STATE OF THE PLAY:

East Kootenay Basin

August 2011



About the BC Oil and Gas Commission

The BC Oil and Gas Commission is an independent, single-window regulatory agency with responsibilities for regulating oil and gas operations in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Commission's core roles include reviewing and assessing applications for industry activity, consulting with First Nations, ensuring industry complies with provincial legislation and cooperating with partner agencies. The public interest is protected through the objectives of ensuring public safety, protecting the environment, conserving petroleum resources and ensuring equitable participation in production.

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1. Executive Summary

This State of the Play report provides an overview of the East Kootenay Basin (EKB), its coal bed gas (CBG)¹ resources and the Commission's role in regulating CBG resource development in the EKB.

The EKB encompasses approximately 328,289 hectares (ha) of land in the East Kootenay region of southeast British Columbia. The basin extends from approximately 60 kilometres (km) north-northwest of Elkford to nearly 35 km south of Fernie and encompasses the community of Sparwood. The EKB is bounded to the east by the Alberta/British Columbia border and the western boundary follows the west edge of the Elk valley (Figure 1). There is an estimated provincial CBG resource potential of 2,535 billion cubic metres (10⁹m³) or 90 trillion cubic feet (Tcf) from several coalfields throughout the province. An estimated 394.4 10⁹m³ (14 Tcf) of CBG or 15 per cent lies within the EKB (Ryan, 2003). The portion of CBG resource that is recoverable is dependent on



Figure 1: Location of East Kootenay Basin

1 - The term coal bed gas (CBG), which is used throughout this report, refers to the commercial natural gas extracted from coal at depth. It is often referred to as coal bed methane or CBM.

technology, drilling density, access and in-situ reservoir quality of the individual coal seams. Recovery factors for CBG vary depending on the aforementioned variables from 10-60 per cent, which would mean there is potentially 39 to 237 10⁹m³ (1.5 to 8 Tcf) of recoverable CBG reserves from the EKB.

Although British Columbia has a variety of potential CBG areas, commercial production to date has been limited. A development near Hudson's Hope in northern British Columbia by Hudson's Hope Gas, Ltd. resulted in the first commercial CBG production in British Columbia in late 2008. The CBG exploration project targeted coal seams within the Cretaceous Gething formation. However, production was halted in early 2010 due to low natural gas prices coupled with longer than expected dewatering time that restricted CBG production from attaining the necessary rates required to offset operating costs. Currently, eight per cent of all natural gas produced in the United States comes from CBG developments; in Canada it is less than one per cent. There has been CBG exploration and development in the EKB over the past 20 years, but no commercial production has taken place to date.

The EKB is made up of two structurally separate coalfields. The southern portion of the EKB is referred to as the Crowsnest coalfield and the northern portion is known as the Elk Valley coalfield (Figure 1). The Commission has omitted the Flathead coalfield, which is often associated with the EKB, from this report, as mining, oil and gas activities and CBG extraction within the Flathead coalfield is no longer permitted.

Currently, there are two active CBG projects in the EKB. The Storm Cat Energy Corporation (Storm Cat) operated Green Hills project is located within the northern Elk Valley coalfield and covers over 26,000 ha of land. The Green Hills project has nine wells producing non-commercial volumes of CBG. Storm Cat continues to evaluate the economic viability and environmental sustainability of the Elk Valley project. The Mist Mountain project, operated by Apache Corporation (Apache), covers over 65,000 ha of land within the southern Crowsnest coalfield. This project continues to be in the appraisal stage, which is expected to last two to three years (with a cost to date of nearly \$20 million). The purpose of this stage is to assess the viability of CBG production by proving technologies and practices that will allow for the design of an environmentally sustainable commercial project. The first well for this project was drilled in the summer of 2010. The initial test well was drilled to aid in determining the quality and quantity of produced water from the coal seams, and at what rate CBG would flow once dewatering is completed. Open discussion with local residents and First Nations has been on-going since the project was proposed in 2007. This includes continued public consultations, open house meetings, opening local offices and an environmental baseline study.

2. Overview of the East Kootenay Basin

2.1 Environmental Setting

The EKB is located within the Elk Valley Ecosection of the Northern Continental Divide Ecoregion. Biogeoclimatic zones consist of: Engelmann Spruce Subalpine Fir (ESSF) – 66.1 per cent; Montane Spruce (MS) – 21.1 per cent; Interior Douglas Fir (IDF) – 9.3 per cent; Interior Mountain Heather Alpine (IMA) – 3.2 per cent and Interior Cedar Hemlock (ICH) – 0.3 per cent.

The EKB contains four provincial parks (Morrissey, Crowsnest, Elk Valley and Mount Fernie), totalling 382 ha. An additional 12 per cent (39,035 ha) of the EKB is designated as conservation areas held by Tembec, Nature Trust and the Nature Conservancy of Canada.

The EKB contains 220 km of mainstem channels from the Elk and Flathead rivers, more than 100 named streams totalling over 770 km and hundreds of unnamed streams totalling over 6,000 km. Some 386 lakes occupy approximately 0.1 per cent (448 ha) of the basin, while 285 wetlands occupy approximately 0.2 per cent (768 ha). There are four community watersheds (supplying Fernie, Sparwood and Elkford) located in the EKB, totalling 20,718 ha (6.3 per cent), while 346 documented water wells also exist within the basin.

2.2 Geography and Geology

Commercially significant coal occurs within the Mist Mountain formation of the Jurassic-Cretaceous Kootenay Group (Figure 2). The formation is primarily composed of clastic sediments that range from shale to conglomerate with coal beds making up eight to 12 per cent of the total stratigraphic thickness. There are

four to 30 individual coal seams dispersed throughout the Mist Mountain formation that can have a cumulative coal thickness of over 70 metres. The coals range in rank from low to high-volatile bituminous coal. The EKB has a coal resource of 44 billion tonnes and a CBG resource in excess of 394.4 10⁹m³ or 14 Tcf (Ryan, 2003).

The EKB has a complex structural history with several episodes of deformation. This has complicated the exploration for CBG, since the Mist Mountain formation can be less than 240 metres to nearly 1,000 metres in total stratigraphic thickness depending on the structural location within the EKB. The Mist Mountain formation within the EKB is located on the down thrust block of the Lewis thrust sheet. Coal within the Mist Mountain formation has been preserved within structurally depressed areas of the EKB and is constrained by either faulting or surface outcrops. Several types of deformation with varying magnitudes within the Mist Mountain formation have affected the CBG potential. Normal faulting



Figure 2: Stratigraphic Overview

and gentle folds can increase coal permeability by extension of the reservoir. Thrust faulting may reduce the CBG potential by shearing the coals, which causes coal fines that restrict permeability.

2.3 Coal Bed Gas

2.3.1 Coal Bed Gas Formation

The British Columbia Ministry of Energy and Mines describes CBG as the natural gas found in most coal deposits. It is created during coalification – the process by which plant material is compacted and converted into coal over millions of years through naturally occurring heat and pressure encountered during burial (Figure 3).

The natural gas generated by the coal remains contained within the coal seam, as pressure from the overlying rock (lithostatic pressure²) and water (hydrostatic pressure³) within the coal cleats (natural fractures) keeps the gas adsorbed⁴ onto the coal. To initiate gas desorption from the coal, the hydrostatic pressure is reduced by removing the water within the coal system. This process is referred to as dewatering. As the pressure reduces in the reservoir, the natural gas will desorb from the coals and migrate to the wellbore.

The Coalification Process (Simplified)



Figure 3: Coalification (Trident, 2010)

2.3.2 Coal Bed Gas Development

No two CBG sites are exactly alike. An area's geological history and the depth of its buried coal determine a coal's rank and gas content, which will factor into the resource development. In most cases, conventional natural gas drilling techniques can develop a CBG deposit; however, initial testing is often completed on four or five wells in close proximity.

