage Facilities
 - .1 The siting and installation of all fuel storage facilities shall be the responsibility of the Contractor. Fuel storage shall not be located within 30 m of a watercourse, within a watercourses flood plain, or where there is a potential for any spilled fuel to enter a watercourse or groundwater. Fuel storage facilities shall be located on flat or gently sloping ground and shall be dyked to, contain at least 125% of the total capacity of the storage containers. Dykes shall be constructed of impermeable material or lined to ensure that petroleum products cannot escape and will be maintained empty of liquids.
 - .2 All large fuel storage tanks must be locked and secured when not in use. Automatic shut-off nozzles shall be installed on all dispensing units over 250 litres capacity. Fuel storage tanks must

be drained within one week of completion of construction or within one month of a prolonged shutdown period.

- .3 All small fuel storage containers, such as 45 gallon (200 litres) drums, used as a fuel cache shall be installed on a stable storage rack, within an impermeable containment device capable of capturing at least 125% of the total capacity of the storage container(s). A cover, such as a tarp, must be placed over the top of the fuel cache to prevent accumulation of precipitation in the containment device. The small fuel storage containers shall contain a metal spigot with a padlock placed on the container when not in use.
- .4 In the transport, storage and/or dispensing of fuel and other petroleum based products, the Contractor shall comply with the requirements outlined in the Ministry of Environment publication: "Environmental Standards & Guidelines for Fuel Handling, Transportation and Storage" (December, 1995).
- .5 The Contractor shall be responsible for all costs associated with clean-up and disposal of any escaped toxic and hazardous substances.

.3 Servicing of Equipment

- .1 The fuelling servicing or washing of machines or equipment within the wetted perimeter or riparian zone of watercourses is prohibited. On-Site fuelling and lubrication of equipment shall also be conducted as far as possible from detention and sediment control facilities. Servicing should be conducted at designated Sites that are properly protected and approved by Fisheries and Oceans Canada and British Columbia Ministry of Environment.
- .2 Refuse generated during the servicing of equipment (e.g., air and oil filters, hydraulic fluids, petroleum products) shall be collected and disposed of in an environmentally acceptable location and manner. Where possible, the Contractor is encouraged to recycle lubricants and other waste materials generated during the servicing of equipment and machinery, or alternatively dispose of such materials and refuse at nearby recycling depots. The dumping of oil or other deleterious materials on the ground or in any watercourse is strictly prohibited. The Contractor shall provide a means of catching and retaining drained oil or other deleterious materials and shall properly dispose of these materials.

.4 Equipment Operation in Environmentally Sensitive Areas

- .1 Construction equipment shall be operated only within the designated construction Site and access roads. Equipment operators shall not be allowed to damage or destroy vegetation or streambanks outside of this area.
- .2 The operation of equipment and machinery in a Fisheries Sensitive Zone must be:
 - .1 authorized by the Environmental Agencies,
 - .2 kept to an absolute minimum, and

.3 undertaken only during the period(s) specified in the Contract.

.3 When working in any designated watercourse, equipment shall use biodegradable hydraulic fluid and shall be steam cleaned of oil, grease and other contaminants deleterious to aquatic species, prior to commencing work. When working in or near any watercourse, the Contractor shall ensure that all hydraulic systems, fuel systems and lubricating systems are in good repair. Equipment with fuel or fluid leaks shall not be permitted to enter the wetted perimeter of any watercourse. Equipment developing such leaks shall be removed immediately and repaired.

1.14 Waste Disposal and Non Toxic Materials

.1 All non-toxic or non-hazardous wastes shall be either recycled or disposed of in an approved sanitary landfill or other specialized area as indicated in the Contract. Any waste material that is inadvertently dumped in or adjacent to watercourses or other designated environmentally sensitive areas shall be removed by the Contractor and disposed of in an approved manner at the Contractor's expense.

.2 The Contractor shall be responsible for the regular collection and disposal of all waste material generated by employees and sub-contractors. The Contractor shall take the necessary precautions to prevent loss of these materials during transport on public highways and roads, and shall be responsible for cleanup of all of these materials and all litter deposited by employees and subcontractors along access routes during construction-related activities, at no expense to PWGSC. Construction debris shall not be allowed to accumulate on the construction Site but shall be collected promptly and regularly removed from the Site. The Contractor shall ensure that waste materials are placed and stored in suitable containers. Waste material shall be disposed of at an approved waste disposal Site. The Contractor shall be responsible for providing and regularly servicing animal-proof refuse containers and for ensuring that all employees and subcontractors dispose of wastes to keep the Project clear of waste and garbage.

.3 Spill Clean-Up Plans for Toxic/Hazardous Materials

.1 Contingency plans for the clean-up of toxic or hazardous spills shall be prepared prior to construction and submitted, together with a list of spill abatement equipment to be stored on the job Site. The Contractor shall have on Site any additional equipment or materials deemed necessary to deal with a potential spill. For operations adjacent to a watercourse, an approved spill kit is to be present. The Contractor shall promptly replace any used spill abatement and clean-up materials and maintain a sufficient inventory of materials throughout construction operations. For operations being conducted adjacent to or within the wetted perimeter of a watercourse or other Environmentally Sensitive Area, the Contractor shall have an approved spill kit ready for use nearby.

.2 The Contractor shall immediately report any spill of any toxic or hazardous material verbally to the PWGSC Representative and the Provincial Emergency Program (24 hour phone line; 1-800-663-3456). Written notification of the spill must follow within two weeks of this verbal report. The Contractor shall immediately

take the necessary steps to abate the discharge and provide the necessary labour, equipment, materials and absorbents to contain and remove the spill, clean up the affected area, dispose of waste materials at an approved disposal Site, and restore the area to the satisfaction of the Environmental Agencies, at the Contractor's expense. Any soil contaminated by spills shall be removed and replaced by comparable substitutes at the expense of the Contractor.

.4 Concrete Wastes

- .1 The Contractor shall isolate fresh concrete or cement from any designated watercourse for 48 hours after placement. Containers or trucks carrying cement or fresh concrete shall be washed at a Site approved by the Environmental Agencies. Concrete wastes, including wastewater from batching or cleaning, shall only be disposed of at approved and designated disposal Sites (i.e., location designated with proper signing). All cement-contaminated wastewater from cleaning or mixing is to be considered toxic, and must be prevented from entering any designated watercourse for at least 48 hours to allow the water to reach neutral pH. Any cement or concrete-contaminated wastewater shall be tested prior to release into a designated watercourse. In the event that such wastewater pH levels are unacceptable in terms of water quality for fish and other aquatic species, the Contractor shall take the necessary measures to contain and treat such wastewater until acceptable pH levels are achieved (i.e., pH levels are the same as the receiving waters).
- .2 The Contractor shall securely store on-Site and use suitable equipment and materials for the mitigation of concrete spills into or in areas adjacent to watercourses.
- .3 Aged, broken concrete shall only be used as riprap with the approval of the Environmental Agencies. The Contractor shall remove broken concrete or concrete wastes that have been inadvertently placed in non-approved Sites on the Project and dispose of them at an approved waste disposal Site.

.5 Petroleum Wastes

- .1 Refuse generated during the servicing of equipment shall be removed from the Site and disposed of in a location and manner that has been approved. The dumping of oil or other deleterious materials (such as diesel used to wash out dump boxes) on the ground is prohibited.
- .2 Solids, sludges and other pollutants generated as a result of construction or removed during the course of treatment or control of wastewaters shall be disposed of in a manner that prevents their direct or indirect discharge to any watercourse or groundwaters.
- .3 Asphalt pavement shall be stockpiled for recycling in a specified location, or disposed of in a location approved by the British Columbia Environmental Protection branch

1.15 Air and Noise Pollution

- .1 All activities, equipment, processes and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict accordance with Federal, Provincial and local regulations governing noise levels and air emission standards.

1.16 Resolution of Disputes

- .1 In the event that a dispute arises between the Contractor and the PWGSC, or the Environmental Monitor and the PWGSC regarding environmental matters related to the project, the PWGSC, or where appropriate, the Environmental Agencies, will have the final decision.

END OF SECTION

1.17 Work by PWGSC and/or Others

.1 The following are some of the activities related to the Work that will be performed by PWGSC or PWGSC's Representative:

- .1 Provision of a legal survey plan.
- .2 Provision of a Site topographical survey and plan.
- .3 Designation of soil cuttings storage and provision of discharge water control at the Site.
- .4 Provision of Quality Assurance for water discharged from temporary settling system into any local water courses.
- .5 Collection of QA samples and testing and approval of samples during well plugging operations
- .6 Camera surveys of holes as required
- .7 Provision of QA report for PWGSC and Contractor review by PWGSC Representative.
- .8 Monitoring of discharge rates/ amounts to evaluate carrying/ absorption capacity of the surrounding landscape and water courses and to determine appropriate discharge rates and locations.

END OF SECTION

2113 TECHNICAL SPECIFICATIONS

33 21 14 Water Supply Wells

1.1 Mobilization

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, supervision, materials, quality control, and other incidentals required to, mobilize equipment, materials, and personnel to complete required activities to carry out the Work in accordance with the Contract.
- .2 Provide a mobilization plan, including, but not limited to:
 - .1 Identification and description of all known equipment required for each construction activity.
 - .2 Planned timing and delivery method for mobilization of equipment.
 - .3 For optional items, proof of a contingency plan and schedule (maximum period from notification of equipment requirement, before equipment arrives at Site and is in place for use) for providing equipment and or materials at Site to:
 - .1 rip and or perforate the nominal 30 inch casing.
 - .2 provide at site, sufficient high solids bentonite, of specification to be agreed on prior to mobilization, to conduct permeation grouting of the ripped nominal 30 inch casing.
 - .3 Any additional equipment required for permeation grouting.
 - .4 Initiate the drilling of RW4, in a meaningful manner, once authorization to proceed is provided.
 - .4 Provision of unit rate for equipment already at site and on standby while additional equipment and materials are mobilized to site.
- .3 Provide all labour, equipment, supervision, materials and other incidentals required for the mobilization of equipment, materials, and personnel to complete the Work.

1.2 Demobilization

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, supervision, materials, quality control, and other incidentals required to, demobilize equipment, materials, and personnel brought to Site to complete required activities to carry out the Work in accordance with the Contract.
- .2 Provide a demobilization plan, including, but not limited to:
 - .1 Identification and description of all known equipment required for each construction activity.
 - .2 Planned timing and removal method for demobilization of equipment.

- .3 Provide all labour, equipment, supervision, materials and other incidentals required for the demobilization of equipment, materials, and personnel to complete the Work.

1.3 Project Management

- .1 The Contractor must designate a project manager available to PWGSC or PWGSC's Representative at any time by mobile telephone and electronic mail, who shall have the authority to sign for the Contractor and shall make themselves available on the job Site within twenty-four (24) hours of any such request by PWGSC or PWGSC's Representative.
- .2 Upon notification of PWGSC's acceptance in principal of the Contractor's proposal, the Contractor shall execute a mutually agreeable formal contract as soon as possible.
- .3 The Contractor will schedule and administer project meetings throughout progress of work with PWGSC and other parties.
- .4 The Contractor will be responsible for preparing the agenda and minutes of all meetings.
- .5 The Contractor will issue a "Contractor's Declaration" to the PWGSC or PWGSC Representative in order to:
 - .1 Make a declaration of acceptance or objection to contents of "Change Order or Non-compliance report.
 - .2 Formally present the Contractor's opinions, problems or requirements for clarification.
- .6 The Contractor shall protect all Work and surrounding infrastructure from injury or damage until the issuance of a Work Completion declaration.
 - .1 If the Contractor fails to prevent any injury or damage to the Work, the Contractor shall rebuild, repair, and restore at its expense any portion of the Work so injured or damaged.
- .7 The Contractor must provide manufacturer certification or certified testing results for PWGSC's use, for any materials used for the Work and must supply the manufacturers certification or certified testing results sufficiently far in advance to enable the PWGSC or PWGSC's Representative to review the data or inspect the materials at the source.
 - .1 All materials incorporated into the Work shall conform to the requirements of the Contract unless previously approved otherwise by the PWGSC Representative.
 - .2 Materials supplied by the Contractor must be approved prior to incorporation in the Work.
 - .3 The PWGSC or PWGSC Representative may perform random inspection and testing of the materials.
- .8 The Contractor shall be responsible for the timely delivery of materials so that Work is not delayed and this shall include:
 - .1 Acceptance of all materials; careful unloading and handling; hauling and delivery from delivery point to job Site; storage and security; prompt turn-around of tank or shipping cars, trucks or delivery containers.
 - .2 Ensuring that a proper account is kept of all materials received.

1.4 Weather

- .1 No work shall be undertaken by the Contractor when, in the opinion of the PWGSC or PWGSC Representative, the weather is unsuitable or unfavourable for that particular class of work. The Contractor shall not be entitled to make any claim for damages due to such delay.

1.5 Layout of Work and Calculation of Quantities

- .1 Property boundaries have been defined on Site with a number of key reference points. It will be the responsibility of the Contractor to establish control lines and to lay out the required Work Area. The Contractor shall assume full responsibility for the alignment, dimensions and elevations of each and every part of the work and their mutual agreement with the PWGSC or PWGSC's Representative.

1.6 Project Coordination Requirements

- .1 The Contractor will contact and coordinate the Work with PWGSC or PWGSC Representative, and shall obtain concurrence with Work plans before they are implemented.
- .2 Refer to Standard Operating Procedure (SOP) documents for general operating procedures during the Work and applicable for the duration of the contract.
- .3 Upon notification of PWGSC's acceptance in principal of the Contractor's proposal, the Contractor will arrange to meet PWGSC's Representative as soon as possible to discuss and resolve administrative procedures and responsibilities.
 - .1 The Contractor will chair the meeting with agenda to include:
 - .1 Project Schedule
 - .2 Work Plan
 - .3 Proposed changes, change orders, procedures, approvals required, and administrative requirements
 - .4 Review of submittals
 - .5 Health and safety plan
- .4 The Contractor will schedule and administer project meetings throughout progress of work with PWGSC and other entities.
- .5 The Contractor will be responsible for preparing the agenda and minutes of all meetings.

1.7 Site Security

- .1 Provide and maintain a perimeter fence surrounding the work area during all testing, killing and construction activities.
- .2 Except for access points, individual sections of fencing will be chained and locked at all times and must be sufficient to prevent access to the Site.
- .3 A key for all Site locks will be provided to PWGSC and their representatives.

1.8 Site Preparation

- .1 Summary
 - .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, materials, and other

incidentals required to prepare the Site for remediation activities. Preparation of the Site includes but is not limited to:

- .1 Preparing the Staging/Work Area
 - .2 Connecting the settling tankage system to the existing discharge system.
- .2 In addition to the above, the contractor will be responsible for utilizing the pre-constructed drilling pad in the area of the Relief Well (Figure 6). The drilling pad consists of a geotextile membrane placed over top of the native soil, with crush rock, compacted in lifts, place on top of the geotextile, approximately 1 m above the existing elevation.
- .3 General clearing: consists of removal of surface debris rubbish, as well as fences and incidental structures necessary.
- .4 Protection
- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping. Provide bracing, shoring and underpinning as required. Repair damage caused by drilling or other Work.
 - .2 Prevent debris from blocking surface drainage system.
 - .3 Ensure that well abandonment operations do not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
 - .4 Fires and burning of waste or materials is not permitted on Site.
 - .5 Do not bury waste or materials on Site.
 - .6 Do not dispose of waste or volatile materials such as: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout project.
 - .7 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
 - .8 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities.
 - .9 Protect trees, plants and foliage on Site and adjacent properties where applicable.
 - .10 Prevent extraneous materials from contaminating air beyond application area.
 - .11 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on temporary roads.
 - .12 Take precaution to protect adjacent structures, paving, services and planting from damage, movement, or settlement during drilling work. Make good damage caused by drilling and testing activities.
 - .13 Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed, reference and have it replaced by a licensed BC Land Surveyor.

- .14 Ensure adequate surface drainage in affected area is maintained.
 - .15 Provide traffic control as required, in accordance with applicable regulations.
 - .16 Adhere strictly to requirements of Section 2.3 – Protection of the Environment.
- .5 Submittals
- .1 Materials Management Plan: prior to beginning of Work on Site submit detailed Materials Management Plan and indicate:
 - .1 Descriptions of and anticipated quantities of soil cuttings to be recycled and landfilled.
 - .2 Schedule of Site clearing.
 - .3 Materials handling and storage.
 - .2 Field Reports: submit to PWGSC or PWGSC Representative on Site, within 3 days of review, verifying compliance of Work.
 - .3 Shop Drawings: Submit in accordance with Contract requirements.
 - .1 Drawings to bear seal of qualified Professional Engineer or Geoscientist licensed to practice in the Province of British Columbia.
- .6 Health and Safety
- .1 Conduct construction occupational health and safety in accordance Construction Site Safety.
- .7 Waste Management and Disposal:
- .1 Collect and separate for disposal packaging material for recycling in accordance with Materials Management Plan (MMP).
 - .2 Clean up waste resulting from Site clearing operations continuously with the progress of the work.
 - .3 Remove cleared materials off Site to authorized disposal areas.
- .8 Environmental Requirements
- .1 The Contractor will be responsible for monitoring during the on Site operations as per their Environmental Management Plan.
 - .2 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials.
- .9 Preparation
- .1 Inspect Site with PWGSC or PWGSC Representative and verify extent, location and scheduling of building and Site elements designated for demolition, relocation, removal, disposal, and salvage. Identify and mark new location for items to be relocated. Verify source, capacity, and routing for utilities required to service relocated items.
 - .2 Identify and protect items designated to remain.
 - .3 Do not disrupt active or energized utilities designated to remain undisturbed.

- .4 Contractor will be responsible for baseline survey and control.
- .5 Use natural lighting to work by wherever possible. Shut off lighting except those required for security purposes at end of day.
- .10 Staging/Work Area
 - .1 The Staging Area is to accommodate equipment and materials storage, the settling tankage system, construction offices, and other miscellaneous structures or construction material storage Sites.
 - .2 Contractor is responsible for final design and construction of the Staging/Work Area, with approval from PWGSC and/or their representative.
 - .3 The Staging Area is to be located on Coldstream Ranch lands/fields to the west and north of the Coldstream Ranch Well (Figure 5). In general terms, the southern half to two thirds of the area is for laydown and storage of equipment. The northern half or one third of the area is for the construction of a settling tankage discharge systems (Figure 5).
 - .4 Preparation of the Staging Area will consist of the removal of any fencing or structures that limit the use of and access to the Staging Area.
 - .5 Contractor will provide an on Site trailer located approximately 50 m from the CRW and provided with power, light and heat for use by the Project Team.
 - .6 Contractor will provide an itemized cost estimate for Site preparation covering all foreseeable costs and items.
 - .7 Supply of all materials, labour, supervision, and quality control services is the responsibility of the Contractor.
- .11 Quality Control
 - .1 The Contractor will provide verification and review of Site clearing and submit reports, in acceptable format, to verify compliance of work with contract.
 - .2 Verification requirements include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
- .12 Quality Assurance
 - .1 PWGSC or PWGSC's Representative will provide quality assurance services during the Site Preparation works.
 - .2 The Quality Assurance may include reviewing construction records, reviewing quality control data and product sampling for independent testing purposes.
- .13 Cleaning
 - .1 Clean and reinstate areas affected by Work.
 - .2 Keep pavement and area adjacent to Site clean and free from mud, dirt, and debris at all times.

1.9 Site Erosion Control, Sediment Removal and Recycling

- .1 Summary
 - .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, materials, quality control services, and other incidentals required to control erosion and sediment movement into adjacent water courses at the Site.
 - .2 Section Includes:
 - .1 Protecting the Work Area from erosion or prolonged exposure to adverse weather.
 - .2 Removal of all soil cuttings and drilling debris material created as a result of the drilling and testing process in accordance with the methods and resources of the accepted Material Management Plan or as otherwise directed by PWGSC or PWGSC's Representative.
- .2 Submittals
 - .1 Submittals: in accordance with the Contract.
 - .2 Submit Materials Management Plan including:
 - .1 Destination of materials listed.
 - .2 Deconstruction/disassembly techniques and sequencing.
 - .3 Schedule for deconstruction/disassembly.
 - .4 Location.
 - .5 Security.
 - .6 Protection.
 - .7 Details on materials handling and removal procedures.
 - .8 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
 - .3 Submit Health and Safety Plan.
 - .4 Submit plan for Erosion Control:
 - .1 Equipment required.
 - .2 Organizational Chart.
 - .3 Schedule.
 - .4 Phasing.
 - .5 Responsibilities.
- .3 Regulatory Requirements
 - .1 Ensure Work is performed in compliance with applicable Provincial regulations for disposal of debris.
 - .2 Burning debris on Site is not permitted.
- .4 Health and Safety
 - .1 Follow construction occupational health and safety in accordance with Construction Site Safety.

.5 Fill Materials

- .1 Should fill materials be required, one of the following may be used, on approval from PWGSC or a PWGSC Representative.
- .2 Coarse granular fill: free of shale, clay, friable material, sand, debris. This material will meet the specification for “Intermediate Graded Sub-base (IGSB) – Sub-base Aggregates;” Section 202, Sub-section 202.05.01 Table 202-C Aggregate Gradations; of the BC Ministry of Transportation and Infrastructure, 2009 Standard Specifications for Highway Construction (October 1, 2008), Volume 1.
- .3 25 mm minus well-graded granular fill: free of clay, shale, organic matter, This material will meet the specification for “Well Graded Base (WGB) – 25 mm Base Course;” Section 202, Sub-section 202.05.01 Table 202-C Aggregate Gradations; of the BC Ministry of Transportation and Infrastructure, 2009 Standard Specifications for Highway Construction (October 1, 2008), Volume 1.
- .4 To consist of clean round stone or crush rock.
- .5 Sand/Silt Substrate: free of, friable and soluble materials, and organic matter. This material will meet the specifications for “Pit Run Sand;” see Section 02226, Sub-section 2.4, BC Master Municipal Contract Document (2000).
- .6 Top soil fill: free of inorganic material and debris.

1.10 Installation of Settling Tankage System

.1 General

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, materials, quality control services, and other incidentals required to install a settling tankage system that connects to, and/or discharges to the following:
 - .1 Skobalski Brook
 - .2 Coldstream Creek through the existing 8 inch diameter discharge pipe system.
 - .3 The Coldstream Ranch’s irrigation system, which pumps water from the existing concrete cistern for the CRW.

.2 Equipment Provision and Installation

- .1 A complete equipment and equipment specification list will be provided by the Contractor.
- .2 Contractor will provide tank equipment that can readily accept a flow rate of approximately 2,000 USgpm, with a total tank area of 300 m², and a minimum tank volume of 300 m³. This tank area/volume will provide a residence time of approximately 40 minutes and is based on the ability to settle out minimum 25 micron particle sizes within the pumped water.
- .3 Discharge system for the settling tank must be able to discharge directly to Skobalski Brook, the existing CRW concrete cistern,

and/or the CRW discharge pipe, which discharges to Coldstream Creek.

- .4 Additional contingency tankage of the same area and volume should be available within one (1) day, if required and requested by PWGSC or their Representative.

1.11 Plugging of CRW, RW1 and MW11-01

.1 General

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, materials, quality control services, and other incidentals required to install, provide adequate back up power for, commission and operate dewatering pumps in RW3, RW1 and MW11-01 and to operate and provide back-up power for the RDNO Well No.1 To then operate these pumps while plugging and abandoning the wells: CRW, RW1 and optionally MW11-01 under (as far as possible) static (non-flowing) well conditions. Plugging and abandoning is, as far as possible, to be performed using Low Mobility Grouting (LMG) methods. Contingency operations are also described in this section, primarily alternate grouting methods and the drilling of an additional relief well RW4.

.2 Sequencing and Scheduling

- .1 Well abandonment and plugging will not commence until the settling tankage system is installed and operational and approved by PWGSC or the PWGSC Representative.
- .2 Well abandonment and plugging will not commence until the existing discharge pipe from the CRW to Coldstream Creek has been replaced (to be conducted by others).
- .3 Well abandonment and plugging will not commence until dewatering pumps and associated back-up power systems are installed and operational in all of the identified dewatering wells (RW1, RW3, MW11-01 and the RDNO Well No.1) and drawdown has been achieved in the CRW to the satisfaction of the PWGSC and discharge is being controlled to the satisfaction of PWGSC,
- .4 Contractor is required to schedule so that LMG can proceed within 24 hours of cleaning and opening the CRW to the top of the Lower Aquifer.
- .5 Contractor is to provide reasonable contingency times for alternate procedures, if required, as specified below.

.3 Work Standard

- .1 All work will be to a professional standard as expected in the water well and oilfield drilling industry.
- .2 Contractor will provide grout specifications to be approved by PWGSC's representative a minimum of 72 hours prior to grouting any hole section(s). PWGSC's representative will have full and final control of the final grout mix.

.4 Equipment Provision

- .1 A complete equipment and equipment specification list will be provided by the Contractor.
- .2 Contractor will provide equipment that can readily cut or remove casing as specified and grout the specified hole and casing sizes at the required depths with all required tubular and support equipment to complete the job without recourse to down time, to effect general maintenance or routine repairs.
- .3 Contractor will provide equipment for normal mud circulatory conditions that can readily drill in the formations indicated and circulate weighted drilling fluid up to a maximum density of 1800 kg/m^3 . This provision is for the eventuality of uncontrolled artesian flowing conditions or drilling of additional relief well(s).
- .4 Contractor will provide equipment for electronically and automatically monitoring the placement of LMG.
 - .1 During placement of grout, measurements of grout injection parameters shall be made with electronic data logging equipment positioned within 10 m of the hole collar. Measured flow rate, effective pressure and injected volume shall be digitally recorded. Recording shall include all data into a single, time synchronized, ASCII text file (*.csv) at a scanning frequency of at least 0.5 Hz (i.e. 1 reading every 2 seconds).
 - .2 At all times during grouting, real-time plots of the following should be available, as 10-point running averages, for direction of the grouting works:
 - Effective Pressure (bar) vs. Time (min); and
 - Flow Rate (L/min) vs. Time (min);
 - .3 In addition to the graphical plots, digital displays of the following should be provided:
 - Hole Number;
 - Stage Depths from/to (m);
 - Effective Pressure (bar);
 - Flow Rate (L/min);
 - Total Volume (L);
 - .4 Flow meters shall be of the electromagnetic type. Flow meters for grouting shall have a full scale capacity of 50 litres/minute and shall be capable of resolving flows as low as 8 litres/min with an accuracy of ± 0.2 litre/minute. All flow meters shall provide an electronic signal of the 4 to 20 mA type.
 - .5 Pressure transducers shall be of ~ 138 bar (2000 psi) maximum pressure and of the 4 - 20 mA type. Transducers shall have an accuracy of better than 1% FSD. During grouting activities, pressure transducers shall be mounted on the grout line tee at the hole collar, and shall be protected from the grout using an in-line

- gauge saver. Only one hole shall be monitored with each pressure transducer.
- .6 Concrete pumps used for compaction (or low mobility) grouting activities shall be outfitted with a stroke counter; the volume per stroke being used to cross-check measured volumes provided by the electromagnetic flow meter.
 - .7 No grouting will be permitted and all costs for any delay and re-grouting required shall accrue to the Contractor if flow meters and their monitoring equipment are out of calibration, or are defective or plugged.
- .5 A complete mud mixing and circulation system with adequately sized mud tanks, shale shaker, and cyclones will be provided to allow, in the event of flowing well conditions, the pumping of weighted drilling fluid up to a maximum density of 1800 kg/m³.
 - .6 Excavated mud pits or any other excavation will not be allowed at the Site.
 - .7 Back-up tankage of total volume 65 m³ is also required as described.

1.12 Abandonment of CRW, RW1 and MW11-01.

- .1 Contractor will provide mud pumps appropriate for the circulating system that they have proposed (normal or reverse circulation) that are capable of maintaining up hole velocities at minimum of 0.63 m/sec.
- .2 A minimum of 65 m³ of storage tanks will be maintained on Site close to wells that are actively being worked on to allow batch storage of drilling mud, or cement contaminated water that flows from the well. The tankage can be rock boxes or the like. The specified volume is approximately three times the calculated volumes of the nominal 30 inch casing and open hole below to a depth of approximately 61 m. The storage requirement is over and above any volume required for the mud circulation and grouting system and should be maintained available (empty) whenever the hole is being actively drilled or worked on.
- .3 Contractor will provide appropriate valving and piping so that any fluids from holes being worked on can be diverted to the storage tanks when needed. Efficacy of the valving and piping will be demonstrated with water prior to mudding-up.

1.13 Electrical Systems

- .1 Contractor will be required to use the specified site power drop to operate the following duty pumps
 - .1 up to 75 hp pump in RW3
 - .2
 - .3
 - .4
- .2 The duty power for the pumps will be provided by the power drop available at the Site. To provide for the eventuality of a power failure, contractor will provide an electro mechanical system whereby a suitably sized generator(s) for the above noted duty pumps would automatically take over power supply. Except when the generator had taken over

primary power duties, the generator would have to idle/ be in standby mode for the duration of the project.

- .3 At the RDNO Well No.1) well to the east of the CRW a well pump is installed and hard wired in place and the combination of well and pump will be used to aid in dewatering. To provide for the eventuality of a power failure, contractor will provide an electro mechanical system whereby a suitably sized generator for the installed pump would automatically take over power supply. Except when the generator had taken over primary power duties, the generator would have to idle/ be in standby mode for the duration of the project. The RDNO Well No.1 is presently supplied by 100 amps at approximately 575 Volts and is 100 HP. However RDNO operates this pump throttled back to a minimal flow (approximately 700 USgpm) with a gate valve and an orifice plate to restrict the output. This potentially reduces the load and the ampacity that the pump runs at.

.4

1.14 Well Modifications and Pumping Systems

- .1 Note: where pump installations are indicated this means: the pump as indicated with the specifications noted with: appropriately sized drop pipes for the flows required; electrical connection; piping to the specified discharge location and operation of the pump continuously for the duration of the project.
- .2 Modification of the wellhead of flowing well RW1 to bring its at-surface available diameter to the 8 ⁵/₈ inches (Flush joint and threaded) production casing that the well was originally completed with. Additionally the top of the well should be completed with a flange ring or threaded nipple and the contractor shall have on hand appropriate valving and matching flanged or threaded piping that would allow, if needed, the pump to be withdrawn under flowing conditions and valves bolted or threaded to the top of the casing and the flow shut-off. The well at surface is presently completed with approximately 3 inch fittings on top of the 8 ⁵/₈ inch casing.
- .3 Installation of a pump in relief well RW1 capable of flows up to 12.6 L/s (200 USgpm) with the pump set at approximately 36 mbg and drawdown below grade of approximately 33 mbg.
- .4 Installation of a pump in relief well RW3 at a total depth of 52 mbg with a flow capacity up to 89 L/s (1400 USgpm) at a drawdown of ~48 mbg and sized to fit and operate in nominal 12 inch casing. Valving to shut off RW3, once the pump is removed and when the pump is in place, is available.
- .5 Installation of a pump in the nominal 4 inch monitoring well MW11-01 capable of flows of up to 6.3 L/s (100 USgpm) at a drawdown of approximately 38 mbg (125 ft). A plug is available for this well when the pump is withdrawn.
- .6 Installation of a pump in the CRW annular space. Pump to be set at approximately 43 mbg and the annular space potentially drawdown to 38 mbg with flows up to 44 L/s (700 USgpm). The flow from this well will be controlled to equilibrate the pumping level in the annular space with levels in RW3 or as directed by PWGSC's Representative.
- .7 Installation of all necessary piping to allow discharge from well pumps to the settling tankage system to the west of the CRW and to the pipe that leads from the CRW cistern to Coldstream Creek and piping running through the culvert under Kalamalka Road, south of the site, to allow water discharge on the field south of Kalamalka Road. Valves must be incorporated to allow rapid switching or adjustment of water flows from the settling system to the various discharge areas.

- .8 The existing RDNO Well No.1 pump will be used as-is with the only modification being the installation of back-up power. Discharge piping to the Coldstream River to the south is already in place at the location.
- .9 Removal of all flanges and well head appurtenances at the CRW to expose the 16 inch and 30 inch casings at ground surface and to allow ready and safe access to the CRW for well plugging operations. Where necessary, support of 16 inch and 30 inch casings to ensure they do not move down.
- .10 Once the pumps are installed and connected to the discharge systems, pumps and discharge systems will be commissioned and be proven to be operating to the satisfaction of PWGSC's Site Representative prior to proceeding with well plugging operations.
- .11 Pumping and discharge systems will be expected to be operated continuously throughout the well plugging operations.

1.15 CRW Well Abandonment

- .1 There is a serious concern that the original open hole may collapse with the loss of the location of the original hole and the loss of the ability to re-enter the original hole to effect plugging at the correct location if tubulars are not maintained in the open hole: With only a few specified exceptions and only when expressly agreed to by PWGSC or PWGSC's Site Representative, until the operation is deemed to have been completed, a minimum nominal 8 inch continuous (from surface) steel casing or pipe must be maintained in any open hole. Open hole is defined as any hole section that is neither grouted nor cased. This specification must also be adhered to when casing is being pulled to reveal open hole prior to grouting. The casing or pipe will be welded or joined in such a manner that it can be pulled from caved or collapsed formation without failure of the pipe. The casing to be fitted with a reverse reamer at its shoe.
- .2 Set up all drilling and plugging equipment at the CRW.
- .3 Pull the nominal 16 inch well screen without moving the nominal 16 inch casing vertically.
- .4 Support 16 inch casing as needed but leave in place. Measure to shoe of nominal 16 inch casing using video inspection (by PWGSC's Representative). The recorded depth of the shoe of the nominal 16 inch casing is approximately 49 m (160 ft bg). The measured depth of the shoe of the nominal 16 inch casing will be a reference point for the top of the first stage of LMG in the Lower Aquitard.
- .5 Clean materials from the borehole in the Lower Aquitard below the shoe of the nominal 16 inch casing using the cleaning casing/ drilling until the top of the Lower Aquifer is reached at a depth of between approximately 200 ft and 210 ft bg. The materials removed may be up to cobble or boulder size. This is a critical part of the operation and the bore must as far as possible be cleaned back to competent native material. Contractor to provide eccentric style bit to ensure diameter larger than the casing is cleaned. Each 3 m (10ft) section to be cleaned to the satisfaction of PWGSC or PWGS's representative before proceeding with the next 3 m section.
 - .1 To ensure the bore wall is clean and free of sediment and assuming that the sections are cleaned/ drilled using water as a drilling fluid, after each section, pull back the temporary casing approximately 10 ft to allow camera inspection of the borehole wall. When temporary casing is pulled back it will NOT be pulled back above the top of the Lower Aquitard. Flushing of the

section may be required to allow camera inspection which, at the discretion of PWGSC and or PWGSC's Site Representative, may be by temporarily throttling RW3 to allow flow from the Lower Aquifer up the CRW.

- .6 After each section, pull back the casing approximately 10 ft to allow camera inspection and measurement of the breach above the Lower Aquifer in the generally competent Lower Aquitard and inspection of the top of the Lower Aquifer. Ensure that the bore wall is free of loose sediments and caving material.
- .7 Using the low mobility grout (LMG) method initiate sealing of the breach above the Lower Aquifer. Particular time and care will be taken in compacting the LMG in the lowest 20 ft of the Lower Aquitard to ensure that the Lower Aquitard formations have been compacted as much as possible and that the LMG completely fills the void space and as far as possible has closed off any fractures or voids that may have developed in the Lower Aquitard.
- .8 The LMG placement across the Lower Aquitard will be in two stages to allow removal of the nominal 16 inch casing between each stage. During the LMG placement process, the responses and water levels in RW3, RW1, MW11-01 and MW13-01 to 04 and the RDNO Well No.1 will be closely observed and recorded by PWGSC's Site Representative. It is predicted that once the Lower Aquifer is isolated that the flow rates from RW3 and RW1 will change, if the flow from RW3 were stopped and the well shut in, that the shut in pressure of RW-3 would increase. Once the CRW hole section across the Lower Aquitard is assessed to have been sealed off across its entire length (that is from its interface with the Lower Aquifer up to its interface with the Middle Aquifer), pumping from RW3 and RW1 may (subject to testing and required time for grout to set) be temporarily reduced to a flow rate that keeps the water levels in RW1 and RW3 just below ground level. The stages of LMG placement and nominal 16 inch casing removal in the Lower Aquitard will be:
 - .1 First Main Lift of LMG: Place LMG From the top of the Lower Aquifer to 1.2 m (4ft) below the shoe of the 16 inch casing;
 - .2 Nominal 16 inch casing to be pulled and removed to ground-surface for recycling. Requirement for temporary casing to remain in the hole, particularly below the top of the Lower Aquitard must be met;
 - .3 Conduct camera inspection of the nominal 30 inch casing to evaluate its condition and determine the depth of the shoe of the nominal 30 inch casing.
 - .4 Place LMG from the top of the First Main Lift of LMG to just below the base of the nominal 30 inch casing reported at 47 mbg (154 ft bg.).
 - .5 If required, remove all tubing from the nominal 30 inch casing, displace casing with fresh water and conduct a second camera survey.
- .9 The grouting casing *may* be removed to allow equipment to be placed inside the 30 inch casing; however, during removal of the nominal 30 inch casing, a minimum nominal 8 inch temporary casing must be maintained in the hole to approximately 46 mbg (150 ft bg).

- .1 Contractor should allow to potentially remove fines and sand and gravel from inside the nominal 30 inch casing down to approximately 47 mbg (153 ft bg).
- .10 The 30 inch casing will be removed to allow placement of LMG across the remainder of the Middle Aquifer and across the entire section of the Upper Aquitard.
- .11 Options for removal of the nominal 30 inch casing are
 - .1 Linear shape charges (LSC) that would allow the nominal 30 inch casing to be cut into plates from its bottom up in maximum 20 ft lengths will be deployed. Essentially all steel casing fragments to be removed following cutting. If this method is used it would be allowable not to keep a pipe in the hole to the full depth of the well as long as LMG placement were completed in lifts as the casing sections are removed.
 - .2 Inserting a nominal 24 inch casing into the nominal 30 inch casing and using packers to temporarily join the nominal 24 inch and 30 inch casing and then vibrating (APE vibratory driver or puller specified by the successful bidder and to be approved by PWGSC's Representative) and pulling the 30 inch out of the ground until its shoe is at approximately the base of the Upper Aquifer. For this operation, it would be acceptable to maintain the hole open with drilling fluid. Contractor should allow for the drilling fluid to be weighted to ensure that there is no flow from the Middle Aquifer. Based on present knowledge, it is assessed that a mud density of 1300 kg/m³, or less, would be sufficient to maintain the hole static if there were no beneficial drawdown from the RDNO Well No.1; however, pumping tests indicate that the well should be static as a result of the operation of the RDNO Well No.1.
 - .1 The plan for pulling the nominal 30 inch should include provision to shut in the top of the nominal 30 inch (a flange and valve is present at the well) while reducing flow rate at the RDNO Well No.1 to induce flow around the nominal 30 inch and as far as possible to loosen the nominal 30 inch. Consideration *may* be given to attempting to initiate movement on the nominal 30 inch using the pressure from the Lower Aquifer, prior to commencing the plugging of the Lower Aquifer.
 - .3 If Option .2 (above) is used LMG will be placed from the original shoe depth of the nominal 30 inch casing (recorded by others as being 47 mbg (154 ft bg) to the base of the Upper Aquifer. As with the Lower Aquitard, significant care and time should be allowed for placement of LMG under maximum pressure for the first 40 ft vertically of the Upper Aquitard to provide maximum compaction of the surrounding formation
 - .4 Alternate methods to be proposed by the Contractor. Methods will not be accepted which, if unsuccessful, would preclude

ripping and perforating through all casing to the outside of the nominal 30 inch casing.

- .12 In the event that the nominal 30 inch casing cannot be pulled, the casing will be ripped and perforated and permeation grouting will be conducted at surface pressures of approximately 70 psi reducing to 40 psi at the bottom of the Upper Aquifer at approximately 60 ftbg. The allowable surface pressures will be calculated at the time of grouting and will be based on the grout density at the time of placement.
- .13 Where casing ripping or perforation is required, contractor must achieve full perforation of a minimum of 15% of the inner nominal 30 inch casing wall area being perforated and the perforations must be essentially evenly distributed from approximately 46 mbg to 15 mbg (150ft bg to 50 ft bg). Casing perforation will be video inspected and assessed by PWGSC's Representative.
- .14 Where the casing has successfully been pulled from the ground, the remaining nominal 30 inch casing (to approximately 65 ftbg) will be pulled from the ground as the Upper Aquifer is backfilled with clean coarse sand and gravel to approximately 0.6 m below natural grade. The remainder of the hole will be filled with topsoil.
- .15 Where the casing has been perforated and grouted, the casing will be grouted to the base of the Upper Aquifer, the upper section ripped and perforated as per these Specifications and backfilled with sand and gravel to 4 mbg. Contractor will excavate around the casing to 4 mbg, cut casing and backfill with excavated material made up with topsoil to grade.