On the surface, a CBG drilling system looks much like a typical oil and gas operation. In some cases, it most closely resembles the equipment used to drill water wells. Underground, the CBG production

^{2 -} Lithostatic pressure – The pressure of the weight of overburden, or overlying rock, on a formation; also called geostatic pressure. 3 - Hydrostatic pressure – The pressure exerted from water. 4 - Adsorption – Refers to the molecular bonding of a gas to the surface of a solid. In the case of CBG, methane is adsorbed or bonded to the coal.

system is unique. Typically, a steel-encased hole is drilled into the coal seam first. Unlike conventional reservoirs, which will produce gas through the wellbore at high pressures, simply penetrating the coal seam will not cause the CBG to flow.

Generally, the permeability which occurs via cleats, or natural fractures, in the coal seam must be enhanced by a process known as hydraulic fracturing. A fracture fluid, a mixture of sand, water and additives, is forced into the existing cleat system to widen and prop them open. Gas and water then flow through these enlarged and interconnected sand-filled fractures as shown in Figure 4.

To establish CBG production, the natural pressure in the coal seams must be decreased through dewatering. A pump either located inside the wellbore or at the surface removes the water that naturally occupies the cleats. This lowers the reservoir pressure along the particular coal seam, draws the natural gas out of the coal and allows it to flow to the wellhead. Effective dewatering may take anywhere from several months to several years. When commercial production is established the produced natural gas and water are separated and measured at a small metering facility where the production volume from each well is recorded.

Typically, CBG is collected from a number of wells and then flows to a central gathering system where it may undergo compression prior to being fed into a pipeline for transport to market. Produced water is piped or trucked to a central location for proper disposal. Under most circumstances, CBG consists of mainly pure methane, but it may also contain varying levels of CO_2 and N_2 . Natural gas production from coal is considered sweet⁵, as hydrogen sulphide (H₂S) is absent. As CBG contains few, if any, impurities, it requires minimal processing. CBG production must be continuous to ensure a constant low-pressure gas flow that will sustain a commercially viable operation. If a CBG well is shutdown for an extended period after it has completed dewatering and started commercial gas production, hydrostatic pressure will begin to increase within the coal seam and produced water will collect within the wellbore. As a result, the dewatering process will have to recommence.



Figure 4: CBG production system



^{5 -} Natural gas with no measurable quantities of hydrogen sulphide (H₂S).

3. First Nations Engagement

The EKB lies within the traditional territory of the Ktunaxa Nation, which is represented by the Ktunaxa Nation Council Society (KNC). The Commission, as an agent of the Crown, has a duty to consult and, where required, mitigate any concerns raised by the KNC on all oil and gas applications in the Ktunaxa territory that have the potential to impact their interests or aboriginal rights, including aboriginal title, as affirmed by section 35(1) of the Constitution Act, 1982.

First Nations consult with government and other government agencies on policy issues related to their rights (eg. caribou and water) and their input is an integral component of a basin management analysis. First Nations may use basin-specific analyses to engage with industry to identify important areas for traditional activities and of cultural value. The information may also be used during consultation on applications to provide a higher-level and longer-term view of landscape conditions and dynamics. Valued ecosystems components will be identified by First Nations and utilized in the basin approach.

First Nations are consulted at the application stage as well and the Commission encourages proponents to discuss their projects with the KNC prior to submitting their applications to the Commission.

4. Oil and Gas Development

4.1 Tenures

To explore for CBG, industry must acquire Petroleum and Natural Gas (PNG) tenure rights. The Ministry of Energy and Mine's Titles Division is responsible for issuing and administering provincially owned PNG rights.

The PNG rights for the coal bearing Mist Mountain formation in the EKB have been held by several companies. There are currently 91,726 ha (28 per cent of the EKB) of active PNG tenure rights within the EKB, belonging to Apache (65,249 ha) and Storm Cat (26,477 ha). Apache acquired its rights within the EKB when it purchased all of British Petroleum's (BP) Canadian assets in 2010. Storm Cat acquired its acreage by purchasing all of Encana's Green Hills assets. Figure 5 provides an overview of the active PNG rights within the EKB.



Figure 5: Active PNG rights within the EKB

4.2 Oil and Gas Activity

4.2.1 Geophysical Exploration Activity

Oil and gas companies conduct geophysical exploration using seismology to map the subsurface structure of rock formations from reflected seismic waves. Energy sources, such as dynamite or vibroseis, send sound energy waves into the earth, where different geologic layers reflect this energy back to the surface. These reflected energy waves are recorded over a predetermined time period with geophones. Once the data is digitally recorded, it can be processed using special software, resulting in processed seismic profiles. These profiles, or data sets, can then be interpreted to locate potential subsurface accumulations of oil and natural gas.

To date, the Commission has approved a total of three geophysical programs in the EKB. This included one three-dimensional and two two-dimensional seismic⁶ programs.

4.2.2 Well Activity

Wells have been drilled in the EKB since 1960 for conventional oil and gas with no commercial volumes having been encountered to date. Exploratory drilling in the EKB for CBG resources began in 1981, but no commercial production has been established. To date, the Commission has approved a total of 75 well permits within the EKB. A company that holds a well permit may elect to postpone or cancel the permit, thus not all wells approved by the Commission are drilled. If an authorization to drill has not been exercised within two years of approval, the Commission will cancel the well permit, unless a one-year extension is applied for by the permit holder. Out of the 75 wells approved in the EKB, 22 permits have been cancelled, 51 wells were drilled and two permits are currently approved, but have not yet been drilled. Seven of the 51 drilled wells were either an additional well on an existing pad or a re-entry (that is, no new well pad constructed). From the 51 wells that have been drilled, 25 have since been permanently plugged and cemented in accordance with the Drilling and Production Regulation, 17 have been completed⁷, eight have been cased⁸ and one has been suspended⁹. Currently, nine of the 17 completed wells are producing non-commercial volumes of CBG. Of the 25 wells permanently plugged and cemented, four have been fully reclaimed and have received a Certificate of Restoration from the Commission.

^{6 -} Three-dimensional seismic requires the deployment of geophones in a two-dimensional array together with a two-dimensional pattern of source points, resulting in a three-dimensional image of the geology beneath the array. Two-dimensional seismic operations deploy geophones in one-dimensional lines, resulting in a cross-section of the geology below. 7 - A well that has had the necessary work done to enable petroleum production. 8 - A well that is lined with a string of casing across the reservoir zone. 9 - A well that was previously completed but is now no longer being produced.



Table 1: Well Activity

Well Permit Status	Wells	Status	Wells
		Completed	17
	51	Cased	8
Drilled		Suspended	1
		Permanently plugged	25
		and cemented	
Approved	2	Approved	2
Cancelled	22	Cancelled	22
Total	75	Total	75

4.2.3 Pipeline Activity

The Commission reviews all pipeline applications for projects within the province for both private and Crown lands. Some pipelines are under federal jurisdiction within British Columbia, namely interprovincial pipelines and international pipelines, which are regulated by the federal government via the National Energy Board (NEB). However, there is the opportunity for agreements allowing the Commission to regulate on behalf of the NEB for certain projects.

To date, the Commission has approved a total of 22 pipeline applications for a total of 68.6 km within the EKB and all applications have been on behalf of Storm Cat. Of the 22 approved pipeline applications, nine have been constructed and are operational. Eight of the remaining 13 applications were cancelled due to inactivity, while the rest are still valid, but not yet constructed. Table 2 summarizes pipeline activity within the EKB.

Status	Pipelines	Length (km)
Operating	9	27.0
Approved	13	41.6
Total	22	68.6

 Table 2: Pipeline Activity

The TransCanada Foothills Pipeline, an NEB regulated pipeline, passes through the area carrying British Columbia gas to the United States. FortisBC supplies gas to the East Kootenay region though a network of pipelines in the area that distributes gas from the TransCanada Foothills Pipeline.

4.2.4 Oil and Gas Surface Land Analysis

Land and resource values, including a minimized surface land disruption wherever possible, are a priority for the Commission, its stakeholders, First Nations and the public. Successful land and resource planning is key to effective management of the EKB.

Table 3 summarizes the surface land utilized for oil and gas activities within the EKB. Based on this analysis, the total oil and gas disturbance represents about one thirteenth of one per cent (0.13 per cent) of the EKB area. This is based on standard assumptions the Commission uses when translating industry activity into surface land utilization, for each major disturbance type. These assumptions are listed in Appendix A.