1.16 RW1 Abandonment

- .1 The flow rate from RW3 will be increased until the RW1 is either killed; or, until the maximum achievable flow rate from RW3 is reached. Pumping from MW11-01 will be conducted at the maximum possible rate; although, it is conceded that this will probably have little effect on reducing the flow from RW1, its only possible effect being by reducing the flow through the short circuit at RW1 between the Middle and Lower Aquifer.
- .2 If necessary, RW1 will be killed by circulating weighted mud to allow the sealing of the Lower Aquitard under static (killed) conditions. At this time, it is assessed that with RW3 in operation, a mud weight in the order of 1300 kg/m³ would be sufficient to kill RW1.
- .3 The well screen attached to the 4 ½ inch liner of RW1 will be cut from the liner at the top of the well screen, using either explosives or a casing cutter. Note: that the liner is not recorded as being cemented in place so it may spin if casing cutters are employed. The sequencing may be reversed to avoid problems with the liner spinning; or, Contractor should use other methods to stop the liner spinning.
- .4 The contractor will then either latch onto the liner which has an external thread which will then become the spear for placement of LMG; or, may pass a tremmie pipe through the liner so that LMG can be placed below the liner. The liner MUST be withdrawn as the LMG is placed across the Lower Aquitard
- .5 LMG will be placed from the depth of the bottom of the liner as it is withdrawn up to the base of the Middle Aquifer. Placement of LMG will continue up to 4 mbg. A 1 metre concrete plug will be placed above the LMG, the 8 5/8 inch and 13 inch casings cut off at 3 m below ground surface and the hole backfilled with the material removed to cut the casing, made up to ground surface with topsoil

1.17 Grout Type

- .1 All grout specifications will be provided as part of the submittal. Finalization or final approval of the grout design will be provided to the Contractor a minimum of 72 hours before any grout job commences.
- .2 The Contractor shall submit a Low Mobility Grout mix(s). The LMG mix shall have a slump of 3 to 4-inches. Low mobility grout shall meet the following requirements;
 - .1 Bleed 0%
 - .2 Stiffening Time >4 hours
 - .3 In addition to satisfying requirements stated in ASTM C33, the sand for LMG shall be clean and consist of natural, hard, tough, durable, uncoated particles with no more than 10 percent passing the #200 sieve. The shape of the particles shall be generally rounded or cubical. The sand shall be generally well graded from fine to coarse in accordance with ASTM C136 with 100 percent passing the No. 4 sieve. The sand shall be subjected to such tests as are necessary to determine its acceptability.
 - .4 Sand shall be stored in such a manner as to avoid the inclusion of any foreign materials in the grout. All sand shall remain in free draining storage for at least 72 hours prior to use. The percentage of surface moisture in terms of the saturated surface-dried sand will be determined in accordance with ASTM C 70, or other method giving comparable results. Dependent upon satisfactory performance, natural concrete sand may be acceptable for use in this work
- .3 Optional Item: Following the killing of the CRW and RW1, should it be determined that MW11-01 is not required for monitoring purposes, MW11-01 will be properly abandoned.
 - .1 To facilitate the closure of MW11-01, the RDNO Well No.1 will continue to be pumped at a rate of up to 1000 USgpm, to maintain the water level at MW11-01 below ground surface.
 - .2 Remove the pump, pump column and associated piping from MW11-01.
 - .3 Fill the existing nominal 4 inch diameter stainless steel well screen with a sand and gravel material, between 152 ft and 158 ft below ground.
 - .4 To minimize loss of the cement plug through the filled in well screen and into the Middle Aquifer and using a maximum 2 inch tremmie pipe, a sufficient volume of a slurry to place an approximately 1 ft floor of fine (mortar) sand, homogeneously mixed with bentonite powder, will be tremmied or pumped down a nominal 2 inch tremmie pipe to spread over the top of the sand and gravel material filling the well screen. The intent of the floor is to limit the amount of cement (if any) entering the Middle Aquifer.
 - .5 A sufficient volume for a 1 ft to 2 ft lift of Oilwell Class G, high early strength cement will be tremmied over top of the well plug. The high early strength cement will be allowed to set and the water column above to clear.

- .6 Contractor will mix cement in sufficient volume to fill the remaining casing to a depth of 54 ft below ground. The preliminary cement design is 2 – 2.5 water:1 cement: 0.25 – 0.3 bentonite by weight. Bentonite will be smoothly mixed in once the cement and water are mixed. Cement mixing equipment will be used to ensure proper shearing and mixing of the cement.
- .7 The cement plug will be allowed to set-up for a period of 48 hours. Contractor will provide costs for standby, operation of relief pumps and adequate round the clock manning of the Site.
- .8 Once the cement filling the casing has set-up, the RDNO pump will be shut off.
- .9 Contractor will cut the nominal 4 inch casing with casing cutters just above the cement (at a depth of approximately 54 ft), or as required, to allow the nominal 4 inch casing and outside 6 inch casing to be withdrawn. The casing cutter should be able to extend through the 4 inch casing, annular cement between the 4 inch and 6 inch casing and outside the 6 inch casing, to allow the casing to be removed.
- .10 The cut casing (from ground surface to approximately 54 ft) will be pulled from the ground as the Upper Aquifer is backfilled with clean coarse sand and gravel to approximately 0.6 m below natural grade. The remainder of the hole will be filled with topsoil.

1.18 RW4 - Relief Well Drilling and Construction (Optional Item)

.1 General

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, materials, quality control services, and other incidentals required to mobilize, and conduct drilling activities associated with the completion of a new Relief Well (RW4) at the Site and to complete the Work in accordance with the Contract, IF REQUIRED.
- .2 Two options are proposed for the drilling of RW4, with one option of completing RW4 in the Middle Aquifer. The second option would result in RW4 being completed in the Lower Aquifer, similar to the completion of RW3.

.2 RW4 – Option 1 – Completion in Middle Aquifer

.1 Summary

- .1 The proposed Project includes contingency for drilling of one (RW4) relatively large diameter relief well (i.e., water well designed to allow high flow pumping) within 5 m (16.4 ft) to 15 m (49.2 ft) of the CRW.
- .2 Two concentric casings set at successively greater depths. It is anticipated that the relief well would be nominal 12 inch in diameter (production casing size), with the production casing cut back to a liner with its top situated at approximately 140 ftbg. At the present time, flow rates of 100 USgpm are anticipated.

- .3 The general relief well design is shown on Figure 7. Contractor will provide an itemized cost estimate to complete a nominal 12 inch well (referred to as “Nominal Well Size” on Figure 7 with all materials, equipment and appurtenances required). In general terms, the first hole and casing section (20 inch hole and 16 inch casing) and its cementing should be bid as a lump sum. All subsequent sections will be bid on a footage and unit rate basis but with an estimate of expected number of units with the applicable rate to provide a best estimate of expected cost for each operation and for all equipment and materials required.
- .4 The relief well design, which may be modified slightly in the field based on where formations are encountered during drilling, is:

Table 2: General Well Design

Open Hole Diameter (nominal inches)	Casing Centralized and Cemented in Open Hole (nominal inches)	To Depth (ft)	Comments
20	16	120	<i>Cemented in place. Drilled without weighted mud.</i>
16	12	160	<i>Cemented in Place. Middle Aquifer 140 to 160 ft bg. Set and expose 12 inch telescopic well screen, cement 12 inch casing over Upper Aquitard.</i>

- .2 Work Standard
 - .1 All work will be to a professional standard as expected in the water well and oilfield drilling industry.
 - .2 All materials are to be of typical BC water well specification with minimum permanent steel casing thicknesses to be ¼ inch (6.35 mm) for casing sizes less than nominal 20 inch and 5/16 inch (7.93 mm) for casings of 20 inch or above.
 - .3 All casings will be plumb and without doglegs.
- .3 Equipment Provision
 - .1 A complete equipment and equipment specification list will be provided by the Contractor.
 - .2 Contractor will provide equipment that can readily drill the specified hole size to the required depths and install the casing as specified with all required tubular and support equipment to complete the job without recourse to down time, to effect general maintenance or routine repairs.
 - .3 A complete mud mixing and circulation system complete with adequately sized mud tanks, shale shaker, and cyclones will be provided.

- .4 Contractor will provide mud pumps appropriate for the circulating system that they have proposed (normal or reverse circulation) that are capable of maintaining up hole velocities at minimum of 0.63 m/sec.
 - .5 Excavated mud pits used during drilling will not be allowed at the Site.
 - .6 The specified 65 m³ storage tanks will be maintained on Site close to wells that are actively being worked on to allow batch storage of drilling mud, or cement contaminated water. The tankage can be rock boxes or the like. The specified volume is approximately four times the calculated volumes of any of the hole / casing sections. The storage requirement is over and above any volume required for the mud circulation system and should be maintained available (empty) whenever the hole being actively drilled or worked on is filled with anything other than clean water.
 - .7 Contractor will provide appropriate valving and piping so that drilling fluid can be diverted from the borehole to the storage tanks while drilling. Efficacy of the valving and piping will be demonstrated with water prior to mudding-up.
- .4 Drilling Method for Option 1 Relief Well (RW4)
- .1 The upper casing (20 inch hole with 16 inch casing set at approximately 36.6 m [120 ft bg]) can be drilled and installed with any suitable method (for instance, air rotary, dual air rotary, cable tool).
 - .2 The lower hole sections and casings and the setting of well screens will be drilled and completed with the mud rotary methods and with equipment that ensures an uphole velocity for the circulation method specified by the driller (either normal circulation or reverse circulation) of 0.63 m/sec at all stages of the work.
 - .3 For the lower two hole sections, the Contractor will provide and install a suitably sized annular blow out preventer. The blow out preventer will be tested and its testing and operation proven to PWGSC and/or their representatives at the start of each hole section and every five days thereafter.
 - .4 Drilling fluid will be maintained through the use of suitable additives and will have a Marsh Funnel viscosity of between 35 and 85 seconds which will be controlled as directed by PWGSC and/or their representatives. Additionally, the density of the drilling fluid will be maintained at those specified by PWGSC and/or their representatives. In general terms, the following densities are expected.
 - .1 0 – 36.6 m (120 ft) – Fluid type and density selected by driller for maximum efficiency

- .2 36.6 m (120 ft) – 56.4 m (160 ft) – mudding up to required density of approximately 1150 kg/m³ before drilling into the Middle Aquifer.
- .5 To ensure that the mud system is properly maintained the Contractor will engage a qualified mud “engineer” who will be on the project throughout the mud drilling.
- .5 Centralized Casing
 - .1 All casing will be centralized in the holes in which they are being cemented using strap on bridle centralizers of sufficient strength and stiffness to hold the casing away from the borehole sides and to be approved by PWGSC and/or its representative prior to use.
- .6 Annular Cement Seal
 - .1 The contractor will install an annular cement seal around each casing which, when set-up will be free of voids or channels (as evaluated with a cement bond log) and which will be able to withstand a pressure at its exposed end, adjacent to the casing shoe, greater than the expected maximum fracture pressure for the formation at the shoe of the casing.
- .7 Cement Type
 - .1 Cement will be Oilwell Class G with suitable additives such as super-plasticizers (fluid loss agents) and additives to ensure that the viscosity of the cement remains acceptably low. Finalization of the cement design will be provided to the contractor a minimum of three days before any cement job.
- .8 Specifications for Placing the Annular Cement Seal
 - .1 When cementing the annular space around casings, the minimum acceptable up-hole velocity for the cement in the annular space will be 0.75 m/sec (this equates to a pumping rate of approximately 43 L/s for 12 inch casing in 16 inch hole). Contractor will provide equipment capable of this rate of pumping when taking into account friction losses in tremmie pipes (if used) and the annular space.
 - .2 When cementing, and for cementing the casing in place, the casing will NOT be filled with cement; the Contractor will either:
 - .3 Spud the casing into low permeability formation and for casing sizes equal to and below nominal 12 inch provide four equally spaced tremmie pipes diameter around the circumference of the casing being cemented and six tremmie pipes for casing sizes being cemented of above nominal 12 inch. Cement will be pumped into the tremmie pipes at equal rates until five consecutive measurements of the density of the cement discharge at the annular exit are equal to the density of the cement being pumped down the well ($\pm 3\%$ of the input density).

- The tremmie pipes are to be withdrawn once cementing is completed.
- .4 or, will use some means by which cement is only pumped into the lowest section of casing and around the annulus similar to an oilfield style primary (single stage) cement job employing top and bottom plugs and suitable drillable guide shoe and float collar and float plugs.
- .9 Pressure Testing of Annular Cementing
- .1 The capability of the annular cement placed to withstand pressure will be evaluated using a standard formation integrity test (FIT) conducted by PWGSC and/or its representative. Once the cement has set-up the Contractor will drill below the shoe a sufficient distance to expose new formation (0.3 m to 1 m or 1 ft to 3 ft). "Sufficient distance" will be dictated by PWGSC and/or its representative in the field.
 - .2 The target fracture pressure (and measure of cement job quality) at the shoe will be calculated by the vertical depth to the casing shoe in ft multiplied by 0.75 psi/ft⁽¹⁾; however, a fracture pressure that equals or exceeds the vertical depth in feet multiplied by 0.68 psi/ft will be accepted.
 - .3 Where possible, the FIT will be conducted with clean water in the casing and the fracture pressure will be calculated as the hydrostatic pressure at the casing shoe plus any additional pressure applied and measured at surface.
 - .4 Where weighted drilling mud is used for the FIT, contractor shall circulate the drilling mud to condition it to a constant density ($\pm 3\%$ for 10 density measurements taken over one complete circulation).
- .10 Drilling of Final Hole Section and Setting Well Screens
- .1 Drilling out of the 16 inch casing shoe and into the Middle Aquifer will be conducted under a circulating drilling fluid density filling all exposed inside tubulars up to surface and throughout the surface mud tank system at a minimum average drilling fluid density of 1240 kg/m³ to 1250 kg/m³, which is the mud density required to control groundwater flow from the Middle Aquifer during the drilling of RW3.
 - .2 The actual density used may be changed in the field based on instructions from PWGSC and/or its representative.
 - .3 Contractor will have sufficient materials and equipment on Site and will have arranged a two or three shifts per day crew schedule to allow the drilling of the final hole section through the Middle Aquifer, the cementing of

¹ Note the value of 0.75 psi/ft is compromise based on the highest value provided in Golder, 2010 of 0.8 psi and a lower value of 0.68 psi based on calculation by Hubert and Willis (see Golder, 2010 for details)

- casing and the installation of well screens in one essentially un-interrupted operation.
- .4 Materials to allow rebuilding the mud system to five times its circulating volume will be maintained on Site during this final phase.
 - .5 The continuous working period would include any standby time while well screens are specified and constructed and during which time drilling fluid would be circulated and maintained until the well screens are finally set and the well developed.
 - .6 The screen slot size for the aquifer well screens and for the pressure relief screen will be provided to the Contractor by PWGSC and/or its representative once the aquifer has been drilled and cuttings collected and analyzed.
 - .7 The proposed well configuration is shown on Figure 7.
- .11 Well Screen Assembly
- .1 A nominal 10 inch telescopic well screen assembly will be used.
 - .2 A minimum of 1.2 m (4 ft) of telescopic well screen will be set and exposed in the Lower Aquifer; or, approximately 80% of the aquifer thickness encountered, whichever is less.
 - .3 The riser for the telescopic well screen assembly will extend 4.6 m (15 ft) into the nominal 12 inch casing and will have an appropriate diameter pressure relief well screen section 1.5 m (5 ft) long incorporated into the riser section that will be entirely located within the nominal 12 inch casing.
 - .4 An appropriately sized shale trap will be provided immediately above the pressure relief well screen.
 - .5 The general well screen assembly design and screen slot size for the aquifer well screens and for the pressure relief screen will be provided by PWGSC and/or its representative, after consultation with the driller, once the aquifer has been drilled and cuttings collected and analyzed.
- .12 Well Completion
- .1 The last and smallest surface casing of the well (proposed nominal 12 inch) will be completed with a full sized flange. If open channels are selected for transferring water from the well to the storage tanks, or to the settling tanks, the finished elevation of the well will be such that flow from the well can gravity drain to storage tanks and settling tanks. A gate valved (note butterfly valves will not be accepted) nominal 12 inch T, fitted with two ¼ inch NPT threaded ports for attaching pressure gauges to be provided by Golder and as shown in Figure 8.

- .2 Discharge from one of the valves will be capable of being directed without spillage to the storage tanks or being diverted, without spillage, to the settling tank system.
- .13 Well Screen Development
 - .1 The drilling mud will either be pumped from the well or may be cut by introducing water from surface into the well until the well starts flowing.
 - .2 All drilling fluid and drilling fluid contaminated water will be collected in the on-Site storage tanks for disposal.
 - .3 If the storage tanks are filled before all drilling fluid or drilling fluid contaminated water has been flushed from the well, then flow will be stopped until the drilling fluid in the tanks has been properly disposed to a licensed disposal company and the process repeated until clear and clean water is flowing from the well.
 - .4 The well should be developed using air lifting. Contractor should allow for a minimum of 1 day to develop the well screens.
- .14 Lead Time Required
 - .1 Contractor to indicate the lead time required to source and deliver equipment required to start installing RW4 and then to drill and work continuously until its completion.
 - .2 Contractor to indicate which item in the delivery of RW4 requires the greatest lead time.
 - .3 Contractor to indicate the lead time required to source and install the locking packer mechanism for the well screen assembly.
- .3 RW4 – Option 2 – Completion in Lower Aquifer
 - .1 Summary
 - .1 The proposed Project includes the drilling of one relatively large diameter relief well (RW4) i.e., water well designed to allow high flow pumping, located between 4 m(13.1 ft) to 5 m(16.4 ft) from the CRW. The well will be drilled by experienced and competent crews using mud rotary methods either using standard water well equipment and materials or approved equivalent oil field drilling equipment and materials. Regardless of the method proposed, all work will be conducted under the supervision of a Qualified Well Driller in BC and the designated persons shall individually have a minimum of 15 years of well drilling experience. Where well pump installation or removal is required, only a Qualified Well Pump Installer, as specified under the BC Groundwater Protection Regulation, will perform this work.

- .2 The current proposed relief well design provides for three concentric casings set at successively greater depths, as shown in Figure 9. Golder’s assessment (2010) provided details on how the current well design and casing set depths were selected. The relief well will be nominal 12 inch in diameter (production casing size), with the production casing cut back to a liner with its top situated at approximately 46 m below grade (mbg) (150 ft). At the present time, post project flow rates of 125 L/s to 225 L/s are anticipated.
- .3 Contractor will provide a detailed cost estimate to probe to 40ft bg prior to drilling. Method to be proposed by the driller but it should result in a 6 inch hole having been drilled the entire depth required.
- .4 The proposed relief well design is shown on Figure 9. Contractor will provide an detailed cost estimate to complete a nominal 12 inch well (referred to as “Nominal Well Size” on Figure 9 with all materials, equipment and appurtenances required as shown on Figure 9 and with particular methods, and specialized appurtenances detailed below. Contractor will provide in the bid package specifications of all materials and parts that are proposed for well completion.
- .5 The relief well design, which may be modified slightly in the field based on where formations are encountered during drilling, is as follows:

Table 3: RW4 Well Design (Option 2)

<i>Open Hole Diameter (nominal inches)</i>	<i>Casing Centralized and Cemented in Open Hole (nominal inches)</i>	<i>To Depth (ft)</i>	<i>Comments</i>
24	20	120	<i>Pressure cemented in place.</i>
20	16	175	<i>Pressure cemented in place. Drilled through the middle Aquifer 140 to 160ft bg. Shoe set in Lower Aquitard at 175 ft bg. Lowest 5 ft inside casing to be rigid (see below for definition).</i>
16	12	195	<i>16 inch hole drilled and casing set with weighted mud. Casing pressure cemented in place and overlapping 16 inch casing to 150 ft bg. Outside 5 ft of casing adjacent lower 5ft of 16 inch casing to be ridged</i>
10	<i>10 telescopic well screen assembly</i>	<i>240 (estimated)</i>	<i>Section drilled and cased under mud. Top of screen assembly riser to be at 175 ft bg completed with double reducing AGE M Packer set as an overshot. Casing removed.</i>

- .2 Work Standard and Material Quality
 - .1 All work will be to a professional standard as expected in the water well and oilfield drilling industry.
 - .2 All materials designated for well construction are to be new and are to be; either of,
 - .1 Typical BC water well specification with minimum permanent steel casing thicknesses to be ¼ inch (6.35 mm) for casing sizes less than nominal 20 inch and 5/16 inch (7.93 mm) for casings of 20 inch or above; or,
 - .2 Approved equivalent dimension, appropriately sized API 5L threaded casing as specified by Michigan Department of Environmental Quality: Well Construction Unit.
 - .3 All casings will be plumb and without doglegs.
- .3 Equipment Provision
 - .1 A complete equipment and equipment specification list will be provided by the Contractor with the bid package.
 - .2 Contractor will provide equipment that can readily drill the specified hole size to the required depths and install the casing as specified with all required tubular and support equipment to complete the job without recourse to down time, other than to effect general maintenance or routine repairs.
 - .3 A complete mud mixing and circulation system complete with adequately sized mud tanks, shale shaker, and cyclones will be provided. Mud will be mixed via a mechanical method using make-up water that has been appropriately tested and pH balanced.
 - .4 Contractor will provide mud pumps appropriate for the circulating system that they have proposed (normal or reverse circulation) that are capable of maintaining up-hole velocities at minimum of 0.63 m/sec.
 - .5 Excavated mud pits will not be allowed at the Site
 - .6 A minimum of 45 m³ of isolation storage tanks will be maintained on Site close to wells that are actively being worked on to allow batch storage of drilling mud, or cement contaminated water. The tankage can be rock boxes or the like. Unless approved by PWGSC or their representative, the maximum height of the tanks above grade will be 1.5 m. The specified volume is approximately four times the calculated volumes of any of the hole / casing sections. The storage requirement is over and above any volume needed for the mud circulation system and should be maintained available (empty) whenever the hole being actively drilled or worked on is filled with anything other than clean water.

- .7 Contractor will provide appropriate valving and piping so that drilling fluid can be diverted from the borehole/mud system to the storage tanks while drilling. Efficacy of the valving and piping will be demonstrated with water prior to mudding-up.
- .4 Drilling Method for Relief Well (RW)
 - .1 All hole sections and setting of casings and well screens will be drilled and completed with the mud rotary methods and with equipment that ensures an uphole velocity for the circulation method specified by the driller (either normal circulation or reverse circulation) of 0.63 m/sec at all stages of the work. All casings will be cemented using a single stage pressure cement job. Following sufficient set-up time, each annular cement seal will be evaluated using Cement Bond Logging (CBL) and Formation Integrity Testing (FIT).
 - .2 To ensure that the mud system is properly maintained the Contractor will engage a qualified mud “engineer” who will be on the project throughout the mud drilling and until the relief well annulus is completed. A CV for the proposed mud “engineer” or engineers must be provided. The mud engineer will be able to show a minimum 10 years of experience designing and maintaining drilling fluid circulating systems.
 - .3 For the lower two hole sections, the Contractor will provide and install a suitably sized annular blow out preventer. The blow out preventer will be tested and its testing and operation proven to PWGSC and/or their representatives at the start of each hole section and every five days thereafter.
 - .4 Drilling fluid will be maintained through the use of suitable additives and will have a marsh funnel viscosity of between 35 and 85 seconds which will be controlled as directed by PWGSC and/or their representatives in consultation with the mud engineer. Attention will be paid to mud characteristics such that clogging of the aquifer is minimized. Additionally, the density of the drilling fluid will be maintained at densities specified by PWGSC and/or their representatives. In general terms, the following densities are expected.
 - .1 0 to 36.6 m (120 ft) – Fluid type and density selected by driller for maximum efficiency (expected to be water plus entrained fines).
 - .2 36.6 m(120 ft) –to 56.4 m(185 ft) – mudding up to required density of approximately 1150 kg/m³ before drilling into the middle Aquifer.
 - .3 56.4 m(185 ft) to Total depth – bringing mud density to 1650 kg/m³ before drilling out of the nominal 16 inch shoe at approximately 53.3 m(175 ft).

- .5 Centralized Casing
 - .1 All casing will be centralized in the holes in which they are being cemented using strap on bridle centralizers of sufficient strength and stiffness to hold the casing away from the borehole sides and to be approved by PWGSC and/or its representative prior to use.
- .6 Annular Cement Seal
 - .1 The contractor will install an annular cement seal, using pressure cementing methods, around each casing with the intent that, when set-up, it will be free of voids or channels (as evaluated with a cement bond log - CBL) and which will be able to withstand a pressure at its exposed end, adjacent to the casing shoe, greater than the expected maximum fracture pressure for the formation at the shoe of the casing.
- .7 Cement Type
 - .1 Cement will be Oilwell Class G with suitable additives such as super-plasticizers (fluid loss agents) and additives to ensure that the viscosity of the cement remains acceptably low. Finalization of the cement design will be provided to the contractor prior to the commencement of the drilling program. The cement will be designed to achieve a minimum strength of 3 MPa within 24 hours. .
- .8 Specifications for Placing Annular Cement Seals
 - .1 When cementing the annular space around casings, the minimum acceptable up-hole velocity for the cement in the annular space will be 0.75 m/sec (this equates to a pumping rate of approximately 68 L/s for 20 inch casing in 24 inch hole). Contractor will provide equipment capable of this rate of pumping.
 - .2 When cementing, and for cementing casing in place, the Contractor will employ a drillable, valved, stab-in or screw-in float shoe (as employed in oilwell completions or water well completions in the Australian Great Artesian Basin), to perform a pressure cement job and by which means cement will only be in contact with the inside of the casing below the float and will be pumped to the float using specified cement pumps via the drilling string. Once adequate cement returns that are consistently of the same density as the cement being pumped into the well, are seen at surface and as directed by PWGSC, contractor will remove drill pipe from the float shoe, circulate out any cement or cement contaminated fluids above the float shoe and store that liquid until it is assessed that it can be released to the settling tanks or is trucked to an approved disposal facility. The contractor will then stand-by as the annular cement sets-up. A minimum strength of 3 MPa is required before further drilling proceeds. Driller must

maintain the casing full with water or drilling mud and must keep sufficient downward force on the casing to ensure that it does not float up while the cement is still liquid. The downward force may also be provided by weighted drilling fluid in the casing of the same density as the annular cement.

- .9 Overlap Cementing for Nominal 12 inch Casing
 - .1 As noted in Table 3 and as shown on Figure 9, the nominal 12 inch casing will be pressure cemented in an overlap manner from just above the top of the Lower Aquifer (~60 m/ 195 ft bg) to approximately the midpoint of the middle Aquifer (~46 m/ 150 ft bg). The casing above the cement job will be cut at about 46 m (150 ft bg) and removed to provide a larger pump chamber; or, contractor will detail a method to set the casing over the required interval without returning it to surface. The annular facing sides of the overlapping casing section between the lowest 5 ft of the nominal 16 inch casing and the adjacent cemented in place 12 inch casing will be ridged to provide a good bond for the cement between the two casings. Alternatively the outside upsets on threaded casings will be accepted.
- .10 Requirements for drilling into the Lower Aquifer
 - .1 Contractor will have sufficient materials and equipment on Site and will have arranged a 24 hour (round the clock) crew and equipment schedule to allow the drilling out of the nominal 16 inch shoe through the Lower Aquitard and into the Lower Aquifer, the cementing of casing and the installation of well screens in one essentially un-interrupted operation.
 - .2 Materials to allow rebuilding the mud system to five times its circulating volume will be maintained on Site during this final phase.
 - .3 The mandated continuous working period would include any standby time while cement is setting-up or well screens are being specified and constructed and during which time drilling fluid would be circulated and maintained at the density specified by PWGSC or their representative until the well screens are finally set and the well developed.
 - .4 Drilling out of the 16 inch casing shoe and the 12 inch casing shoe into the Lower Aquifer will be conducted under a circulating drilling fluid density filling all exposed inside tubulars up to surface and throughout the surface mud tank system at a minimum average drilling fluid density of 1,650 kg/m³ which is the maximum drilling mud density provided in Golder 2010, plus an additional density to allow for hole swabbing when tubulars are pulled from the hole.

- .5 The actual density used may be changed in the field based on instructions from PWGSC and/or its representative.
- .11 Pressure Testing of Annular Cementing
 - .1 Following appropriate time for setting-up, all annular cement will be evaluated using cement bond logging (CBL) to assess the general quality of cementing around the annulus and a standard formation integrity test (FIT) conducted by PWGSC and/or its representative with assistance from the contractor. Once the cement has set-up, the Contractor will drill below the shoe a sufficient distance to expose new formation (0.3 m to 1 m or 1 ft to 3 ft) and the FIT will then be conducted. "Sufficient distance" will be dictated by PWGSC and/or its representative in the field.
 - .2 The target fracture pressure (and measure of cement job quality) at the shoe will be calculated by the vertical depth to the casing shoe in ft multiplied by 0.75 psi/ft²; however, a fracture pressure that equals or exceeds the vertical depth in feet multiplied by 0.68 psi/ft will be accepted. The responsibility of the contractor will be to ensure an annular cement job that is free of channels as evaluated by Cement Bond Logging. If the results of the Cement Bond Logging are interpreted to be inadequate, and dependent on other factors (the length of acceptable annular cementing above the shoe, the results of the FIT, the assessed general quality of the cement job, the ability to attempt a secondary cement job), then the relief well may be abandoned and re-drilled. Contractor is not expected to bear the responsibility of an adequate strength formation being available.
 - .3 Where possible, and where it is assessed to be safe by PWGSC and or its representative, the FIT will be conducted with clean water in the casing and the fracture pressure will be calculated as the hydrostatic pressure at the casing shoe resulting from the column of fluid above the point of interest, plus any additional pressure applied and measured at surface.
 - .4 Where weighted drilling mud is used for the FIT, contractor shall circulate the drilling mud to condition it and remove drilling cuttings until a constant density ($\pm 3\%$ for 10 density measurements spaced evenly over one complete circulation) is achieved.
- .12 Well Screen Assembly
 - .1 A nominal 10 inch telescopic well screen assembly will be used completed with a double reducing and latched

² Note the value of 0.75 psi/ft is compromise based on the highest value provided in Golder, 2010 of 0.8 psi and a lower value of 0.68 psi based on calculation by Hubert and Willis (see Golder, 2010 for details)

overshot m type packer, as used in the Australian Great Artesian Basin or equivalent oilfield system.

- .2 For the purposes of bidding, a minimum of 4.6 m (15 ft) of telescopic well screen will be set and exposed in the Lower Aquifer completed with a bail bottom; or, approximately 80% of the aquifer thickness encountered, whichever is less. The slot size of the well screen will be specified by PWGSC or its representative based on formation materials encountered in the Lower Aquifer.
- .3 The riser for the telescopic well screen assembly will extend 4.6 m (15 ft) into the nominal 12 inch casing and will have a pressure relief well screen section 1.5 m(5 ft) long, of the same diameter as the riser, incorporated into the riser section. The pressure relief well screen will be entirely located within the nominal 12 inch casing.
- .4 An appropriately sized double reducing K packer, wiper plug or oilfield equivalent will be installed immediately above the pressure relief well screen that will be tightly fitted to the well screen assembly and provides an interference fit with the adjacent casing.
- .5 The final well screen assembly design and screen slot size for the aquifer well screens and for the pressure relief screen will be provided by PWGSC and/or its representative, after consultation with the driller, once the aquifer has been drilled and cuttings collected and analyzed.

.13 Well Completion

- .1 The last and smallest surface casing of the well (proposed nominal 16 inch) will be completed with a full sized flange. If open channels are selected for transferring water from the well to the storage tanks, or to the settling tanks, the finished elevation of the well will be such that flow from the well can gravity drain to storage tanks and settling tanks. A gate valved (note butterfly valves will not be accepted) nominal 12 inch T, fitted with two ¼ inch NPT threaded ports with threaded plugs for attaching pressure gauges will be provided as shown in Figure 8. PWGSC will provide the gauges. The T fitting and flanges will be constructed to the same standards for welding, workmanship and material as specified for the project and as specified in ANSI/AWWA 100-06 Standard for Water Wells (December 2007) and should be capable of safely withstanding 500 psi.
- .2 Discharge from one of the valves will be capable of being directed, essentially without spillage, to the storage isolation tanks or being diverted, essentially without spillage, to the settling pond.

- .14 Well Screen Development
 - .1 The drilling mud will either be pumped from the well or may be cut by introducing water from surface into the well until the well starts flowing.
 - .2 All drilling fluid and drilling fluid contaminated water will be collected in the on-Site storage tanks for disposal.
 - .3 If the storage tanks are filled before all drilling fluid or drilling fluid contaminated water has been flushed from the well, then flow will be stopped until the drilling fluid in the tanks has been properly disposed to a licensed disposal company and the process repeated until clear and clean water is flowing from the well.
 - .4 The well should be developed using air lifting. Contractor should allow for a minimum of 1 day to develop the well screens.
- .15 Lead Time Required
 - .1 Contractor to indicate the lead time required to source and deliver equipment required to start installing RW4 and then to drill and work continuously until its completion.
 - .2 Contractor to indicate which item in the delivery of RW4 requires the greatest lead time.
 - .3 Contractor to indicate the lead time required to source and install the locking packer mechanism for the well screen assembly.

1.19 Construction Facilities

- .1 Summary
 - .1 The purpose of this work will be to provide office, storage space and facilities for use during construction, testing and killing activities.
- .2 Installation and Removal
 - .1 Prepare Site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
 - .2 Identify areas which have to be gravelled to prevent tracking of mud.
 - .3 Indicate use of supplemental or other staging area.
 - .4 Provide construction facilities in order to execute work expeditiously.
 - .5 Remove from Site all such work after use.
- .3 Hoisting

- .1 Provide, operate and maintain hoists and cranes required for moving of materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists and cranes to be operated by qualified operator.
- .4 Site Storage/Loading
 - .1 Define work and operations of employees by Contract Documents. Do not unreasonably encumber premises with surplus materials.
 - .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.
- .5 Offices
 - .1 Provide office heated and cooled to 18 to 24 °C, lighted to 750 lx and ventilated, of sufficient size to accommodate Site meetings and furnished with drawing laydown table.
 - .2 Provide marked and fully stocked first-aid case in a readily available location.
 - .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.
 - .4 The Contractor shall provide a suitable working office with lock-up for the sole use of the PWGSC or PWGSC's Representative. The office shall be weatherproof, reasonably soundproof, and have ample window area and ventilation.
 - .1 Provide temporary office for PWGSC Representative.
 - .2 The office shall be a minimum of 12 m² with floor 0.3 m above grade, complete with 4 50% opening windows and one lockable door.
 - .3 Insulate building and provide heating system to maintain 22 °C inside temperature at -20 °C outside temperature.
 - .4 Finish inside walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish floor with 19 mm thick plywood.
 - .5 Install electrical lighting system to provide min 750 lx using surface mounted, shielded commercial fixtures with 10 % upward light component.
 - .6 Provide private washroom facilities adjacent to office complete with flush or chemical type toilet, and maintain supply of paper towels and toilet tissue.
 - .7 Equip office with 1 lockable desk and chair (office swivel type), 1 layout table, 2 additional chairs, 1 plan case, 1 – 2 drawer filing cabinet, 2 – shelving bookcases, 1 – fire extinguisher (5 kg), 1 – activated phone, access to toilet on Site and 1 first aid kit (#1 Unit Kit).
 - .8 The Contractor shall regularly collect refuse and keep the office clean and properly maintained with heat and light.

- .9 The office and contents shall be for the use of the PWGSC or PWGSC Representative for the duration of the Work and may, if necessary, be used concurrently with other inspection agencies.
- .6 Equipment, Tool, and Materials Storage
 - .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
 - .2 Locate materials not required to be stored in weatherproof sheds on Site in manner to cause least interference with work activities.
- .7 Water Supply
 - .1 Provide for potable water
- .8 Fire Protection
 - .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
 - .2 Burning rubbish and construction waste materials is not permitted on Site.
- .9 Sanitary Facilities
 - .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
 - .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .10 Clean-Up
 - .1 Remove construction debris, waste materials, packaging material from work Site daily.
 - .2 Clean dirt or mud tracked onto paved or surfaced roadways.
 - .3 Store materials resulting from demolition activities that are salvageable.
 - .4 Stack stored new or salvaged material not in construction facilities.
- 1.20 Temporary Site Access and Parking**
 - .1 Summary
 - .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, materials, and other incidentals required to design, mobilize, install, operate and maintain temporary Site access and parking during completion of the Work.
 - .2 Installation and Removal
 - .1 Identify areas which have to be gravelled to prevent tracking of mud.
 - .2 Provide construction facilities in order to execute work expeditiously.

- .3 Remove from Site all such work after use.
- .3 Site Parking
 - .1 Parking will be permitted on Site provided it does not disrupt performance of Work.
 - .2 Provide and maintain adequate access to project Site.
- .4 Protection and Maintenance of Traffic
 - .1 Provide all access and temporary relocated roads as necessary to maintain traffic.
 - .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by PWGSC Representative.
 - .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.
 - .4 Protect travelling public from damage to person and property.
 - .5 Contractor's traffic on roads selected for hauling material to and from Site to interfere as little as possible with public traffic.
 - .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
 - .7 Construct all access and haul roads necessary for the Work.
 - .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
 - .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
 - .10 Dust control: adequate to ensure safe operation at all times.
 - .11 Location, grade, width, and alignment of construction and hauling roads: subject to acceptance by PWGSC Representative.
 - .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
 - .13 Provide snow removal, if required, during period of Work.
 - .14 Remove, upon completion of work, haul roads designated by PWGSC Representative.
- .5 Access to Site
 - .1 Provide and maintain all access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.
- .6 Public Traffic Flow
 - .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

.7 Fire Routes

- .1 Maintain all access to property including overhead clearances for use by emergency response vehicles.

1.21 Project Signage

.1 Summary

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, materials, and other incidentals required to design, mobilize, install, operate and maintain project signage during completion of the Work.

.2 Construction Signage

- .1 Provide and erect project sign, within three weeks of signing Contract, in a location designated by PWGSC Representative.
- .2 Construction sign 1200 mm x 2400 mm, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
- .3 Indicate on sign, name of PWGSC and Contractor.
- .4 No other signs or advertisements, other than warning signs, are permitted on Site.
- .5 Direct requests for approval to erect Consultant/Contractor signboard to PWGSC Representative. For consideration general appearance of Consultant/Contractor signboard must conform to project identification Site sign. Wording in both official languages.
- .6 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .7 Maintain approved signs and notices in good condition for duration of project, and dispose of off Site on completion of project or earlier if directed by PWGSC Representative.
- .8 Post adequate signage along the perimeter of the Work area to notify pedestrians and vehicle traffic of the on-Site activities for the duration of the work. The Signage must include, as a minimum, statements of a similar nature to the following:
 - .1 Authorized Personnel Only. Hard hats and Steel toe boots are mandatory.
 - .2 All visitors report to Administration Building.
 - .3 Do Not Enter – Open Excavation.
 - .4 Smoking only in designated areas as agreed upon by PWGSC.

1.22 Infrastructure Removal

.1 Summary

- .1 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, supervision, materials, quality control, and other incidentals required to

remove or demolish existing structures as required following the successful construction of the relief well.

.2 Items the Contractor will be responsible for include but are not limited to:

.1 Closure and removal of the settling tank system after use.

.2 Definitions

.1 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.2 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.3 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.4 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

.5 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.6 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

.3 Reinstatement

.1 Contractor will remove all equipment and structures, debris and waste resulting from the operations from the Site and, to the satisfaction of Coldstream Ranch, plough out any vehicle tracks and backfill them with topsoil.

.2 Harrow or plough any other areas where grass, vegetation has been killed and re-seed with a mixture approved by Coldstream Ranch. It is suggested that Contractor approaches Coldstream Ranch to complete this work and will provide a cost for the work.

.3 Contractor will provide a minimum cost and volume for that cost to dispose of used drilling mud and fluids and a unit rate per additional m³ of drilling mud disposed. Disposal will be to an approved waste disposal location. Proof of disposal will be required.

.4 Settling Pond Demolition

.1 Upon completion of the Project, the existing straw bale settling pond system will require demolition.

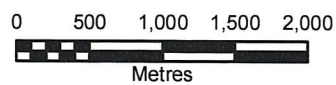
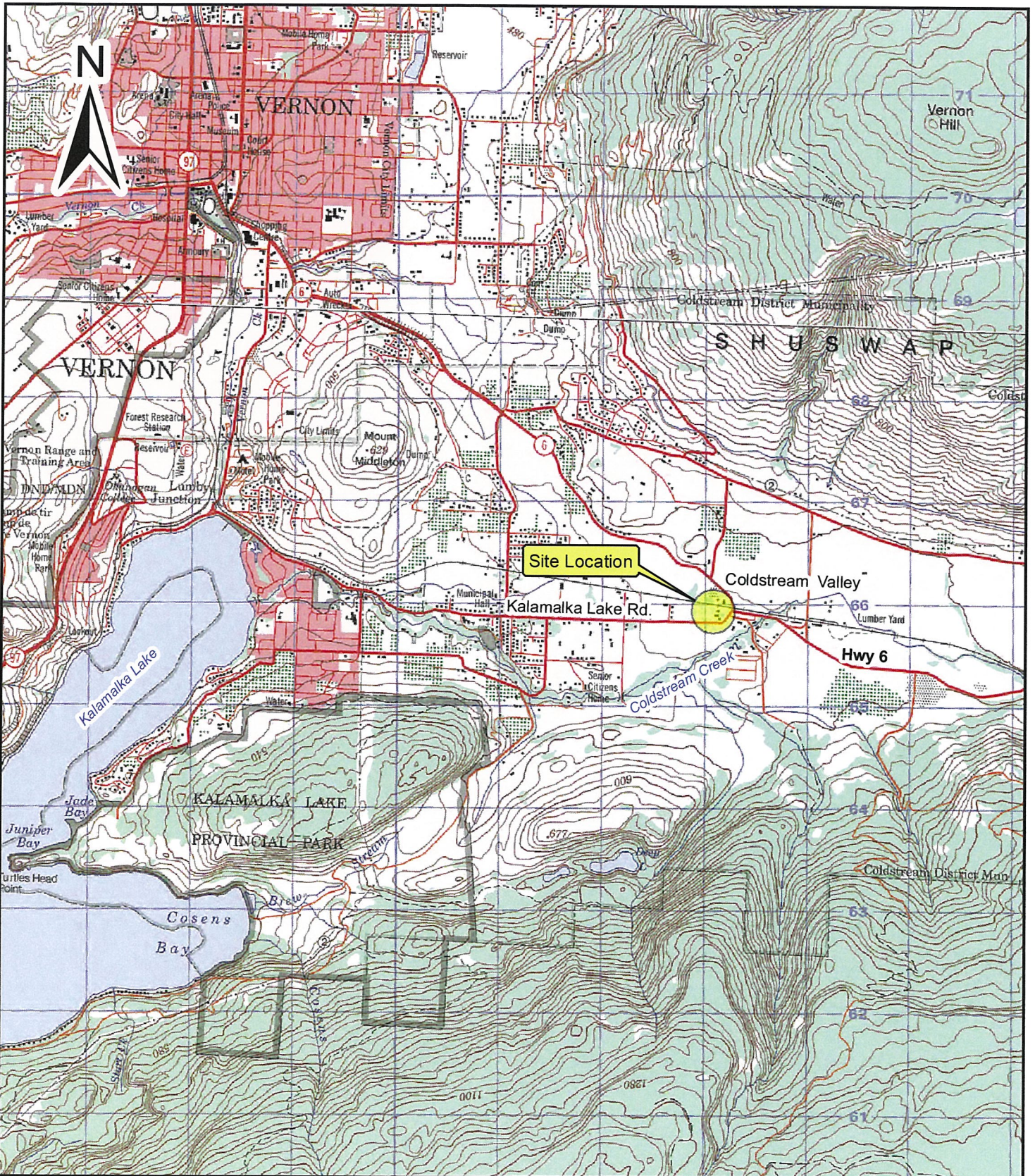
- .2 Pumping and electrical works associated with the settling basin and/or settling tank system will need to be decommissioned and removed prior to the demolition of the basin.
- .5 Removal of Concrete
 - .1 Remove existing concrete slab associated with the CRW Well House (estimated thickness between 0.15 metres and 0.3 metres), if required.
 - .2 Concrete is to be excavated and hauled to a recognized recycling facility.
 - .3 Blocks of concrete, walls and broken concrete slabs on Site will be removed from the Site and recycled.
 - .4 Concrete is to be excavated and hauled to a recognized recycling/disposal facility.
 - .5 Supply all materials, labour, supervision, and Quality Control services for the removal and recycling of concrete from the Site.
- .6 Materials Management Goals
 - .1 Prior to start of Work conduct meeting with the PWGSC Representative to review and discuss PWGSC's Materials Management Plan and goals.
 - .2 Accomplish maximum control of solid construction waste.
 - .3 Preserve environment and prevent pollution and environment damage.
- .7 Storage, Handling and Protection
 - .1 Unless specified otherwise, materials for removal become Contractor's property.
 - .2 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
 - .3 Protect structural components not removed for demolition from movement or damage and take necessary precautions to ensure that no damage to off-Site buildings is caused by Contractor's operations.
 - .4 The Contractor shall be responsible for the monitoring of construction-induced vibrations in adjoining buildings.
 - .5 Damage resulting from actions by the contractor will be repaired by the Contractor at their expense.
 - .6 Protect surface drainage, mechanical and electrical from damage and blockage.
 - .7 Separate and store materials produced during dismantling of structures in designated areas.
 - .8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-Site source separation is recommended.