Table 3: Oil and Gas Surface Land Area Utilized

Activity	Area (ha)
Wells	73.02
Roads	130.93
Facilities	none
Pipelines	72.92
Geophysical Exploration	136.41
Other Oil and Gas Permits	25.92
Total Area of EKB Oil and Gas Activities Constructed	439.2
Net Area ¹⁰ of EKB Oil and Gas Activities Constructed	407.35
Total Area of the East Kootenay Basin	328,289
Oil and Gas Surface Land Area Utilized (%)	0.13
Net Oil and Gas Surface Land Area Utilized (%)	0.12

4.2.5 Compliance and Enforcement Activity

Commission inspectors undertake site inspections generated by risk modelling, complaints, incidents and government agency or public requests to ensure that operators are in compliance with all applicable legislation, standards and approval conditions. Findings of the site inspections are entered into the Commission database and depending on the severity and situation, deficiencies are communicated to the operator during the inspection or upon the inspector's return to the office. Operators are required to correct any identified deficiencies based upon correction timeframes associated with the deficiency ranking. The Commission's 2009/10 Field Inspection Annual Report contains further details on the Commission's compliance and enforcement process and can be found on the Commission's website.

The compliance and enforcement model has transitioned from the deficiency rankings of minor, major and serious to high and low risk non-compliance with the implementation of OGAA. A risk assessment matrix is utilized to predetermine the level of risk inherent to each regulatory requirement. A high risk non-compliance issue requires the company to respond with immediate action and a low risk non-compliance issue gives the company 14-30 days, depending on the situation and associated risk, to deal with the situation to the satisfaction of the Commission. If a non-compliance issue is not addressed, the company may be subject to

^{10 -} The Net Area occurs when there are overlapping permit types that share the same area, this overlap area is removed in the Net Area calculation.

further action, including a complete shutdown of the operation.

The Commission has completed a total of 177 site inspections on CBG projects within the EKB since 1999, which resulted in a total of 94 deficiencies (Table 4). The operators responsible for these sites have corrected the deficiencies and there are currently no sites within the EKB in non-compliance.

Deficiency Class	Major	Minor	# Deficiencies
Location & Safety Signs	5	6	11
Production & Storage Tanks	1	1	2
Pits and Sumps	2	3	5
Wellhead Equipment Condition	35	5	40
Leaks/Spills/Odours	3	2	5
Lease Vegetation	n/a	3	3
Reclamation Work	n/a	4	4
Water Measurement	n/a	1	1
Debris Removal	n/a	5	5
Equipment Spacing	1	n/a	1
Dykes & Firewalls	1	n/a	1
Grounding	2	n/a	2
Exhausts	3	n/a	3
Suspended Wells	6	n/a	6
Reclamation Abandonment	1	n/a	1
Shutdown Systems	4	n/a	4
Total	64	30	94

Table 4: Major and Minor Deficiencies¹¹

4.3 Active CBG Projects

4.3.1 Mist Mountain CBG Project

The Mist Mountain CBG Project is located in the southern portion of the EKB within the Crowsnest coalfield (Figure 6). The project is operated by Apache to assess whether CBG from the Crowsnest coalfield can be produced in a safe, economic and environmentally responsible manner. The project completed three years of consultation, non-invasive geological studies and environmental baseline studies in June of 2010. The studies included methane seep surveys, coal characterization, surface water characterization, aquatic life, avalanche survey, LIDAR, Aero-Mag and multiple wildlife studies. Commencement of the first exploration well was in July 2010 with access to the wellsite via existing logging roads in an on-going effort to minimize the development footprint. Continued subsurface exploration is expected in 2011 along with on-going consultation with First Nations and stakeholders, including local residents.

^{11 -}The terms major and minor were used to define deficiencies prior to the implementation of OGAA for which these results were tabulated.

The project area covers approximately 65,000 ha of the EKB, near the communities of Fernie and Sparwood. The project is currently in the appraisal stage, which is expected to last two to three years. The purpose of this stage is to assess the viability of CBG production by proving technologies and practices that will allow for the design of an environmentally sustainable commercial CBG project.

Commercial development could require up to 130 multiple-well pads with an average of 4.5 wells per pad. The full development plan also includes the potential for 281 km of existing roads to be used and 145 km of new roads to be built. The appraisal stage will determine the technical feasibility of using multiple-well pads to produce CBG from the Mist Mountain coal seams. The project has the potential to produce at over 12,678 e³m³ (450 MMcf) of natural gas per day. The CBG production will generate produced water, both during the dewatering and commercial production stages. This project has not been approved for any surface discharge of produced water. Apache currently plans to truck the produced water to an appropriate disposal facility, but is assessing deeper, saline subsurface formations within the EKB for future disposal.



Figure 6: Mist Mountain CBG Project Area

4.3.2 Green Hills CBG Project

The Green Hills CBG Project is located in the northern portion of the EKB within the Elk Valley coalfield (Figure 7). The project is operated by Storm Cat to assess whether CBG from the Elk Valley coalfield can be produced in a safe, economic and environmentally responsible manner. The entire project area is

considered a special project¹² (sec. 75 Oil and Gas Activities Act), which requires Storm Cat to provide yearly progress reports. To date, 34 wells have been approved in the project area. Of these, 24 were drilled, eight were cancelled and two have yet to spud. The most recent activity in the area occurred in 2006, at which point Storm Cat drilled five new wells, of which four were completed. Including the four wells completed in 2006, the Green Hills project has a total of nine wells producing non-commercial volumes of CBG with associated produced water. Coal bed gas and produced water production volumes since 2006 are summarized in Table 5. Storm Cat is currently compiling their 2010 data for submission.

Current CBG volumes from the project are being used as fuel gas to run wellsite equipment with any excess being burned in a high efficiency incinerator. Currently, all produced water from the Green Hills project is gathered at a central treatment facility before being discharged into Britt creek. Storm Cat conducts a water quality monitoring program that involves regular sampling upstream and downstream of the discharge point and at the water treatment facility.



Figure 7: Green Hills CBG Project Area

 Table 5: Green Hills Project CBG and Water Production

Year	Produced Water (m ³)	CBG production (e ³ m ³)
2006	18,006	2,122
2007	115,169	6,433
2008	118,245	8,344
2009	87,919	5,318

^{12 -} A special project (formerly Experimental Scheme) is granted to encourage operators to evaluate production techniques that are untried or unproven in a particular application. The operator is granted three years of confidentiality on work completed from the date of approval and are required to provide yearly progress reports.

5. Other Resource Development

5.1 Mining

Coal and surface ownership in the EKB is a combination of provincial, freehold and federal lands. Currently, 71,873 ha (21.9 per cent) of the EKB is held in mineral tenure, of which over 13,500 ha (4.1 per cent) has been mined or is scheduled for mining. This freehold tenure is primarily held by Teck Cominco and the Elk Valley Coal Partnership (owned by Fording Coal and Teck Cominco).

Coal has been mined in the East Kootenay for over 100 years. Until the 1960s, most coal mines were underground facilities located close to the rail line along the western side of the coalfields. The coal at all of these mines contained methane. Since 1970, large open pit mining has occurred. An estimated 44 billion tonnes of total coal resource exists in the Elk Valley and Crowsnest coalfields. There are currently five active coal mines in the EKB including Elk Valley Coal Partnership's Coal Mountain Mine (30 km east of Sparwood), Teck Cominco's Elk View Mine (three km east of Sparwood), Teck Cominco's Fording River Mine (29 km northeast of Elkford), Teck Cominco's Greenhills Mine (eight km northeast of Elkford) and Teck Cominco's Line Creek Mine (25 km north of Sparwood). Table 6 summarizes the mining activity in the EKB.

Table 6: Mining Activity

Statistic	Quantity
Active Mines	5
Total Mine Site Area (ha)	71,183
Total Area Mined or Proposed (ha)	13,410
East Kootenay Basin Area (ha)	328,289
% of EKB Allocated as Mine Sites	21.68
% of EKB Mined or proposed to be Mined	4.08

5.2 Forestry

The EKB is located within the Cranbrook Timber Supply Area (TSA) of the Rocky Mountain Forest District. Forestry activities have occurred in the EKB for almost 100 years, with managed forest records dating back to the 1930s. Forest tenures held in the EKB include a volume based forest licence held by Tembec Industries Inc. (Tembec), two volume based forest licences held by BC Timber Sales (BCTS) and a number of small managed forest tenures such as woodlots.

Tembec's forest licence (A19040) gives Tembec access to 607,652 m³ annually within the Cranbrook TSA, and less than half of the management area associated with Tembec's forest license is located in the EKB. The BCTS forest licences gives access to 180,902 m³ annually in the Cranbrook TSA, with the Elkford and Brule Forest Development Units being within the EKB (approximately five per cent of the BCTS operating area in the TSA).

Over 570 cut blocks exist in the EKB, totalling 15,156 ha (4.6 per cent of the EKB) with the majority of the logging to date being completed by Tembec and BCTS. Table 7 summarizes the forestry activity in the EKB.

Table 7: Forestry Activity

Statistic	Quantity
Number of Existing Cutblocks	572
Total Logged Area (ha)	15,156
Total Area Not Declared Free Growing ¹³ (ha)	11,833
East Kootenay Basin Area (ha)	328,289
% of EKB Logged	4.62
% of EKB Cut Blocks Not Free Growing	3.60

^{13 -} The Forest and Range Practices Act (FRPA) defines "Free Growing" as a "stand of healthy trees" that meets the free growing standards for the region the stand is located in.

6. Stewardship

The Commission's stated vision is "To be the leading oil and gas regulator in Canada." One of the many purposes of the Commission, as stated in the Oil and Gas Activities Act (sec. 4), is to ensure that approved applications are in the public interest having regard to environmental, economic and social effects. The Commission employs its responsibility in ensuring environmental issues are fully considered and potential impacts mitigated in regulating oil and gas activities in British Columbia.

Recently updated regulations under the Oil and Gas Activities Act include the Environmental Protection and Management (EPM) Regulation, which provides government environmental objectives for oil and gas activity applications to protect water quantity and quality, riparian values, wildlife and wildlife habitat, old growth management areas, resource features and cultural heritage resources. It also prescribes measures that must be followed in oil and gas operating areas to maintain surface and subsurface water quality, protect riparian values at crossings, conserve soil, manage invasive plants and restore the area when it is no longer required. The Commission has developed a Guidebook which incorporates previous operational environmental policies and guidelines for meeting EPM Regulation requirements. The Guidebook is located on the Commission's website.

CBG development in other regions, primarily the United States, has raised a number of concerns. The main issues brought up by stakeholders, local governments and the public include produced water, land-base and wildlife impacts and air quality.

6.1 Produced Water

During CBG testing and production, water that naturally occurs in the coal seams is pumped out, which reduces hydrostatic pressure and allows natural gas to be released. Typically, the methane and produced water are separated at the wellhead. The water brought to surface at the wellhead is considered produced water. The volume and quality of produced water can vary greatly in any given project.

The BC Energy Plan released in 2007, outlined new standards regarding CBG production and environmental responsibility. It states that the surface discharge of produced water from CBG would no longer be permitted. As a result, the Waste Discharge Regulation and the Code of Practice for the Discharge of Produced Water from Coalbed Gas Operations were amended to initiate that change. Going froward, discharge under the code of practice was limited to those wells actively discharging under the code so that future discharge permits would not be authorized. Also, should the Stormcat Greenhills operation achieve commercial production, surface discharge under the code of practice would no longer be authorized. No other oil and gas or CBG projects in the province have surface discharge authorization for produced water and for any future CBG projects, produced water must be re-injected below domestic water aquifers, an activity regulated by the Commission, or transported for disposal outside of the province.

Produced water is piped or trucked to an injection site for disposal or to an out of province treatment facility. A disposal well is carefully designed to confine disposed water to an authorized geological zone and to prevent the movement of fluids to potable groundwater sources. Injection wells are drilled into deep geologic rock formations. The fluid pressure, fracture pressure, water compatibility chemistry and geological characteristics of the injection zone are taken into consideration when evaluating areas suitable for injection.

Seals or cap zones are impermeable (leak proof) rock formations that restrict the upward movement of the injected water. A seal overlies the geological formation that is being utilized as the injection zone.

Companies must apply to the Commission if they wish to drill and operate a disposal well for produced water. Before the Commission approves an application for a disposal well, applicants must demonstrate that underground disposal areas are isolated from potential potable groundwater zones. To protect drinking water against any possibility of cross-contamination, all disposal wells are lined with steel casing that extends from the surface to the disposal rock formation. This casing is cemented into the wellbore to prevent the migration of fluids into potable groundwater zones. The long string casing and cement sheath are perforated in the injection zone to allow produced water to be directly introduced to the injection zone. As a condition of approval, the Commission requires a Monthly Injection/Disposal Statement, reporting volume of disposed water and average wellhead pressure. The Commission limits the pressure at which water can be injected into the underground rock formation to ensure integrity of the injection zone.

6.2 Land-base and Wildlife Impacts

CBG development requires the construction of wellsites, access roads, facilities and pipelines, all of which have the potential to have surface land impacts. As the provincial regulator of oil and gas activity, the Commission requires that projects be designed to minimize surface land impacts and impacts to wildlife and their habitats. These impacts may be minimized by drilling multi-well pads, sharing existing linear corridors and utilizing existing disturbances (such as cutblocks and existing roads).

The Commission ensures industry addresses potential impacts of oil and gas development at the application stage through a project assessment process. The Commission has developed a spatial analysis tool (MARMOT) that links Commission and ministry databases to assess applications for known resource management values. Commission technical staff will review applications for conflicts with land status, forestry, wildlife and wildlife habitat and archeological resources. They also assess applications for consistency with government land and resource management plans and with the EPM Regulation and Guidebook. Local agencies may also be consulted for their in depth on-the-ground knowledge.

In an application to the Commission, a company must demonstrate how it will mitigate potential impacts to identified resource values such as fish and wildlife and their habitats. Specific assessments and mitigation plans may be required in areas of potential adverse impacts such as:

- Special management areas in government land use or resource management plans.
- · Established or designated fish or wildlife habitat areas or features.
- Issues identified through the Commission's consultation with First Nations or the companies' consultation with landowners and stakeholders.
- Applications are not consistent with applicable regulations and guidebooks such as the EPM Regulation and associated Guidebook.

Upon the application review, the Commission may reject the application, require an amendment to address potential impacts or approve the application and issue a permit. Permits may include conditions to address project specific issues identified through the application review process.

6.3 Air Quality

Flaring (burning of natural gas) during CBG development is relative to the amount of dewatering required to reduce the pressure in the formation, allowing the natural gas to flow. During this dewatering process, some CBG developments may require longer up-front flaring periods due to low early volumes of CBG. It may take several months to well over a year for production tests to demonstrate representative CBG rates; however, as CBG contains very few contaminants, emissions from the flaring of CBG are generally low.

Well permit conditions set by the Commission limit the quantity and duration of flaring (burning of natural gas) during CBG development. The recently updated Flaring and Venting Reduction Guideline defines approval criteria and flaring performance requirements to ensure that flaring does not have an unacceptable impact on air quality.

6.4 Specific CBG Development Considerations

Compared to conventional natural gas production, CBG projects have unique characteristics. Coal seams may demonstrate sufficiently low permeabilities such that they must be hydraulically fractured or stimulated to enable dewatering and the production of CBG. Effective CBG recovery usually requires a number of wells to dewater the coal seam, reduce the hydrostatic pressure and produce CBG. The low-pressure natural gas is then gathered and compressed for delivery to the high-pressure sales pipeline.

CBG projects are normally phased, with the drilling of a few pilot wells to test potential production followed by a larger scale development that may reach tens to hundreds of wells. Gas well spacing areas are set by regulation and define the subsurface area that can be accessed per well. Wells are separated from each other by this distance. Conventional gas well spacing is currently set at one well every 640 acres, which is about one square mile. CBG wells may need to be closer together, with one well every 160 acres or four wells every square mile.