- .2 Remove co-mingled materials to off-Site processing facility for separation.
- .3 Provide waybills for separated materials.
- .8 Disposal of Wastes
 - .1 Do not bury rubbish or waste materials.
 - .2 Do not dispose of waste into waterways, storm, or sanitary sewers.
 - .3 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.
 - .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .9 Scheduling
 - .1 Co-ordinate Work with other activities at Site to ensure timely and orderly progress of Work.
- .10 Quality Control
 - .1 The Contractor will be responsible for Quality Control services during infrastructure removal.
 - .2 The Contractor will be responsible for environmental monitoring during the on-Site operations as per the EMP (Section 2.3 – Protection of the Environment).
- .11 Quality Assurance
 - .1 PWGSC or PWGSC’s Representative will provide Quality Assurance services during infrastructure removal activities.
 - .2 The Quality Assurance may include reviewing construction records, reviewing quality control data and sampling for independent testing purposes.
- 1.23 Well House and Hook Up of Relief Well**
 - .1 Summary
 - .1 One relief well will be maintained on Site and will be used to provide water to replace flow previously directed to Coldstream Creek and to Skobalski Brook. Contractor will provide a day rate for a backhoe and for welding and fabrication to:
 - .1 Re-connect RW3 (or the relief well selected) to the discharge pipe to Coldstream Creek and the discharge pipe to Skobalski Brook or alternatively to install a new discharge pipe for the latter.
 - .2 A price to install a centred nominal 6 inch casing of 10 ft length in RW3 and connected and welded at surface, if required by BC Ministry of Environment. This casing is

- to provide semi-permanent flow restriction to the relief well, if required.
 - .2 Contractor to provide a permanent well house for the relief well. Contractor should recommend a well house design for final approval from PWGSC, their Representative and Coldstream Ranch. PWGSC will consider reuse of existing electrical seacan on Site as well house for RW3.
 - .3 Work under this section to be performed by the Contractor includes the supply of all labour, equipment, supervision, materials, quality control, and other incidentals required to complete the Site decommissioning.
- .2 Decommissioning Requirements
- .1 The decommissioning activities the Contractor is responsible for may include, but are not limited to:
 - .1 Decommission settling pond area.
 - .2 Decommission staging area and work area.
 - .3 Decommission construction offices and storage structures.
- .3 Quality Assurance
- .1 PWGSC or the PWGSC Representative will provide Quality Assurance services during the Site decommissioning process.
- .4 The Quality Assurance may include reviewing construction records, reviewing Quality Control data and product sampling for independent testing purposes.

END OF SECTION

N:\Graphics\2013\1493\13-1493-0005\GIS\1314930005_4000_Figure 1 Site Plan.mxd



REFERENCE

Base mapping from ETOPO 1:50,000 NTS mapsheets 82L/03 and 82L/06

PROJECT PWGSC CRW REMEDIATION
DETAILED TENDER SPECIFICATIONS
COLDSTREAM, BC

TITLE **LOCATION PLAN**


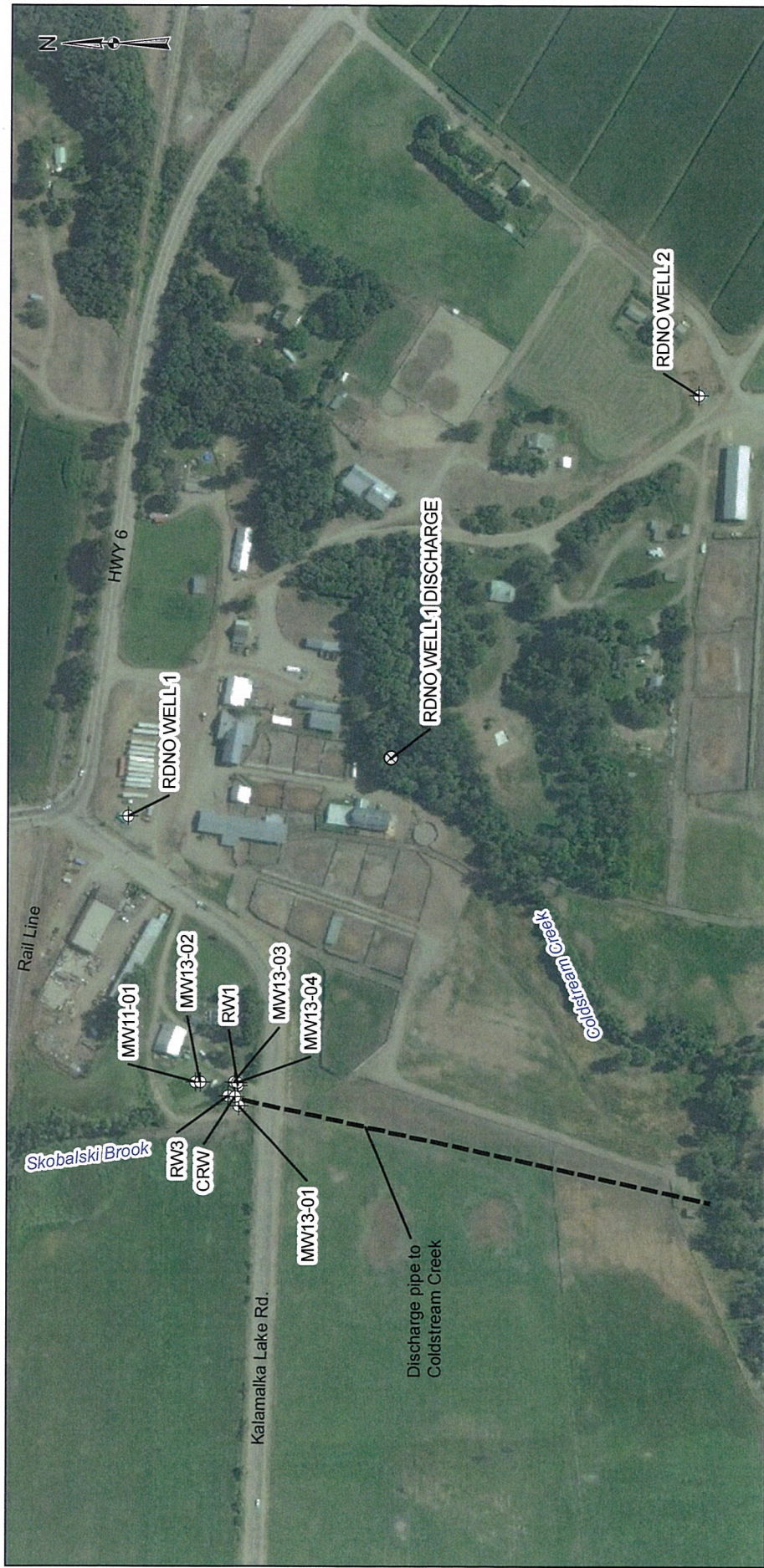
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	CHECK PVA 21 JAN. 2014		
	REVIEW JF 17 MAR. 2014		

FIGURE: 1



SCALE 1:4,000

PROJECT
 PWGSC CRW REMEDIATION
 DETAILED TENDER SPECIFICATIONS
 COLDSTREAM, BC

TITLE
 SITE PLAN

SITE PLAN



PROJECT NO. 13-1493-005		FILE NO.	
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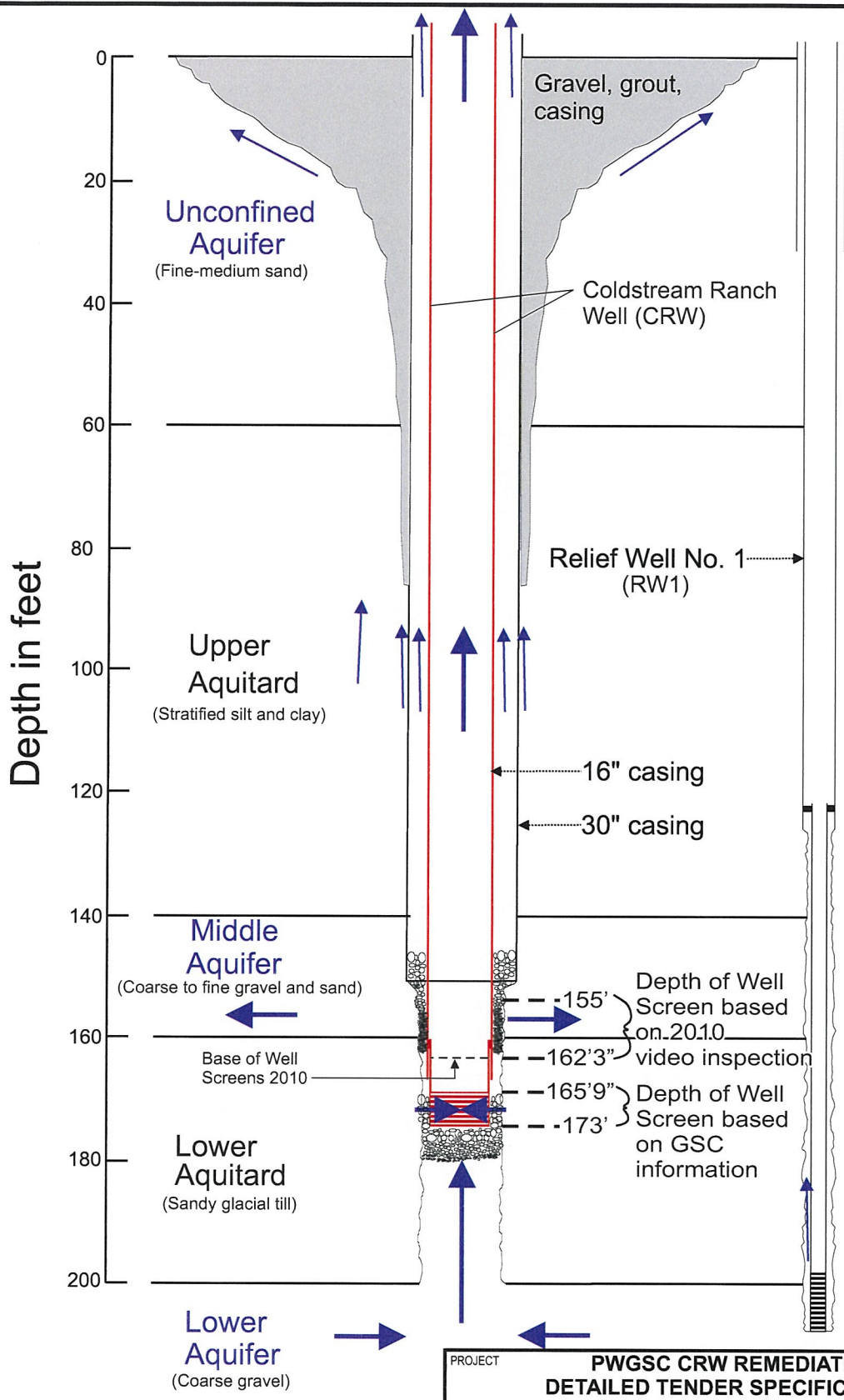
FIGURE : 2

LEGEND

-- Discharge

REFERENCE

OR THOPHOTO. Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



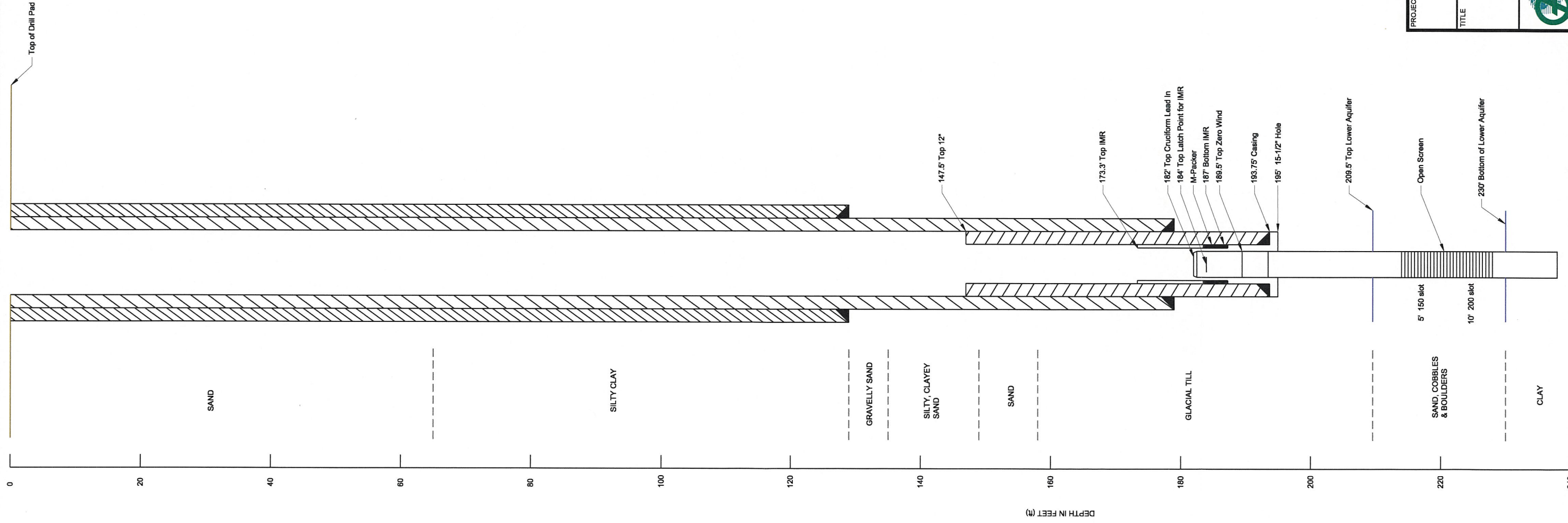
Legend
 → Inferred Direction of Groundwater Flow

PROJECT		PWGSC CRW REMEDIATION DETAILED TENDER SPECIFICATIONS COLDSTREAM, BC	
TITLE		CRW WELL COMPLETION DETAILS AND LITHOLOGY	
PROJECT No. 13-1493-0005		FILE No. PLAN	
DESIGN	NS	27-APR-12	SCALE AS SHOWN
CADD	BKL	02-MAY-12	REV.
CHECK	-	-	
REVIEW	-	-	



FIGURE 3

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NOTE: SEE WELL RECORD FOR DETAILED SOIL DESCRIPTIONS

PROJECT

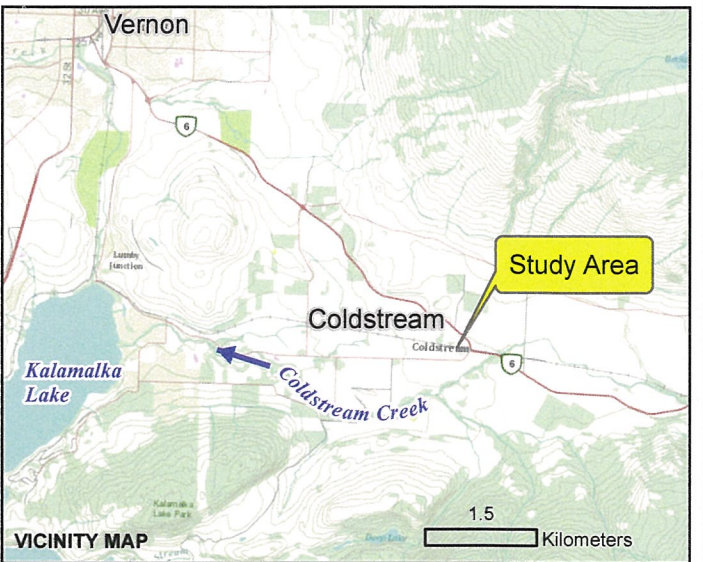
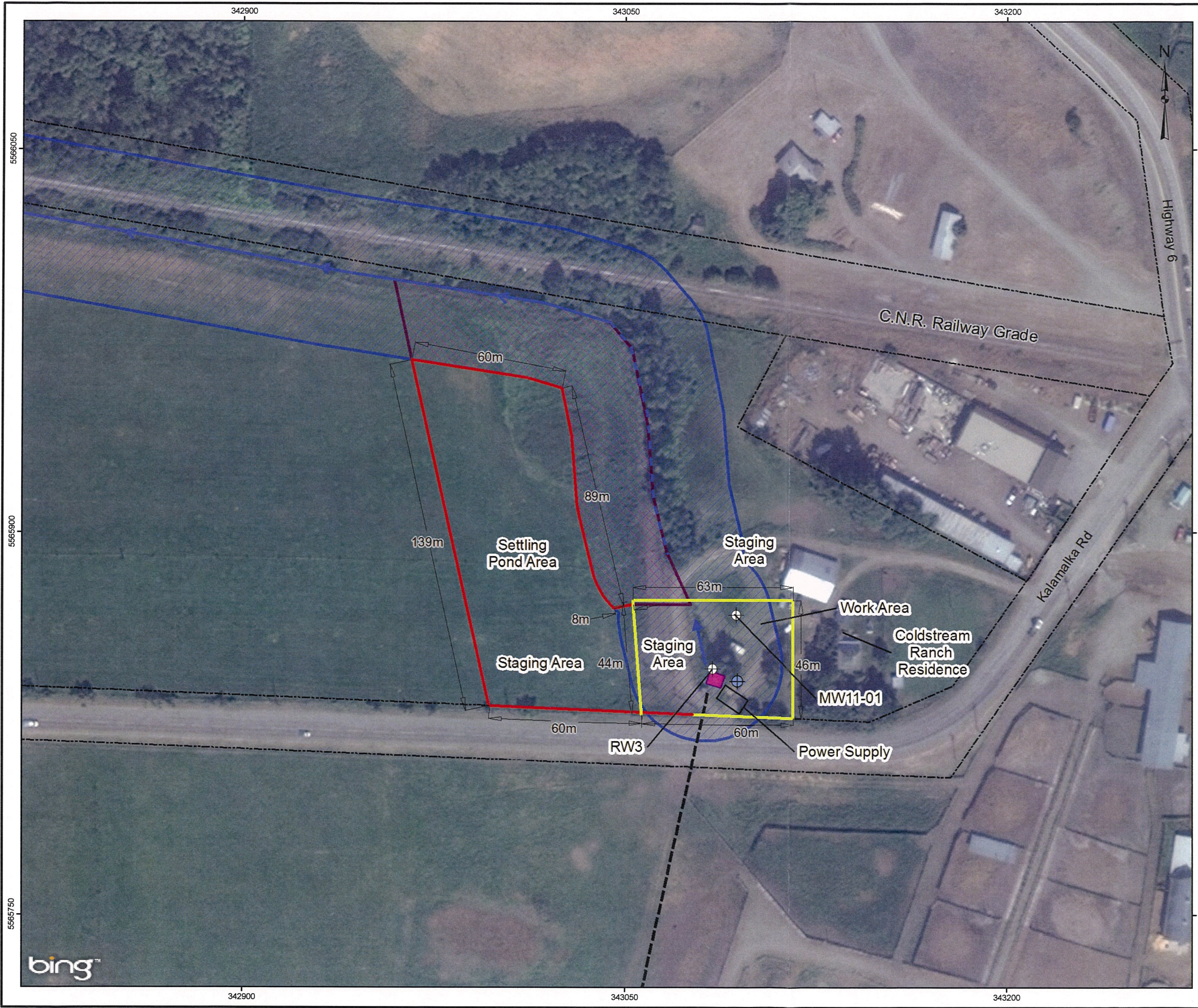
PWGSC
CRW REMEDIATION PROJECT
COLDSTREAM, BC

TITLE

RW3 WELL COMPLETION DIAGRAM

PROJECT No.	13-1493-0005	FILE No.	13-1493-0005 RW3 Diagram
DESIGN	JF	SCALE	AS SHOWN
CADD	BKL	1AUG13	
CHECK	JF	30JUN14	FIGURE
REVIEW	JF	30JUN14	4





LEGEND

- Relief well 1 (RW1)
- Coldstream Ranch Well / Well House
- Property Line (Approximate)
- Proposed Work Plan Features**
- Work Area
- Lay-Down Area (~0.8 ha)
- Environmental Buffer Zone
- Watercourse Features**
- Drainage Ditch
- Skobalski Brook
- Discharge Pipe
- 30m Watercourse Buffer

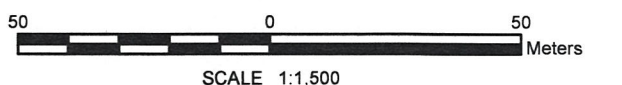
NOTES

1. Fence and building locations recorded using differentially corrected, mapping grade Global Positioning System (GPS).
2. Elevations referenced to metres above sea level (masl).
3. Skobalski Brook's location is digitized from aerial photo and approximate.