Since CBG wells are usually shallower than conventional wells, smaller rigs and smaller surface areas may be used. Once CBG drilling is complete and the well is connected to the pipeline, the area can be reduced to just large enough for a wellhead and pump plus auxiliary wellsite equipment. Later, some of the area can be re-vegetated and re-contoured, leaving a smaller long-term surface impact.

CBG operations require natural gas and water gathering systems. Plastic pipes carry low-pressure natural gas to a central compressor station where the natural gas is pumped into an intermediate-pressure to high-pressure steel pipeline. The natural gas eventually enters a main, high-pressure pipeline where it is transported to market.

Water is collected in storage tanks at the well and transported by truck to a disposal site or moved by pipeline to a suitable central disposal site. Usually, to minimize surface impact, both the natural gas and water pipelines are buried adjacent to access roads.

Ongoing compliance and enforcement activity is necessary to ensure public safety, protection of the environment, accurate product measurement and responsible reservoir management. If an application is approved and construction activity commences, the Commission's inspection staff monitors regulatory compliance. The Commission utilizes a risk-based inspection model as its primary method of prioritizing and allocating site inspection resources. To ensure the highest risk sites are inspected, annual computer modelling iterations rank sites based upon:

- · History of operator compliance.
- Incidents and received complaints.
- Site sensitivity the proximity of the site to residents and sensitive environment.

Inherent risk considers the likelihood of an incident occurring along with the probable consequences, if one were to occur. Site inspections are also triggered through public requests and complaints, as a result of reported incidents, and during the application approval process.

6.5 Existing Information

A variety of environmental studies have been completed in the EKB that are available to oil and gas operators when designing oil and gas developments, and for the Commission to use during project assessment. These studies have been completed by both industry (forestry, mining, oil and gas) and government agencies.

Where appropriate, the Commission collates available natural resource information and studies on a basin. This tactical approach facilitates consideration of surface and subsurface values at the landscape level to better coordinate oil and gas activities through the development and sharing of infrastructure, such as access, pipeline corridors and facilities. It also facilitates a more efficient and effective review and assessment by statutory decision makers. The Commission is currently developing this approach in partnership with government agencies and tenure holders in the Liard Basin in northeast British Columbia.

6.5.1 Ecological Reports Catalogue

The British Columbia Ministry of Environment's Ecological Reports Catalogue (EcoCat) provides access to digital reports and publications and their associated files, such as maps, datasets and published inventory information. EcoCat (located at www.env.gov.bc.ca/ecocat) contains reports from a variety of disciplines, including aquatic species and habitats, terrestrial species and habitats, floodplain mapping, reservoirs, groundwater and vegetation. EcoCat contains hundreds of ecological (such as fish and wildlife) studies when the keywords "Elk River", "Elk Valley", and "East Kootenay" are searched. Appendix B contains a list of studies from this area.

6.5.2 Environmental Resources Information Project

The British Columbia government's Environmental Resource Information Project (ERIP) provides online access to environmental baseline information and also conducts new related studies. ERIP (www.em.gov. bc.ca/subwebs/coalbedgas/ERIP/default.htm) is a collaborative effort between the Ministry of Energy and Mines, the Ministry of Environment, community groups, First Nations, industry and other governments. ERIP contributes to responsible oil and gas development, including CBG, in the province.

Included within the project is an ERIP database (a searchable, web-accessible bibliography of existing reports and databases with the ability to customize search and report features related to a specific geographic area or a particular topic) and baseline surveys, including a collection of reports on environmental data in key coalfields.

The ERIP database contains 375 references for the Crowsnest Coalfield and South Kootenay area, which include environmental studies on aquatic ecosystems, hydrology, water quality, air quality, land use and regional planning.

6.5.3 Mist Mountain Environmental Studies

Apache completed three years of environmental studies, technical development research and consultation for the Mist Mountain Project in June 2010. They internally mandated an environmental assessment as a necessary component of project appraisal and retained Matrix Solutions Inc. to design programs to collect baseline environmental data in a number of areas including air quality, aquatics (fish, fish habitat, and water quality), avalanche mapping, surface water, hydrogeology, vegetation and wildlife. The first data was collected in 2007 and continued through to 2010. Yearly data has been submitted to the Commission and the final environmental study data is being compiled.

7. Moving Forward

Currently, the EKB has seen limited activity for both conventional oil and gas activities and CBG exploration. However, industry focus can quickly shift, due to several factors and activity levels will respond accordingly. This has been seen in the Horn River Basin and along the Montney Trend with industry's demonstrated ability to react to the emergence of new unconventional resource development activities. The Commission is strongly committed to understanding all possible oil and gas activity throughout British Columbia, including within the EKB, despite currently low activity levels within that basin. This allows the Commission to proactively anticipate and, thus, regulate oil and natural gas activity in a manner that provides sound development of the oil and gas sector, conserves oil and natural gas resources, oversees safe and efficient practices and ensures approved applications are in the public interest with regard to environmental, economic and social effects.

Details in this report show that the footprint of CBG activity in the EKB is substantially less than one per cent of the entire study area (0.11 per cent). The Commission is moving toward a basin management approach to regulating oil and gas resource development which will be defined in the upcoming Basin Management Report. It complements continued oversight of localized, site-specific values. Through basin-level management – which encompasses aspects such as more efficient technology and the use of existing infrastructure, while taking into account existing resource values and the unique characteristics of the EKB – the Commission aims to work together with First Nations, stakeholders and local residents to minimize the CBG impact on the land while overseeing the environmental, public and economic values of the region. The Commission is prepared to undertake tactical analysis as interest and/or activity in the EKB increases.

Moving forward, coordinated divisions within the Commission will continue to diligently regulate all oil and gas activity within the EKB to ensure that it is done in an efficient and environmentally sustainable fashion. The Commission will maintain open communications with industry representatives and collaboratively work with the Ministry of Environment and Ministry of Energy and Mines, along with other partner agencies, to ensure First Nations, local residents and stakeholders are properly informed of planned CBG activity and that oil and gas activity undertaken is done so in a responsible and accountable manner.





Works Cited

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Data Assumptions

In all cases the Commission has erred on the high side with its assumptions in order to calculate oil and natural gas activity in the EKB. There is a risk the results are greater than the reality. All historical activity has been captured with no attempt to remove activities from the calculation where surface disturbance may be recovered, reclaimed or returned to natural state.

Oil and	Data Assumptions
Natural Gas	
Activity	The Commission began to collect data on Access and Development roads in October 2006 and actual widths are used for these calculations. The Ancillary and Other Applications (AAOA) file is tested to pull out ROAD data and roads associated with specific wells are tested for the status of the associated well (note, same criteria as Wells script, below).
Roads	To capture roads constructed prior to October 2006, the Commission utilizes a private sector database from Geomatics Data Management Inc. (GDM). This data is tested to pull out all Oil and Gas roads, and these roads are assigned an average width of 20m for calculation purposes.
	The 20 metre average is based on average road widths from submitted data and has been verified by a sample test from within the Liard Basin. The sample road widths varyied between 12.75 and 19.45 metres. All road data is then combined, compared and overlapping areas are removed.
Pipelines	Pipeline Right of Way (RoW) data has been collected since 2004 and includes actual RoW widths. The Pipe- line Right of Way script queries all pipelines that have a 'construction start' date. Pipelines that do not have a construction start are tested to determine if they have a 'leave to open' (LTO) date. The LTO date informs the query that the pipeline has been constructed to prescribed standards. For pipelines constructed prior to 2004, the Crown Tenures file is used to query 'Oil and Gas Pipeline' then queried further for the tenure type 'Right of Way'.This data provides the actual widths of historical pipelines. All pipeline data is then combined, compared and overlapping areas are removed.
Wells	Well data has been collected by the Commission since 2006 and provides the actual well pad size. The data is queried to filter out wells that are cancelled or do not yet have a well authorization date. The wells that are queried out are then tested to add back in any cancelled well that has surface disturbance. Wells constructed prior to 2006 are queried through IRIS and are assigned an average size of 1.44ha. This number is based on a typical well pad size under permit regulations of the day. This average was tested based on sampling within the Liard Basin. Results show an average well pad size of 1.37m; providing verification that 1.44 ha is a reasonable assumed average.

Facilities	The Commission began collecting data on facilities in 2006. This data is tested to identify those facilities that have a 'leave to open' (LTO) date. The LTO date informs the query that the facility has been constructed to prescribed standards. To capture information on facilities that were built prior to 2006, the Commission queries the Crown Tenures file for Oil and Gas features that are NOT Pipelines or Well sites and ARE classified as facilities (for example, a compressor site as opposed to a decking site). All facility data is then combined, compared and overlapping areas are removed.
Other Oil and Gas Permits	 This is a catchall category which includes all oil and natural gas activities that do not fit into the following categories: wells, pipelines, roads, geophysical programs or facilities. The Commission has collected this data since 2006. From the Ancillary and Other Applications (AAOA) file all data is tested to remove 'ROAD' data because it is captured in other queries. AAOA features that are associated with pipelines are queried for construction start and or leave to open (LTO) date (the same criteria as the pipelines script). AAOA features that are associated with specific wells are tested for the status of the associated well (the same criteria as the wells script). AAOA features that are not associated with wells or pipelines are tested to determine if they are related to KERMIT oil and natural gas activities or 'Other'. Once tested all KERMIT files are tested for LTO status; the 'Other' are tested to determine if they are approved. To capture information on other Oil and Gas Permits that were built prior to 2006, the Commission queries the Crown Tenures file for Oil and Gas features that are NOT already captured. Features associated with energy production data that are NOT wellsites or facilities are included here (i.e., campsites, general, inlet site, landfarm etc.). Quarrying and Industrial data that is issued by the Oil and Gas Commission is also included in this query.
Geophysical	 Data has been collected and managed by the Commission on geophysical activities since 1996. This data is tested as follows: 2006 to current uses the actual width associated with each line because it is available in the data. Pre-2006 data does not include seismic line width information and therefore the following assumptions have been made: Two dimensional programs – cat cut is assumed at seven metres wide. Three dimensional programs – Source Lines are assumed at seven metres and Receiver Lines are assumed at two metres The seven and two metre width assumptions are based on submitted geophysical exploration data and sample testing.

Appendix B – Environmental Studies in East Kootenay Basin Area

The following studies can be accessed through the Ministry of Environment's Ecological Reports Catalogue – EcoCat.



Elk River - 64 Report(s) Found

<u>1993 Attainment Report of Ambient Water</u> <u>Quality Objectives.</u> (Dec 1994) Author: Water Quality Branch, Water Management Division, Ministry of Environment, Lands, and Parks	This document presents the results of monitoring done in 1993 to check attainment of objectives by the Ministry of Environment, Lands and Parks.
2002 Attainment Report of Ambient Water Quality Objectives. (Nov 2003) Author: Burke Phippen	This document presents the results of monitoring done in 2002 to check the attainment of objectives set by the Ministry of Environment, Lands and Parks.
Bighorn Creek Case Study - Combining Established and Innovative Approaches to In- Stream Restoration (Dec 2002) Author: Andrew Wilson and Herb Tepper	Bighorn Creek is located in the Wigwam River drainage of the East Kootenays, which subsequently flows into the Elk River.
Characterization of High Elevation Grasslands in the Upper Elk Valley (Mar 2005) Author: EBA Engineering Consultants Ltd.	BAPID# 4793 FIA# 4384001: High elevation grasslands in the upper Elk River and Fording River valleys are unique in the Front Ranges of the Rocky Mtns in the E. Kootenays. This study commenced because these areas have high conservation value. Objectives: Identification and digital delineation of grasslands in the Fording and Elk River watersheds- A literature review/summary of biological information on the plants, vertebrates and invertebrates in area- development of a plant/butterfly survey.
Data Analyses: Long-term Water Quality Monitoring Report for Elk River at Highway 93, 1968-2000. (Dec 2001) Author: L.W. Pommen	This report assesses water quality data and long-term water quality trends in the Elk River near Highway 93, in accordance to the Canada- British Columbia Water Quality Monitoring Agreement.
Data Analyses: Long-term Water Quality	This report assesses water quality data and



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Monitoring Report for Kootenay River at Creston, 1965-2000. (Nov 2001)	long-term water quality trends in the Kootenay River at Creston, in accordance to the Canada- British Columbia Water Quality Monitoring Agreement.
Data Analyses: Long-term Water Quality Monitoring Report for Kootenay River at Fenwick Station, 1971-2000. (Nov 2001) Author: L.W. Pommen	This report assesses water quality data and long-term water quality trends in the Kootenay River at Fenwick Station, in accordance to the Canada- British Columbia Water Quality Monitoring Agreement.
District of Sparwood Source Water Protection Plan Drinking Water Wells (Jan 2008) Author: UMA Engineering Ltd.	A Source Water Protection Plan and an Emergency Response Plan was completed for the District of Sparwood. Report includes a preliminary study to determine if the water supplied by the water wells is considered Groundwater Under the Direct Influence of Surface Water. These plans will identify land use activities that may threaten the quality of well water, develop a strategy to avoid or minimize these threats and have a contingency plan. District of Sparwood, 19 pp., NTS Map 082G10
Electrofishing Summary Results on the Bull and Elk Rivers Permit No. 96-04-0156 (Sep 1996) Author: Allister McLean	Data collected during the August 1996 sampling period on the Bull and Elk Rivers.
<u>Elk River Creel Survey 2002 Quality Waters</u> <u>Strategy (River Guardian Program)</u> (Mar 2003) Author: K.D. Heidt	A creel survey was conducted on the upper Elk River (Elko to Sparwood) from July 1 to October 31, 2002 to estimate angling effort and catch success. This census consisted of two main components; a roving creel survey and an aerial survey.
Elk River Drainage Post Flood Assessment (Aug 1995) Author: Bill Westover	Selected Elk River tributaries were electoshocked following the extensive flood in the spring of 1995.
Elk River Fish Permit Report CB05-12938 & CB05-13702 (Aug 2005) Author: Jon Bisset; Interior Reforestation Co. Ltd.	Fish Sampling in the Elk River.
Elk River Report (Jan 1971) Author: British Columbia Fish and Wildlife Branch; Hooton, R.; Andrusak, H.; Bull, C. J.	A survey of the Elk River and its tributaries to study the effects of mining activities in the adjacent area.
Elk River Study: Hydrology Overview (Sep 1985) Author: W. Obedkoff	This report assesses a hydrology overview study of the Elk River basin using all available hydrologic information from government agencies and private mining companies.



<u>Elk River Watershed Assessment</u> (Mar 1997) Author: Chapman Geoscience Ltd.	The Elk River discharges into the Salmon River approximately 3 km downstream of the White River, and approximately 10.5 km upstream of Johnstone Strait. The watershed has been logged extensively and continues to be an important timber supply area.
<u>Elk River Watershed Assessment Update</u> (Aug 1998) Author: Chapman Geoscience Ltd.	Field work follow up to the watershed assessments of the Elk and Adam River watersheds.
Elk River Watershed Historic Fish Distribution Project PHASE 1: Desktop Study (Apr 2010) Author: Interior Reforestation Co. Ltd.	In this report, assessment of species composition was conducted at a rudimentary level by contrasting mining influenced exposed sites with sites not located downstream of mines or reference sites of similar habitat to consider the effect of habitat preference.
Elk River Winter Creel 2005 (Mar 2006) Author: Angela Prince; Westslope Fisheries Ltd.	This report describes the winter whitefish fishery on the Elk River, B.C. A creel survey was conducted from 17 January to 31 March 2005 to estimate angling effort and catch success on the Elk River from Elko to Sparwood.
Elk River and Michel Creek at Sparwood Floodplain Mapping (including Cummings Creek) (Sep 1995) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River and Michel Creek at Sparwood Floodplain Mapping (including Cummings Creek) and BC Water Surveys Data
<u>Elk River at Fernie Floodplain Mapping (</u> May 1979) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River at Fernie Floodplain Mapping and BC Water Surveys Data
Elk River at Sparwood Floodplain Mapping (Mar 1980) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River at Sparwood Floodplain Mapping and BC Water Surveys Data
Elk River near Elkford Floodplain Mapping (Sep 1989) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River near Elkford Floodplain Mapping and BC Water Surveys Data
Elk River, Fording River, Clode Creek and Primary Pond Fish Permit Report CB05-12933 (Jun 2005) Author: Jon Bisset; Interior Reforestation Co. Ltd.	Fish sampling on Elk River, Fording River, Clode Main Pond, Clode Creek and Primary Pond.