REFERENCE

1. Imagery obtained from Bing Maps for ArcGIS published by Microsoft Corporation, Redmond, WA, May 2009.
2. Vicinity map: Esri, DeLorme, NAVTEQ, TomTom, Intermap, AND, USGS, NRCAN, and the GIS User Community
3. Cadastre digitized from Site Survey Plan of Part of Parcel B, Plan B1299 DL 57, G.I ODYD.; Steven Minnie BCLS, Dated 12Feb2010.

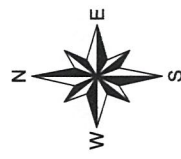
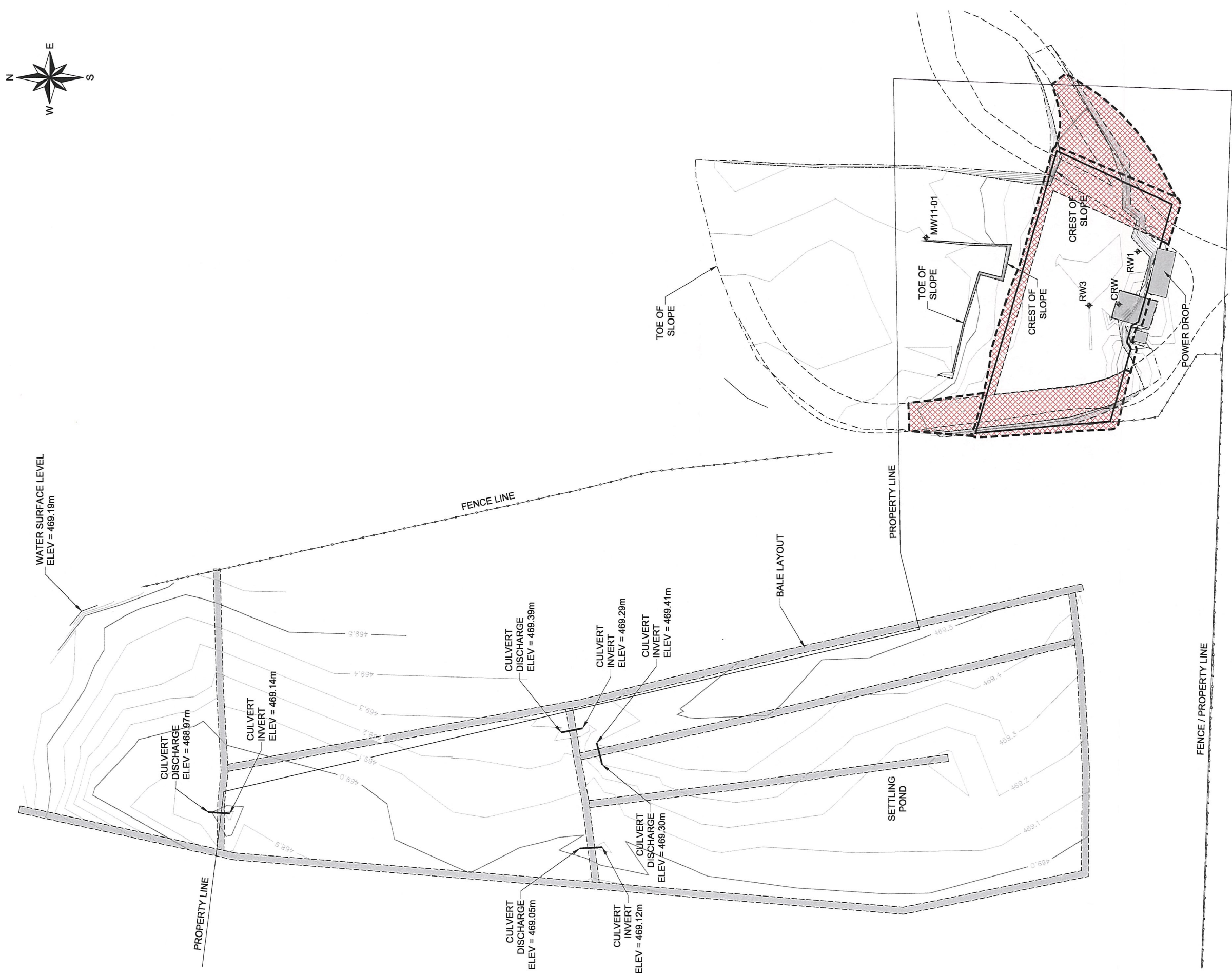
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	GIS	JG/BL 2 Jul. 2014		
	CHECK	JF 2 Jul. 2014		
	REVIEW	NS 2 Jul. 2014		
FIGURE: 5				

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- LEGEND**
- WELL
 - WELL LOCATIONS
 - DRILL PAD FOOTPRINT
 - EXISTING TOP OF DRILL PAD
 - TOP OF DRILL PAD
 - EXISTING
 - BOTTOM OF SLOPE FILL BOUNDARY

PROJECT PWGSC CRW REMEDIATION
 DETAILED TENDER SPECIFICATIONS
 COLDSTREAM, B.C.

**SETTLING POND AND
 DRILLING PAD PLAN**

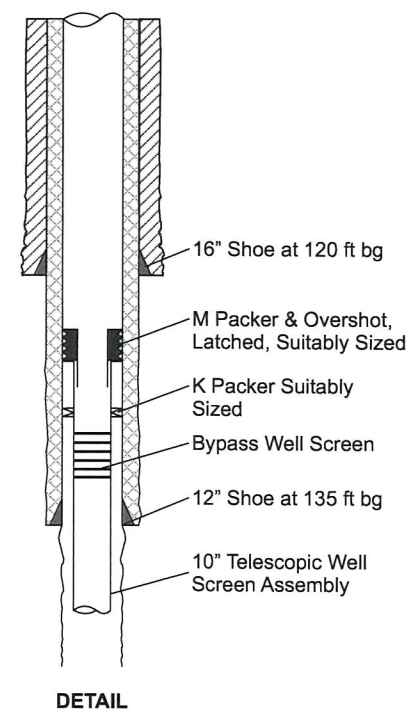
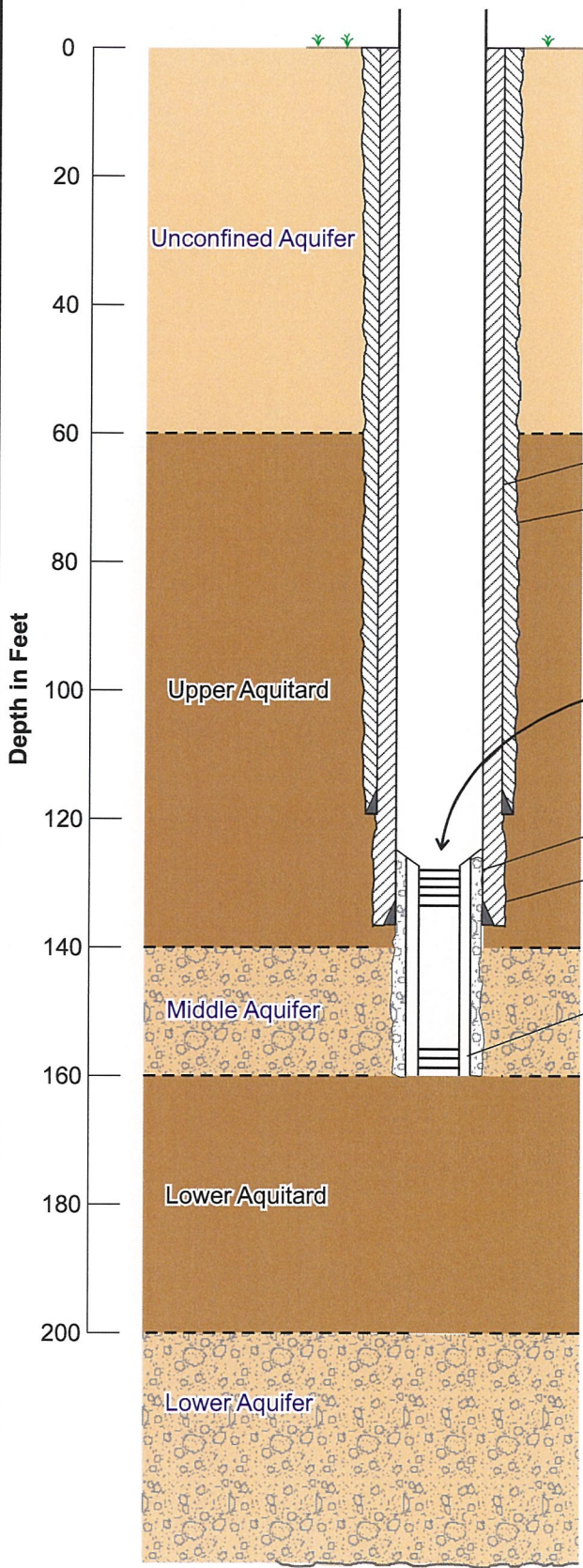
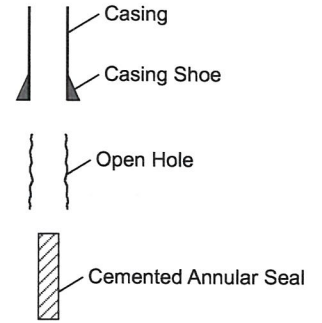


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CHECK	PVA	01-08-13	REV. 0
REVIEW	JF	01-08-13	FIGURE 6

Well Design Dimension

Nominal Well Size (inches)	12
Surface hole	20
Surface Casing	16
Production Casing (liner)	12
Telescopic Well Screen	10

LEGEND



ALL SIZES SHOWN ARE NOMINAL

PROJECT **PWGSC CRW REMEDIATION
DETAILED TENDER SPECIFICATIONS
COLDSTREAM, BC**

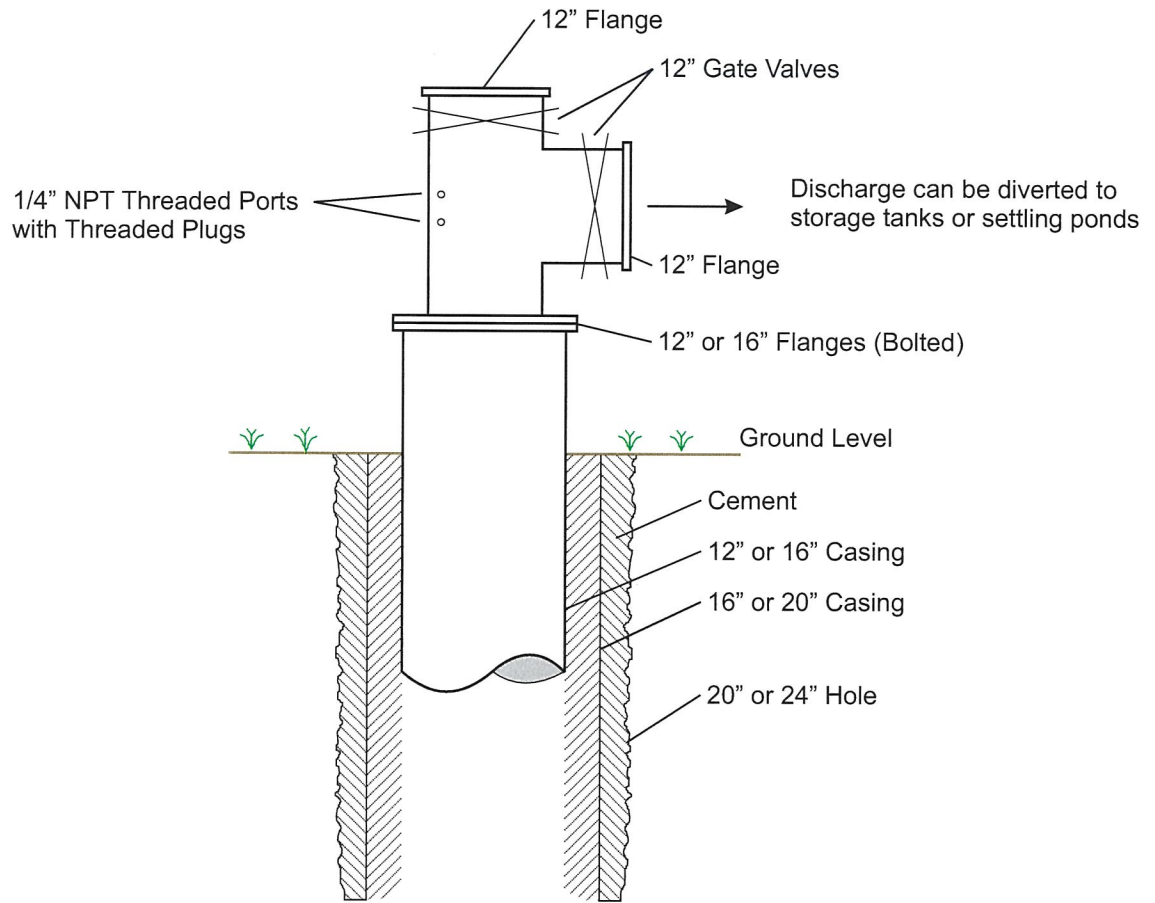
TITLE **RELIEF WELL DESIGN - OPTION 1
(NOMINAL 10 INCH SCREEN)**



PROJECT No. 13-1493-0005	FILE No. PLAN
DESIGN NS 27-APR-12	SCALE AS SHOWN REV.
CADD BKL 2-JUL-14	
CHECK JF 2-JUL-14	
REVIEW NS 2-JUL-14	


FIGURE 7

File Location: N:\Graphics\2013\1493\13-1493-0005\005\1314930005_Figure 7.cdr



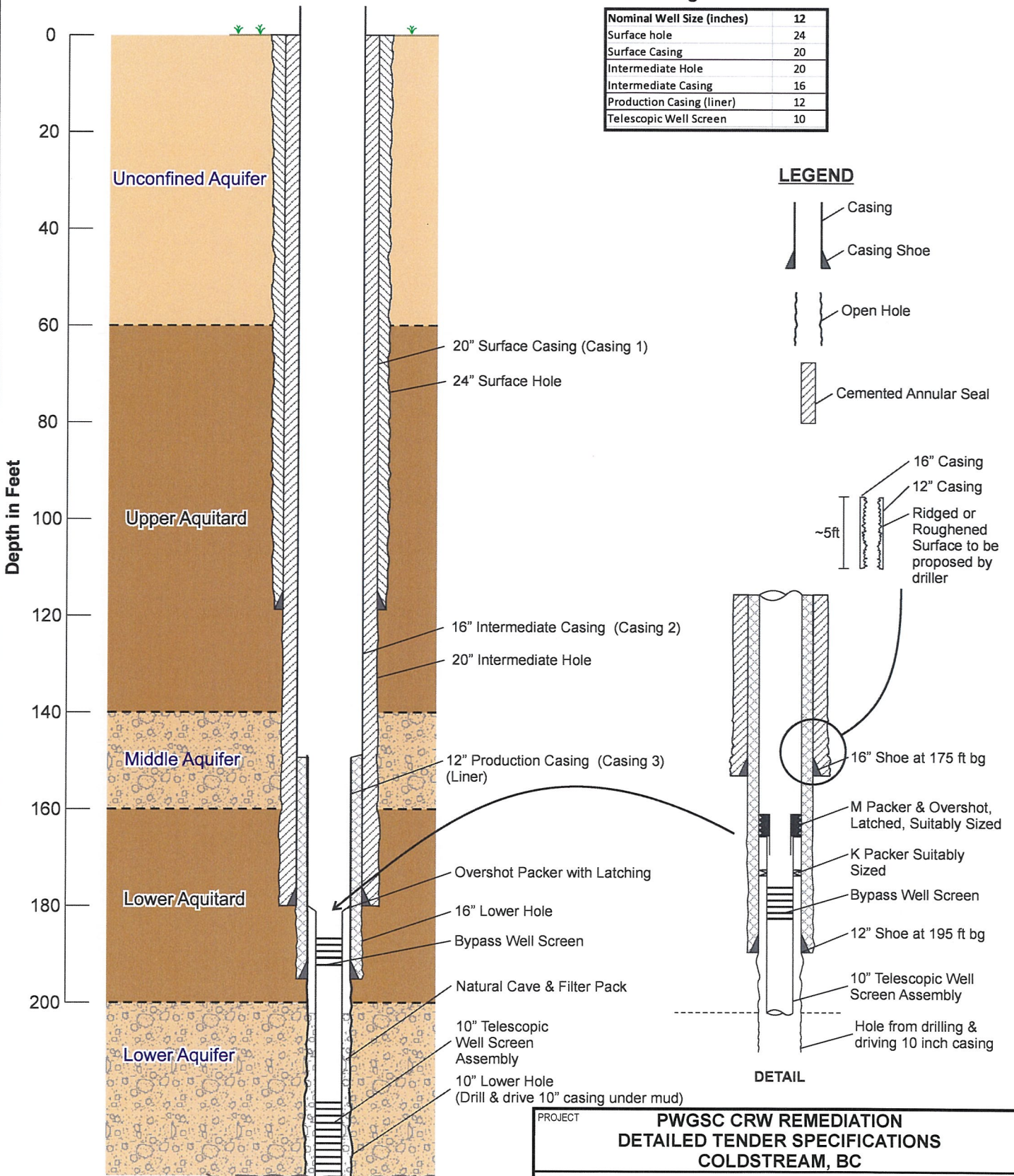
Note: All Sizes Nominal

All materials to be as, or equivalent to, ANSI/AWWA A100-06 standard for water wells.

PROJECT		PWGSC CRW REMEDIATION DETAILED TENDER SPECIFICATIONS COLDSTREAM, BC		
TITLE		SURFACE WELL VALVING		
PROJECT No. 13-1493-0005		FILE No. PLAN		
DESIGN	NS	03-MAY-12	SCALE	AS SHOWN REV.
CADD	BKL	2-JUL-14		
CHECK	JF	2-JUL-14		
REVIEW	NS	2-JUL-14		
 Golder Associates Kamloops, BC		FIGURE 8		

Well Design Dimension

Nominal Well Size (inches)	12
Surface hole	24
Surface Casing	20
Intermediate Hole	20
Intermediate Casing	16
Production Casing (liner)	12
Telescopic Well Screen	10



ALL SIZES SHOWN ARE NOMINAL

PROJECT		PWGSC CRW REMEDIATION DETAILED TENDER SPECIFICATIONS COLDSTREAM, BC	
TITLE		RELIEF WELL DESIGN - OPTION 2 (NOMINAL 10 INCH SCREEN)	
PROJECT No. 13-1493-0005		FILE No. PLAN	
DESIGN	NS	27-APR-12	SCALE AS SHOWN REV.
CADD	BKL	2-JUL-14	
CHECK	JF	2-JUL-14	
REVIEW	NS	2-JUL-14	



FIGURE 9

Table 1: Well Locations and Elevations
Coldstream Ranch Well Remediation Project
Coldstream, BC

Survey Points	Well Locations											
	CRW 16 inch 21/Mar/2012	CRW 30 inch 21/Mar/2012	RW1 21/Mar/2012	MW11-01 21/Mar/2012	RW3 10/Jul/2013	RDNO Well 1 12/Dec/2013	RDNO Well 2 12/Dec/2013	MW13-01 12/Dec/2013	MW13-02 12/Dec/2013	MW13-03 12/Dec/2013	MW13-04 12/Dec/2013	
Nothing	5565842.30		5565839.95	5565867.85	5565846.55	5565920.18	5565635.68	5565839.60	5565864.69	5565842.50	5565840.31	
Easting	343084.40		343091.28	343093.66	343084.40	343265.27	343547.86	343078.03	343093.65	343093.71	343093.47	
Ground Surface	470.365	470.365	470.727	470.519	471.486	475.795	479.550	470.724	470.989	470.529	470.557	
Top of Tee Fitting	-	-	471.019	-	-	-	-	-	-	-	-	
Top of Silver Hex Nut below Pressure Gauge	-	-	471.077*	-	-	-	-	-	-	-	-	
Middle of Thread	-	471.463	-	-	-	-	-	-	-	-	-	
Bottom of Thread	-	471.442	-	-	-	-	-	-	-	-	-	
Top of Flange Cover	472.498	-	-	-	-	-	-	-	-	-	-	
Top of Brass Fitting	472.653	-	-	-	-	-	-	-	-	-	-	
Top of Data Logger Fitting	472.532	-	-	-	-	-	-	-	-	-	-	
Top of Bottom Half of 6 inch casing	-	-	-	470.766	-	-	-	-	-	-	-	
Top of 6 inch casing	-	-	-	471.165	-	-	-	-	-	-	-	
Top of 4 inch casing	-	-	-	471.099	-	-	-	-	-	-	-	
Sump Flange	-	-	-	-	471.486	-	-	-	-	-	-	
Top of Top Flange	-	-	-	-	472.686	-	-	-	-	-	-	
Lower Lip of Top Flange	-	-	-	-	472.366	-	-	-	-	-	-	
Lower Lip of Bottom Flange	-	-	-	-	471.152	-	-	-	-	-	-	
Lower Lip of Bottom Flange	-	-	-	-	471.152	-	-	-	-	-	-	
Pressure Gauge	-	-	-	-	471.963*	-	-	-	-	-	-	
Valve Fitting	-	-	-	-	472.115*	-	-	-	-	-	-	
Water Level Monitoring Port	-	-	-	-	-	476.205	479.831	-	-	-	-	
Overflow Discharge Outlet	-	-	-	-	-	468.066	-	-	-	-	-	
Top of 2 inch PVC casing	-	-	-	-	-	-	-	471.456	471.991	471.2	471.698	

Notes: Elevations in metres above mean sea level.
 Survey points identified in attached photos.
 Ground surface at RW3 in 2013 is higher due to construction of drill pad.
 All well locations collected by Golder Associates Ltd. using a Trimble Recon with Pro XH GPS receiver
 * = Locations were surveyed/resurveyed on December 12, 2013 and corrected.