File 34020-20 Snorkel Survey for Elk River 1992-1994 (Jun 1994) Author: Rimmer, D.W.; Axford, R.; Law, P.

Fish Collection Permit CB08-44417 Foisey, Lodgepole, Michel Creeks, Flathead and Elk Rivers (Sep 2008) Author: Montana Fish, Wildlife and Parks (MFWP)

Fish Collection Permit CB09-53121/56188 Selenium Monitoring (Apr 2010) Author: Interior Reforestation Co Ltd.

Fish Collection Permit CB09-54109 North Fork Flathead River Inventory Project (Sep 2009) Author: Montana Fish, Wildlife & Parks

Fish Collection Permit CB09-54799 & 57706 Aquatic Inventory Elk River (Jun 2010) Author: Interior Reforestation Co Ltd.

Fish Collection Permit CB09-56902 Elk River Fish Salvage (Sep 2009) Author: Gerald G. Oliver

Fish Population and Riverine Habitat Inventory of the Elk River, Sparwood, British Columbia CB07-34054 (Jul 2007) Author: S. Johnston; Applied Aquatic Research Ltd.

Snorkel survey results for Elk River

Excel spreadsheets summarizing the results from sampling project.

Aquatic research on WCT. BT and MW in the Elk River Watershed.

Pollution from proposed mining activities in the British Columbian portion of the Flathead River Drainage has potential to contaminate fisheries of the Flathead Lake and River System. High concentrations of Selenium have been observed in the Elk River, as well as in westslope cutthroat trout in the drainage, due to upstream coalmines.

Aquatic inventory of the Elk River and some of its tributaries. Focus on fish presence absence, invertebrate diversity and biomass, water quality parameters. Streams sampled include Elk River, Fording River, Dry Creek, Little Sand Creek and Kokomun Creek.

Fish salvage in advance of pier construction associated with the installation of a foot bridge crossing of the river.

On behalf of UMA Engineering Ltd. (UMA) and at the request of the District of Sparwood, Applied Aquatic Research Ltd. (AAR) was retained to conduct a fish population and riverine habitat inventory of the Elk River at the crossing proposed. This report presents results of field investigations that were conducted on July 5 and 6, 2007. It is also the purpose of this report to describe aquatic characteristics unique to the crossing proposed.

Fish and Fish Habitat Inventory for Select Tributaries of the Upper Flathead and Elk Rivers reconnaissance level fish and fish habitat (Sep 1997) Author: Interior Reforestation Co. Ltd.

The objective of this project was to undertake inventory to describe watershed wide fish distribution, habitat characteristics and provide stream and riparian classifications.



<u>Drainage</u> (Jan 1996) Author: Interior Reforestation Co. Ltd.	stream classification, four main criteria were identified for each watercourse: 1) The number of stream reaches. 2) Stream channel widths and gradients. 3) Fish distribution throughout each stream length. 4) Identification of species present.
<u>Fisheries Management Implications of Creel</u> <u>Surveys Conducted at the Elk River in Kootenay</u> <u>Region, 1982 - 83</u> (Dec 1983) Author: A.D. Martin	A creel census was conducted in 1982 to 1983 at the Elk River in southeastern British Columbia to examine angler effort and catch distribution, and to analyze age and size structure of catches of cutthroat trout, Dolly Varden char and mountain Whitefish.
Galton Range Bioterrain and Ecosystem Mapping with Wildlife Habitat Ratings Project (Aug 1999) Author: Wildlands Ecological Consulting Ltd - Riddell, R.N.; Genesis Environmental Ltd Riddel, M.; and GVM Geological Consultants Ltd Minning, G.;	Bioterrain and Terrestrial Ecosystem Mapping (1:20000 scale) of the Galton Range consisted of a 15,000 ha study area south of the Elk River located approximately 5 km south of Elko. Information provided describes the study area, methods, digital maps and results.
Genetic analysis of radio-tagged westslope cutthroat trout from St. Marys River and Elk <u>River</u> (Apr 2002) Author: Angela Prince	Tissue samples taken from 40 radio-tagged westslope cutthroat trout caught in two rivers in the Upper Kootenay drainage were analysed using molecular techniques.
Habitat and Fish Population Assessment of the Lower Elk River (Strathcona Park) in Relation to Sport Fisheries Enhancement Potential (May 1979) Author: Tredger, C.D.	Fish habitat and populations of the Elk River, Strathcona Park, Vancouver Island were researched in1978 as part of possible rehabilitation of the Elk Valley. A decline in sport fisheries values in the Elk River and Upper Campbell Lake has occurred from habitat alteration and destruction in the stream. Sports fish not abundant in the Elk River as adult resident or juvenile populations. A general enhancement strategy is outlined and recommendations for stream habitat and improvement are made.
<u>Kootenay River Trout Tagging Program</u> (Apr 1984) Author: Griffith, R. P.	Reconnaissance Report, to observe and assist in the collection of adult trout (for tagging) by means of boatshocking.
Potential Strategies for Fish and Wildlife Habitat Rehabilitation of the Elk River (Strathcona Park), Vancouver Island (Jun 1980) Author: Tredger, C. D.; Russell, J. R. L.: Karanka, E. J.	This entry is a compendum of five separate field investigative studies conducted on the Elk River (Strathcona Provincial Park, Vancouver Island) during 1979, and a separate overall project Summary Report (1980).

Fish-stream Identification in the Upper Elk River For the purpose of assigning the appropriate

Preliminary Summary Report on Potential Strategies for Fish and Wildlife Habitat Rehabilitation of the Elk River in Strathcona Park, Vancouver Island (Jul 1979) Author: Tredger, C. D. At the request of Parks Branch, the Fish Habitat Improvement Section assumed the task of making recommendations regarding restoration and enhancement of fish and wildlife habitat in the Elk River valley. General study objectives included: 1) an evaluation of present fish and elk habitat along the valley, and a determination of protection and enhancement needs, and 2) a hydrological assessment of the Elk River to evaluate channel stability and determine the feasibility of stabilization measures.

<u>A Preliminary Survey of Monument Lake</u> (Jul 1983) Author: Elkfor Rod and Gun Club

<u>A Preliminary Survey of Unnamed Lake</u> <u>00324ELKR</u> (Mar 1985) Author: Elkford Rod and Gun Club

Reconnaissance (1:20,000) Fish and Fish Habitat Inventory of the Upper Elk River Watershed Phases IV to VI (May 2000) Author: Interior Reforestation Co. Ltd.

River Guardian Compliance Monitoring and Angler Survey on 7 East Kootenay Classified Waters - 2006 Quality Waters Strategy (River Guardian Program) (May 2007) Author: K.D. Heidt; BC Ministry of Environment

River Guardian Compliance Monitoring and Angler Survey on East Kootenay Classified Waters - 2007 (River Guardian Program) (Jan 2008) Author: K.D. Heidt

River Guardian Compliance Monitoring and Angler Survey on the Elk River - Winter 2006 Quality Waters Strategy (River Guardian <u>Program</u>) (Jan 2007) Author: K. D. Heidt and B. Stalker 1983 lake survey of Monument Lake in the Elk River watershed.

This lake is located in the Elk River watershed. This brief survey contains drainage information, comments, and a photograph.

Interior Reforestation Co. Ltd. was retained by Crestbrook Forest Industries Ltd. to conduct a reconnaissance (1:20 000) fish and fish habitat inventory of tributaries of the Upper Elk River Watershed.

A compliance monitoring project and angler survey was conducted over a 106 day period by 3 River Guardians on seven classified streams in the East Kootenay Region from July 1 to October 14, 2006. River Guardians were mandated to provide a fisheries presence for compliance monitoring, public relations and educational purposes.