Table 2: RW4 Well Design (Option 1)

Open Hole Diameter (nominal inches)	Casing Centralized and Cemented in Open Hole (nominal inches)	To Depth (ft)	Comments
20	16	120	<i>Cemented in place. Drilled without weighted mud.</i>
16	12	160	<i>Cemented in Place. Middle Aquifer 140 to 160 ft bg. Set and expose 12 inch telescopic well screen, cement 12 inch casing over Upper Aquitard.</i>

Table 3: RW4 Well Design (Option 2)

Open Hole Diameter (nominal inches)	Casing Centralized and Cemented in Open Hole (nominal inches)	To Depth (ft)	Comments
24	20	120	<i>Pressure cemented in place.</i>
20	16	175	<i>Pressure cemented in place. Drilled through the middle Aquifer 140 to 160ft bg. Shoe set in Lower Aquitard at 175 ft bg. Lowest 5 ft inside casing to be rigid (see below for definition).</i>
16	12	195	<i>16 inch hole drilled and casing set with weighted mud. Casing pressure cemented in place and overlapping 16 inch casing to 150 ft bg. Outside 5 ft of casing adjacent lower 5ft of 16 inch casing to be ridged</i>
10	<i>10 telescopic well screen assembly</i>	<i>240 (estimated)</i>	<i>Section drilled and cased under mud. Top of screen assembly riser to be at 175 ft bg completed with double reducing AGE M Packer set as an overshot. Casing removed.</i>



PARTICLE SIZE ANALYSIS OF SOILS

Reference(s)

ASTM C 136, C 117

Client: Public Works and Government Services Canada

Borehole ID: RW3

Project: Coldstream Ranch

Sample No.: 46

Location: Coldstream, BC

Depth (m): 63.86

Project No.: 13-1493-0005 Phase: 3250

Lab Schedule No.:

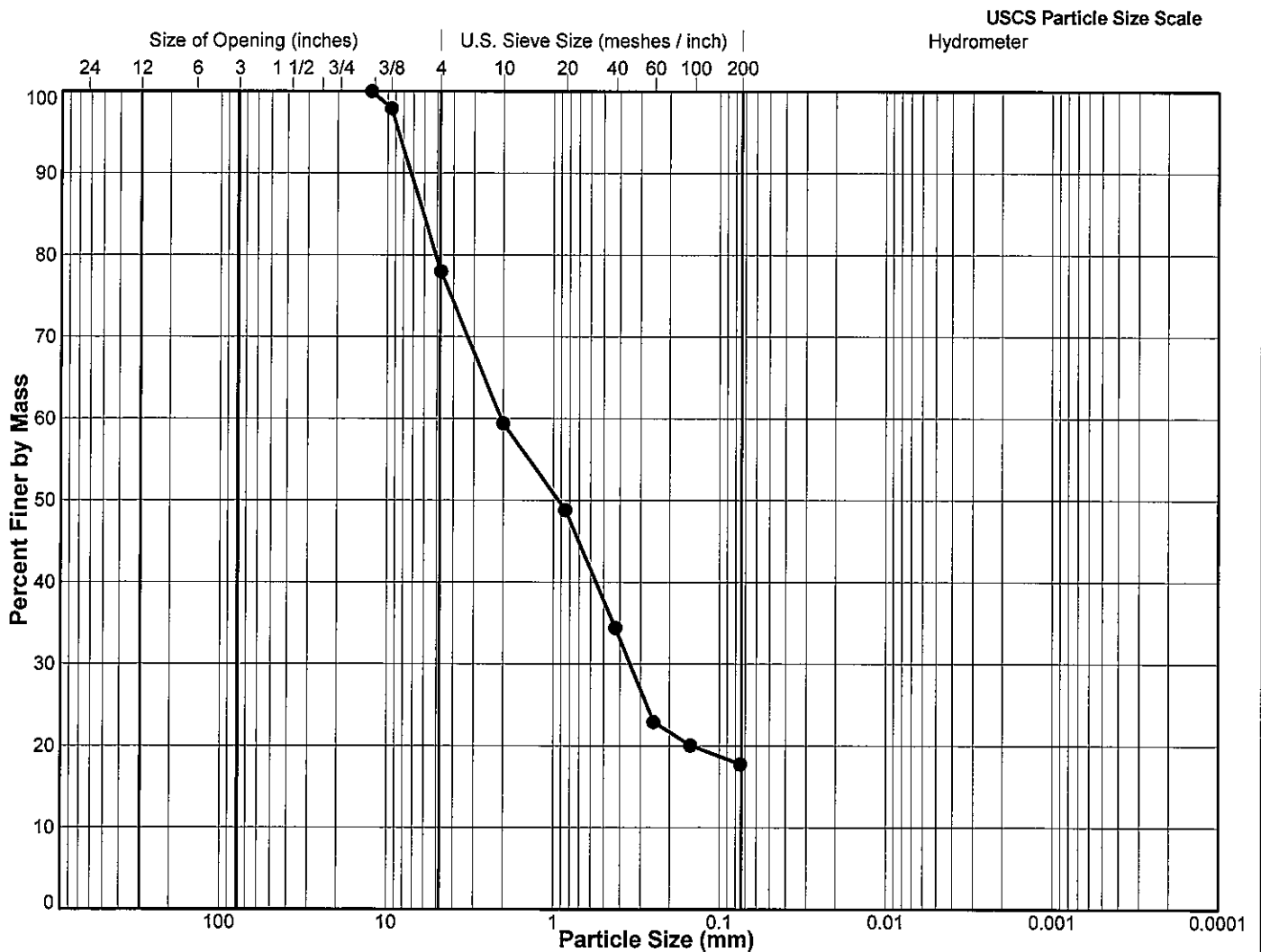
Other Remarks: N/A

Specific Gravity (assumed):

Shape:

Max. Particle Size Passing (mm): 12.5

Method: Combined, Washed



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS

5/24/2013

BS

5/24/2013

Tech

Date

Checked

Date

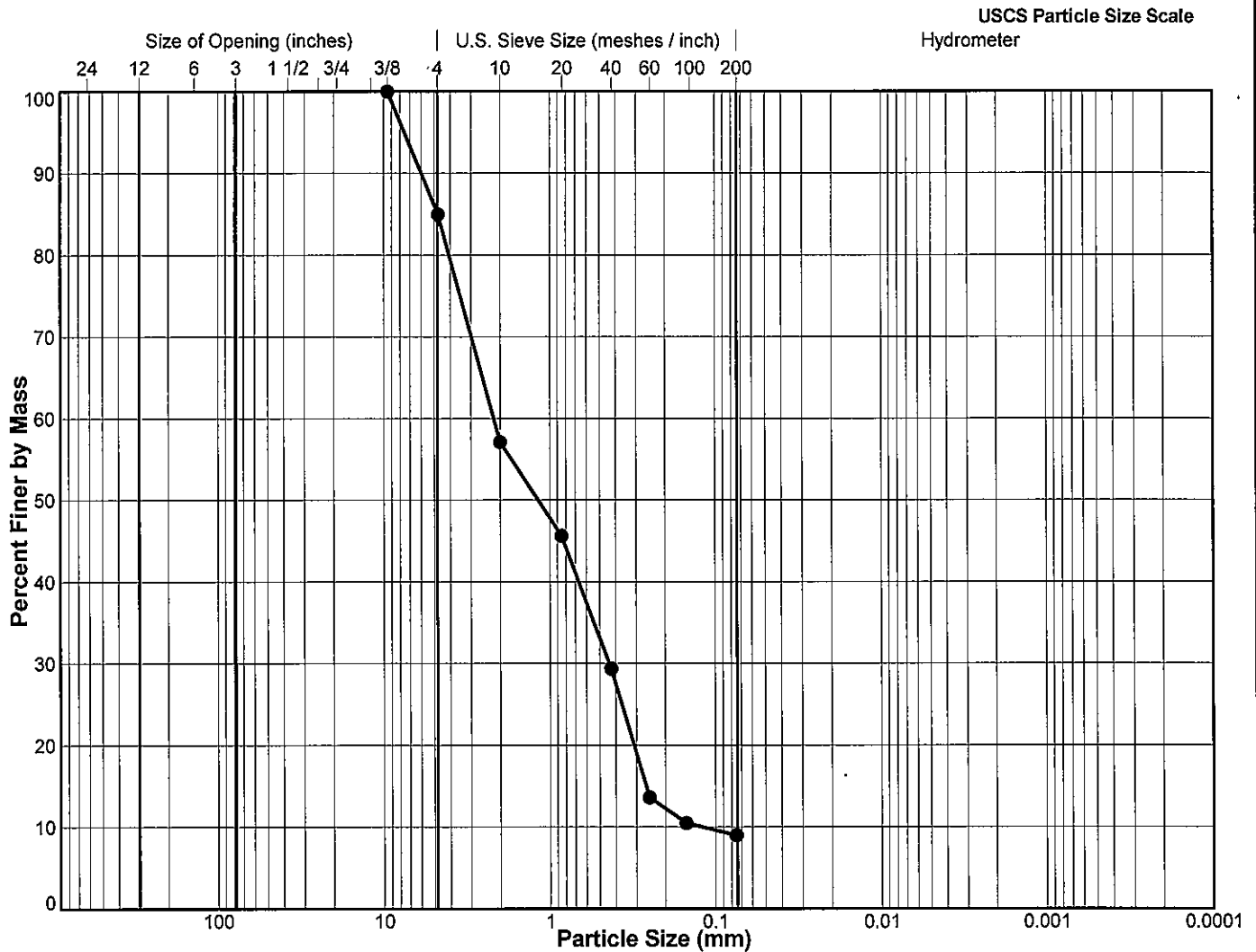
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PARTICLE SIZE ANALYSIS OF SOILS		Reference(s) ASTM C 136, C 117
Client:	Public Works and Government Services Canada	Borehole ID: RW3
Project:	Coldstream Ranch	Sample No.: 48
Location:	Coldstream, BC	Depth (m): 64.92
Project No.:	13-1493-0005 Phase: 3250	Lab Schedule No.:

Other Remarks: N/A

Specific Gravity (assumed):	Shape:
Max. Particle Size Passing (mm): 9.5	
Method: Combined, Washed	



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date

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PARTICLE SIZE ANALYSIS OF SOILS

Reference(s)

ASTM C 136, C 117

Client: Public Works and Government Services Canada

Borehole ID: RW3

Project: Coldstream Ranch

Sample No.: 50

Location: Coldstream, BC

Depth (m): 65.53

Project No.: 13-1493-0005 Phase: 3250

Lab Schedule No.:

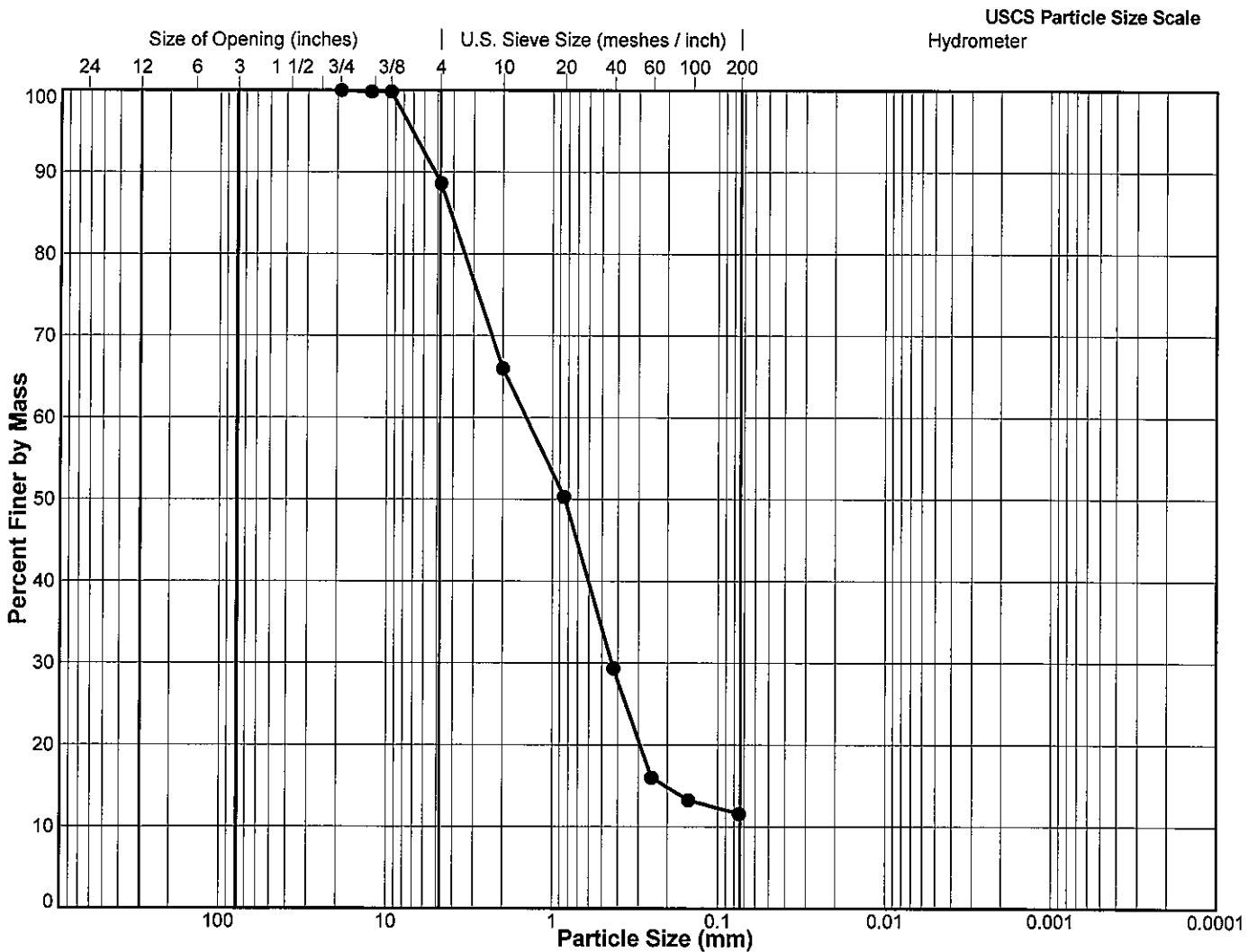
Other Remarks: N/A

Specific Gravity (assumed):

Shape:

Max. Particle Size Passing (mm): 19

Method: Combined, Washed



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date

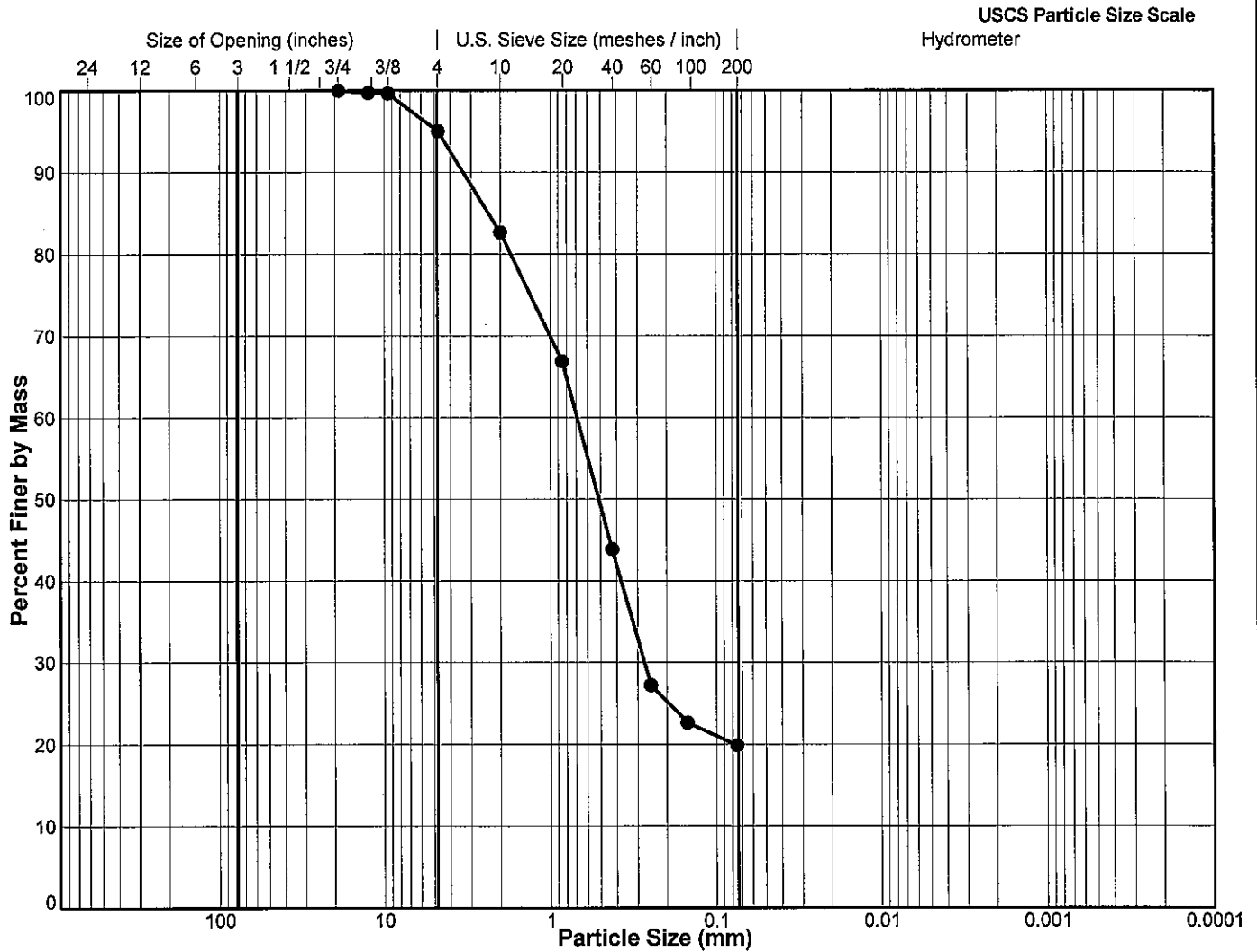
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PARTICLE SIZE ANALYSIS OF SOILS		Reference(s) ASTM C 136, C 117
Client: Public Works and Government Services Canada	Borehole ID: RW3	
Project: Coldstream Ranch	Sample No.: 51	
Location: Coldstream, BC	Depth (m): 66.45	
Project No.: 13-1493-0005 Phase: 3250	Lab Schedule No.:	

Other Remarks: N/A

Specific Gravity (assumed):	Shape:
Max. Particle Size Passing (mm): 19	
Method: Combined, Washed	



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date

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PARTICLE SIZE ANALYSIS OF SOILS

Reference(s)

ASTM C 136, C 117

Client: Public Works and Government Services Canada

Borehole ID: RW3

Project: Coldstream Ranch

Sample No.: 52a

Location: Coldstream, BC

Depth (m): 67.36

Project No.: 13-1493-0005 Phase: 3250

Lab Schedule No.:

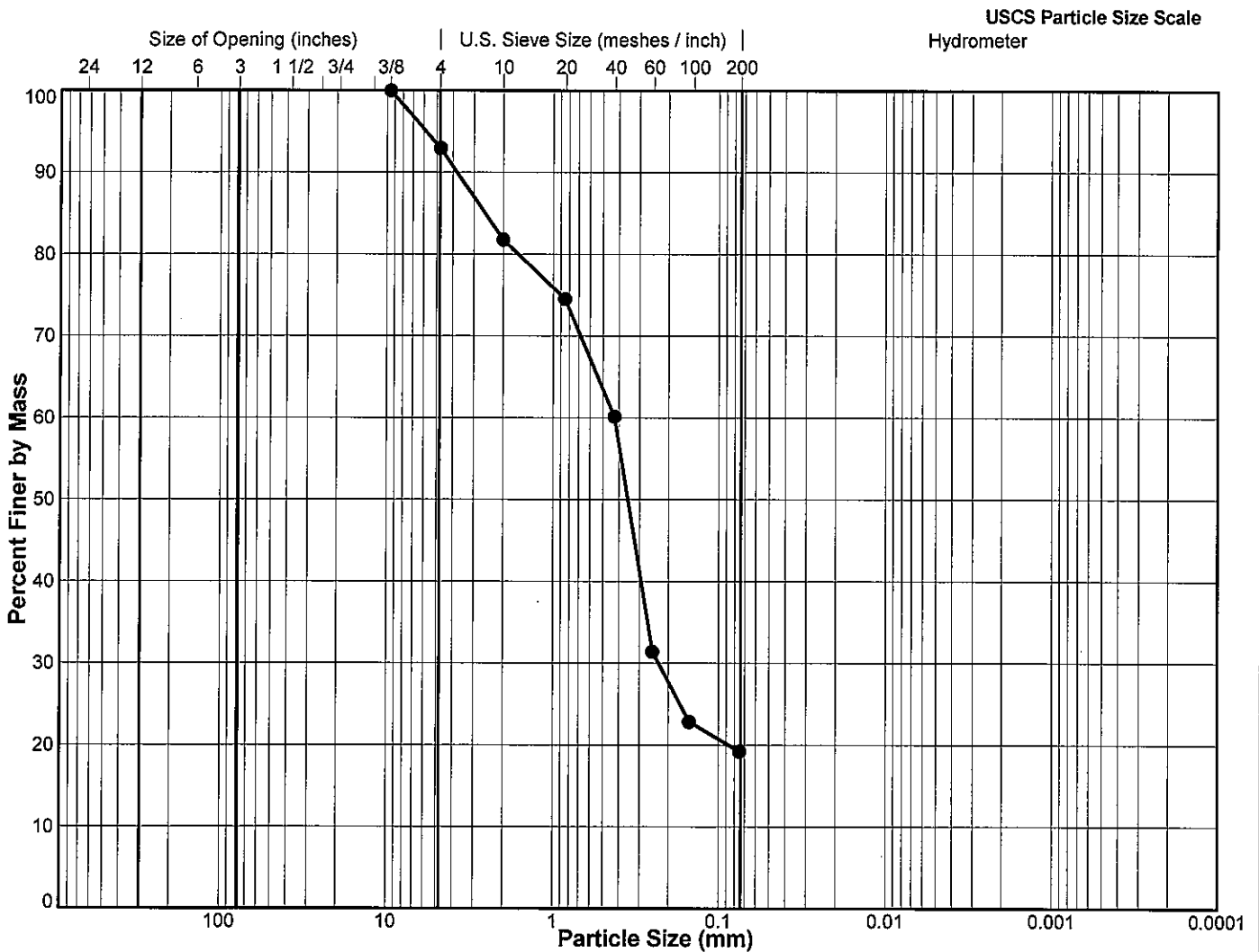
Other Remarks: N/A

Specific Gravity (assumed):

Shape:

Max. Particle Size Passing (mm): 9.5

Method: Combined, Washed



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

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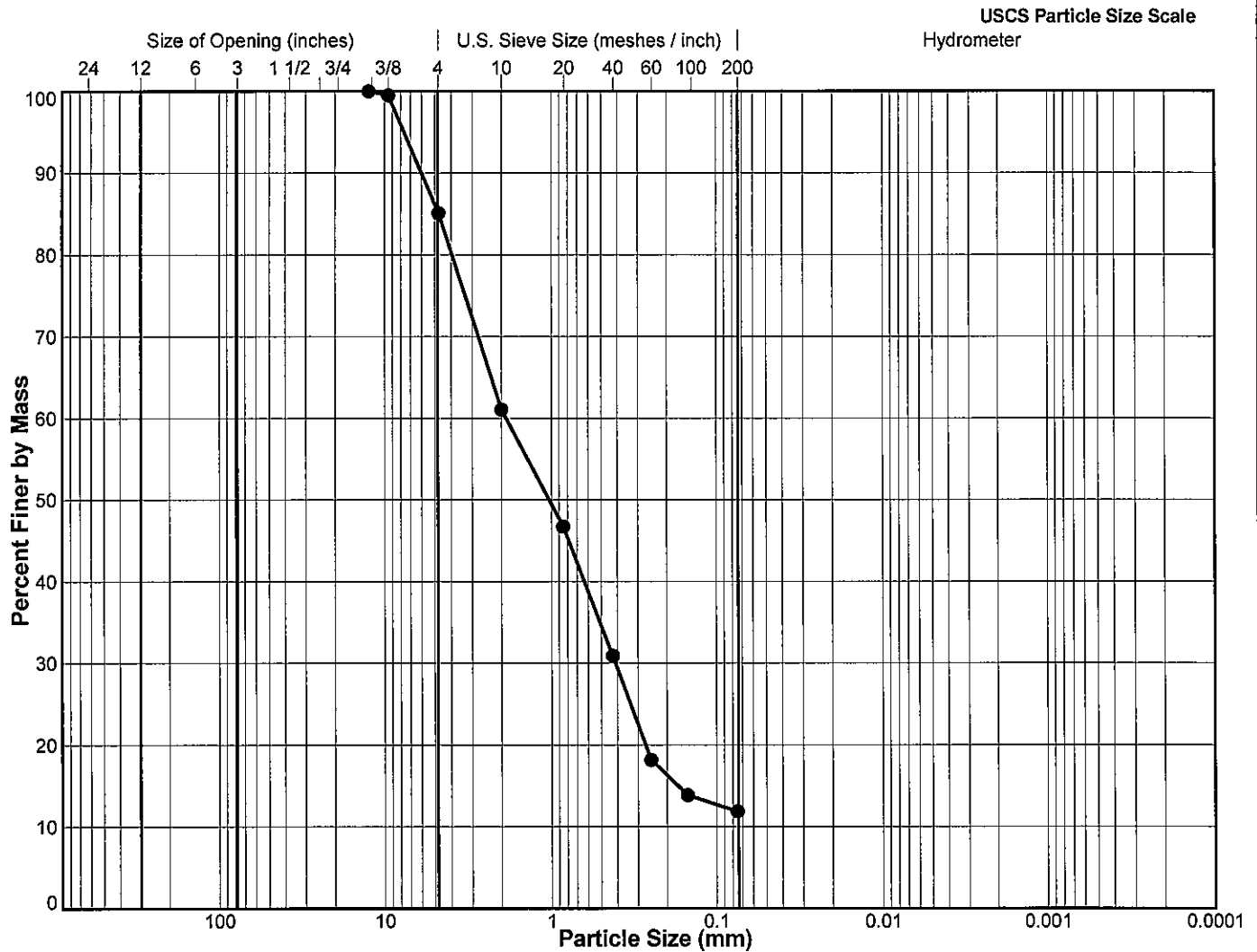
JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date



PARTICLE SIZE ANALYSIS OF SOILS		Reference(s) ASTM C 136, C 117
Client:	Public Works and Government Services Canada	Borehole ID: RW3
Project:	Coldstream Ranch	Sample No.: 52b
Location:	Coldstream, BC	Depth (m): 68.43
Project No.:	13-1493-0005 Phase: 3250	Lab Schedule No.:

Other Remarks: N/A

Specific Gravity (assumed):	Shape:
Max. Particle Size Passing (mm): 12.5	
Method: Combined, Washed	



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date

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PARTICLE SIZE ANALYSIS OF SOILS

Reference(s)

ASTM C 136, C 117

Client: Public Works and Government Services Canada

Borehole ID: RW3

Project: Coldstream Ranch

Sample No.: 53

Location: Coldstream, BC

Depth (m): 68.88

Project No.: 13-1493-0005 Phase: 3250

Lab Schedule No.:

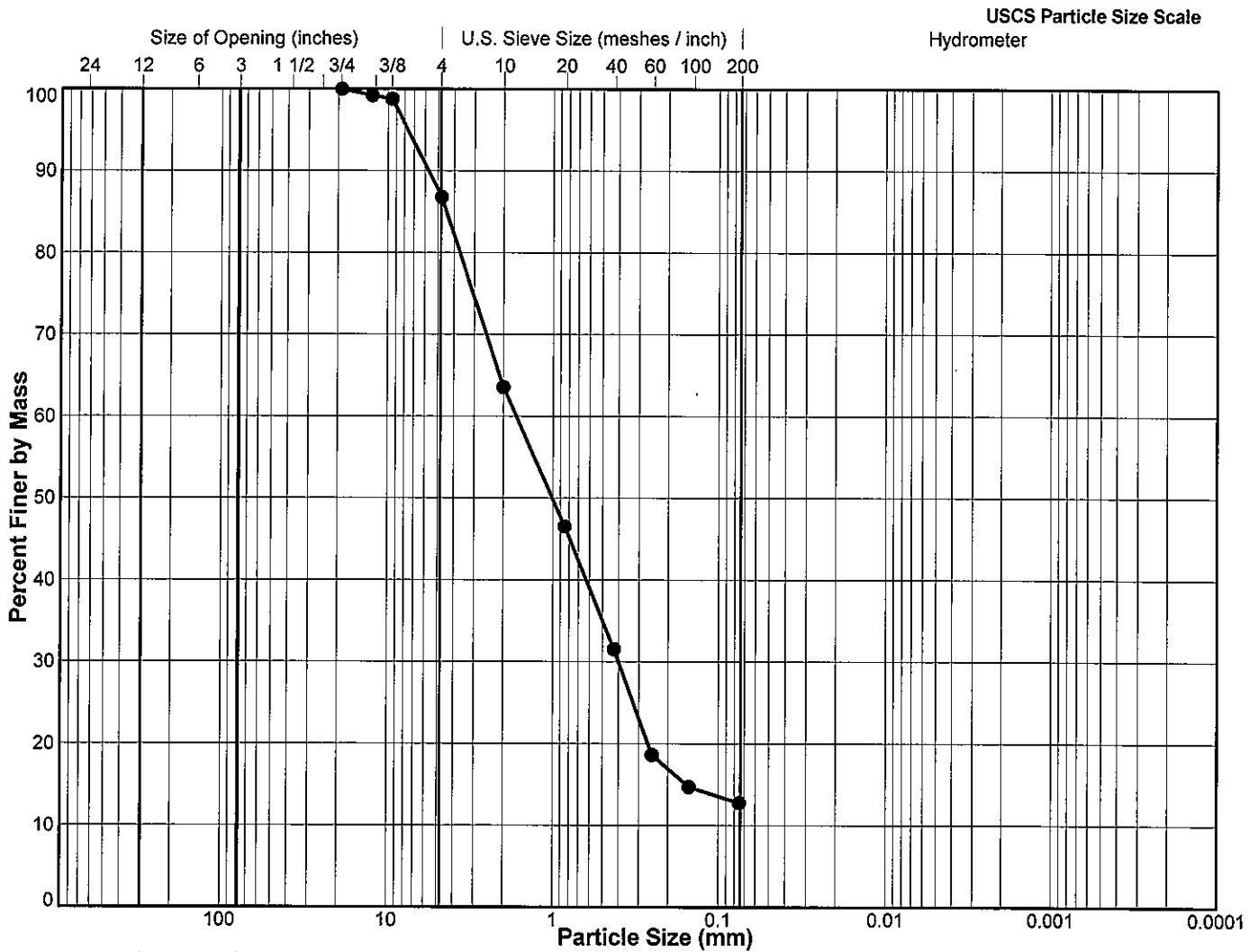
Other Remarks: N/A

Specific Gravity (assumed):

Shape:

Max. Particle Size Passing (mm): 19

Method: Combined, Washed



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date

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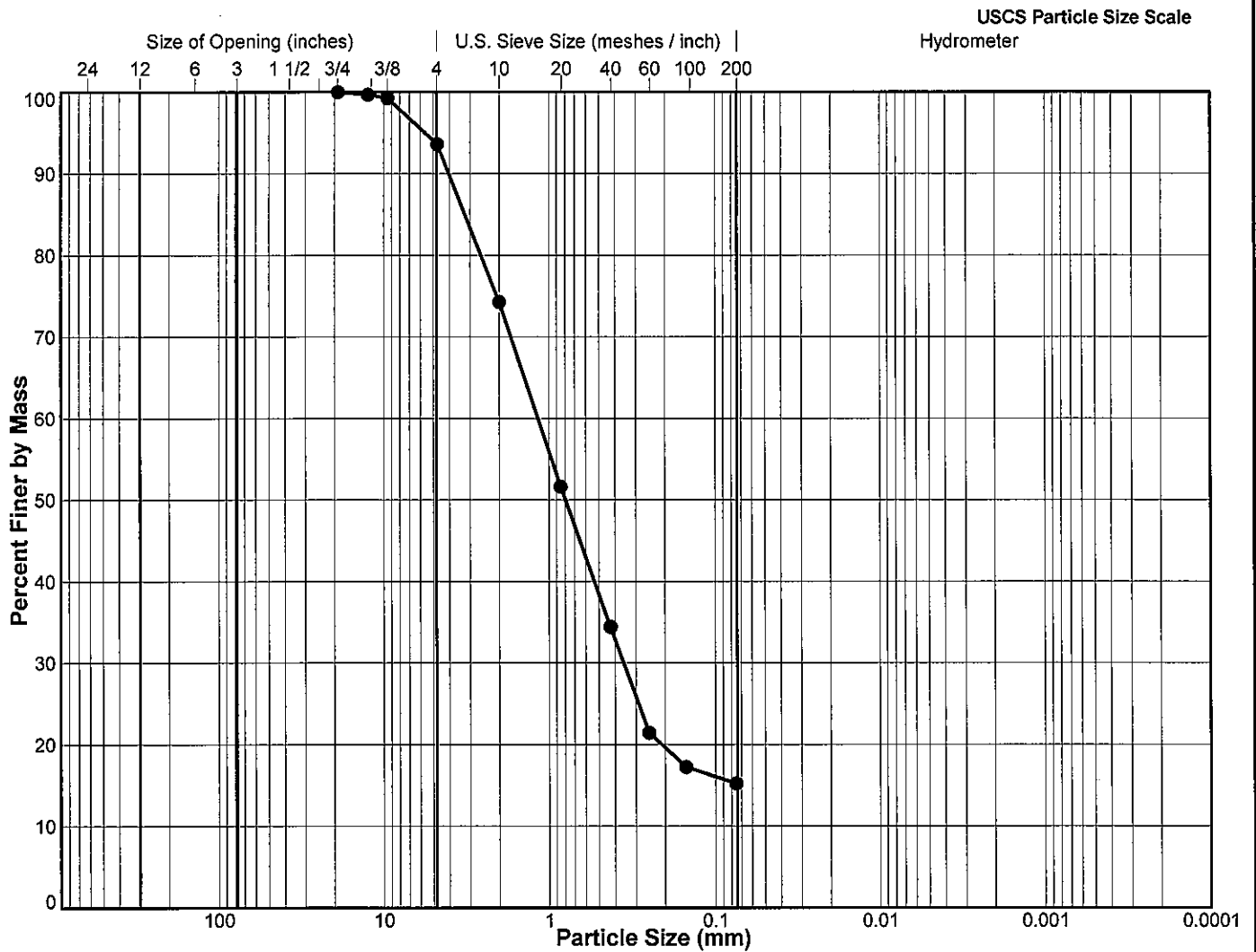


PARTICLE SIZE ANALYSIS OF SOILS		Reference(s) ASTM C 136, C 117
Client:	Public Works and Government Services Canada	Borehole ID: RW3
Project:	Coldstream Ranch	Sample No.: 54
Location:	Coldstream, BC	Depth (m): 69.49
Project No.:	13-1493-0005 Phase: 3250	Lab Schedule No.:

Other Remarks: N/A

Specific Gravity (assumed):	Shape:
Max. Particle Size Passing (mm): 19	
Method: Combined, Washed	

File: \ACTIVE\2013\1493-0005 PMWSC COLDSTREAM RANCH\09 CAD\GINT\13-1493-0005_COLDSTREAM_RANCH_LAB_TESTING_MAY_24-2013.GPJ Output Form: LAB_PARTICLE SIZE (SINGLE) Template: BC REGION TEMPLATE BETA 3.GDT Library: BC REGION LIBRARY.GLB BSpaver_05/24/13



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date



PARTICLE SIZE ANALYSIS OF SOILS

Reference(s)
ASTM C 136, C 117

Client: Public Works and Government Services Canada

Borehole ID: RW3

Project: Coldstream Ranch

Sample No.: 55

Location: Coldstream, BC

Depth (m): 70.10

Project No.: 13-1493-0005 Phase: 3250

Lab Schedule No.:

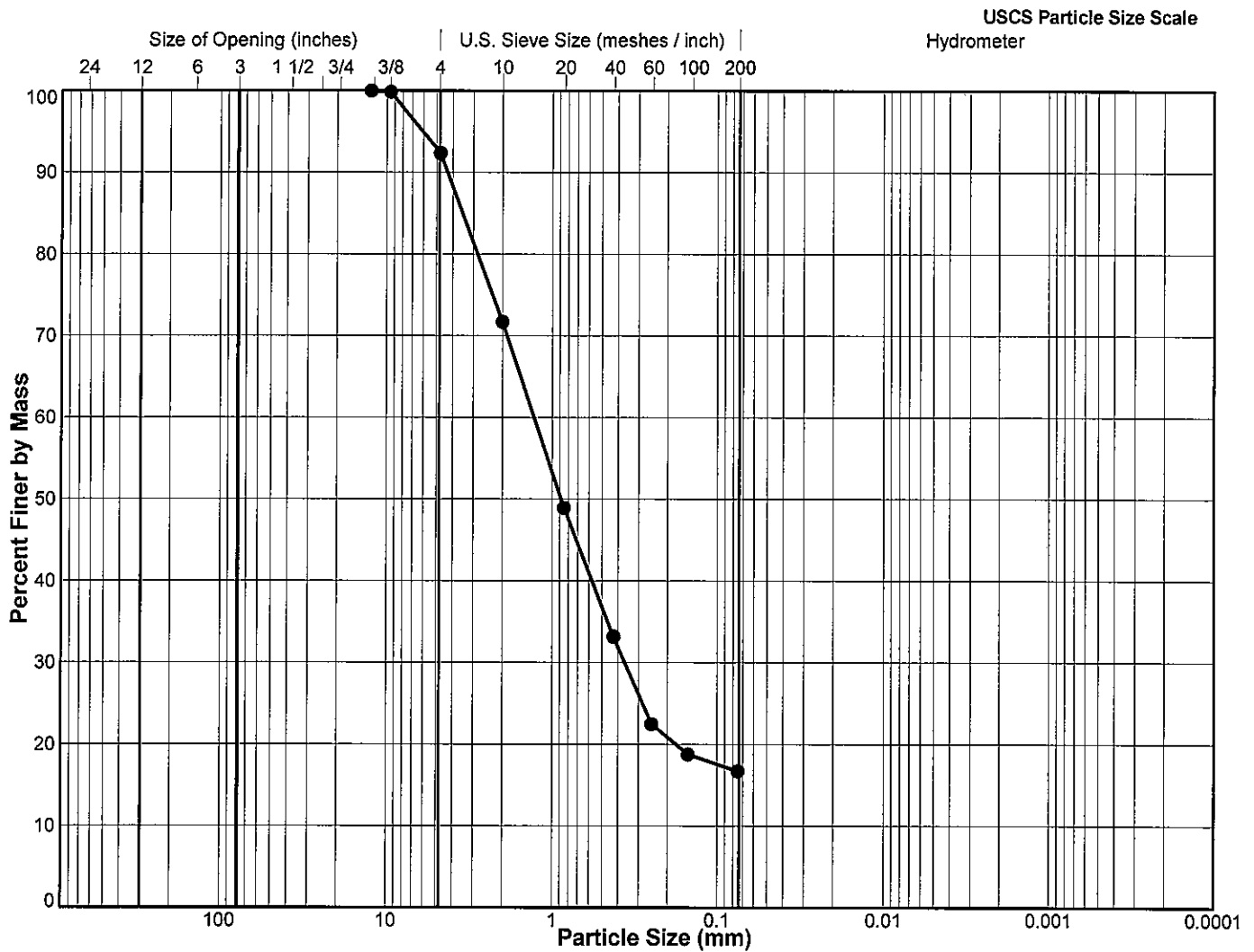
Other Remarks: N/A

Specific Gravity (assumed):

Shape:

Max. Particle Size Passing (mm): 12.5

Method: Combined, Washed



BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

JS	5/24/2013	BS	5/24/2013
Tech	Date	Checked	Date

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