A compliance monitoring project and angler survey were conducted over a 102 day period by 2 River Guardians (RGs) on classified streams in the East Kootenay Region from July 3 to October 12, 2007. Seven streams systems were monitored during the 2007 summer/fall angling season including: Bull River, Elk River, Michel Creek, Skookumchuck Creek, St. Mary River, White River and Wigwam River.

A compliance monitoring project and angler survey were conducted during the winter fishery on the Elk River, in the East Kootenay Region of B.C., from January 13 to March 31, 2006. The survey collected detailed information from anglers including: hours fished, fish caught and released by species, trip length, angling



	methods, residency, license class details, river access, and quality of angling experience.
<u>River Guardian Compliance Monitoring and</u> <u>Angler Survey on East Kootenay Classified</u> <u>Waters - 2008 (River Guardian Program)</u> (Mar 2009) Author: K. D. Heidt; Ministry of Environment	A compliance monitoring project and angler survey were conducted over a 107 day period by 2 River Guardians (RGs) on classified streams in the East Kootenay Region from July 2 to October 17, 2008. Seven stream systems were monitored during the 2008 summer/fall angling season including: Bull River, Elk River, Michel Creek, Skookumchuck Creek, St. Mary River, White River and Wigwam River.
<u>River Guardian Compliance Monitoring and</u> <u>Angler Survey on the Elk and Upper Kootenay</u> <u>Rivers - Winter 2007 (River Guardian Program)</u> (Jan 2008) Author: K.D. Heidt	A compliance monitoring project and angler survey were conducted on the Elk and Upper Kootenay Rivers, in the East Kootenay Region of B.C., from January 29 to March 30, 2007. The project was carried out over a 61 day period during the winter fishery by a River Guardian (RG).
<u>Selenium Mobilization from Surface Coal Mining</u> <u>in the Elk River Basin, British Columbia: A</u> <u>Survey of Water, Sediment and Biota (</u> Sep 1998) Author: Leslie E. McDonald, Mark M. Strosher	The need for a survey of selenium levels in various components of the aquatic environment throughout the Elk River system Arose from the discovery in 1995 of the mobilization of significant quantities of this metalloid element into streams from a large surface coal mine.
Sportfish Population Dynamics In An Intensively Managed River System (Jun 2009) Author: Chad Eric Wilkinson	A Thesis Submitted In Partial Fulfillment Of The Requirements For The Degree Of Master Of Science.
<u>Strathcona Dam and Reservoir Elk River</u> <u>Channel Stability and Mitigative Measures</u> (Jan 1992) Author: Kellerhals Engineering Services Ltd.: Kellerhals, R.	The channel morphology of the lowermost 5 km of the Elk River in Strathcona Park has undergone drastic changes over the last 50 years.
Strathcona Elk Range Restoration Monitoring (BCRP Project # 05.W.Ca.01) (Mar 2006) Author: URSUS Environmental Wildlife and Environmental Resource Consulting; Materi, J. R.P. Bio	This is the fourth year of elk habitat enhancement monitoring in the Strathcona Provincial Park sponsored by the Bridge Coastal Fish and Wildlife Restoration Program (BCRP). The current report summarizes monitoring- related activities from April 2005 through March 2006. A total of 13 sites were enhanced between 2002 and 2004, encompassing roughly 10 ha in each of the Thelwood and Elk River Valleys.
Strathcona Elk Winter Range Restoration Project (BCRP #03.W.ca.01) 2003 Final Report (Mar 2004) Author: Ursus Environmental: Materi, J., R.P.	This report summarizes Bridge Coastal Fish and Wildlife Restoration Program (BCRP) funded elk habitat restoration in Strathcona Provincial Park between April 2003 and March 2004. Its intent is



Bio.	to highlight the restoration and monitoring techniques used, as well as some preliminary results. It is anticipated that several seasons will be required to adequately evaluate the effectiveness of these techniques and their utilization by elk.
<u>Strathcona Park Winter Elk Survey</u> (Mar 1988) Author: Jones, G.	The purposes of this helicopter survey were to: census Roosevelt Elk wintering in the lower Elk River, upper Ucona River, and Pamela Creek areas of Strathcona Park; and assess elk use of the various habitat types in the lower Elk River.
Stream Classification Weyerhaeuser Company Limited North Island Timberlands Block 40259 TFL 39 Elk River Drainage (Apr 2004) Author: FishFor Contracting Ltd	On April 6, 2004, assessments were carried out on a stream located within and adjacent to the proposed Block. Assessment conditions were considered good. The fieldwork was conducted by Cindy Hannah, R.P.Bio. of FishFor Contracting Ltd.
Stream Inventory work conducted in a Variety of Streams in the Kootenays CB05-13702 (Sep 2006) Author: Interior Reforestation Ltd.	Streams surveyed include Angus Creek, Brisco/Botts Bridge Crossing, Bugaboo Creek, Chauncey Creek, Cotton Creek, Elk River, Hartley Creek, Hogg Creek (Peavine Trib.), Hosmer Creek, Line Creek, Little Moyie River, Lois Creek, Lussier River, Septet Creek, Skelly Creek, St. Mary River and Wilkie Creek.
Summer (August 1 - September 15, 1991) Creel Survey on the Elk River from Lladnar Creek to Elko (Jan 1993) Author: W.T. Westover	This report describes the summer fishery on a small portion of the Elk River, six years after a number of restrictive regulations were implemented to improve the fisheries on the system.
Survey Information for the Elk River Watershed CB06-22118 (Jun 2006) Author: Jon bisset; Interior Reforestation Co. Ltd.	FDIS Data for survey work conducted on the Elk River, Michel Creek, Alexander Creek, Barnes Lake Wetland, Harmer Pond, Fording River Oxbow, Line Creek, Clode Pond and Thompsons Pond.
Survey Information for the Elk River Watershed CB06-22627 (Aug 2006) Author: Jon Bisset; Interior Reforestation Co. Ltd.	FDIS Data for survey work conducted on the Elk River, Elk Lakes, Michel Creek, Alexander Creek, Barnes Lake Wetland, Goddard Marsh, Harmer Pond, Fording River, Fording River Oxbow, Line Creek, Clode Pond, Henretta Lake and Thompsons Pond.
Survey Information for the Elk River and Tributaries CB07-33672 (Jul 2008) Author: Interior Reforestation Co. Ltd.	FDIS Data for survey work conducted on Elk River and Tributaries.

Survey of Selenium in Water, Zooplankton and
Fish in Lake Koocanusa, British Columbia, 2008In Augu
water, 2
kokane
downst
conduct(Jul 2009)
Author: McDonald, Lesdownst
conduct

In August of 2008, a survey of selenium (Se) in water, zooplankton and fish (with a focus on kokanee) in Lake Koocanusa, upstream and downstream of the Elk River confluence, was conducted by Kootenay Region, Environmental Protection staff. Selenium is elevated in the Elk River as a result of coal mining within the basin. The goal of this study was to determine metals concentration, specifically Se, above and below inputs from the Elk River.

A creel survey was conducted on seven streams

monitored during the 2004 summer/fall angling season: Bull River, Elk River, Michel Creek, Skookumchuck Creek, St. Mary River, White

in the East Kootenay Region from July 1 to

September 18, 2004. Seven streams were

This report presents water quality trend

information for 68 waterbodies across British

of Environment, Lands and Parks have been

Columbia. Environment Canada and the Ministry

collecting technical data on surface water quality for many years through the Canada - B.C. Water Quality Monitoring Agreement and thus releasing

River and Wigwam River.

this report to the public.

Survey on 7 East Kootenay Streams - 2004 Quality Waters Strategy (River Guardian Program) (Dec 2004) Author: K.D. Heidt; Ministry of Environment

Water Quality Status and Trend Report of 68 Selected British Columbia Waterbodies. (2000) (Mar 2000) Author: Environment Canada and BC Ministry of Environment, Lands and Parks

<u>Wigwam River Bull Trout (Creel Survey) Habitat</u> <u>Conservation Trust Fund Progress Report</u> (<u>1999)</u> (Mar 1999) Author: W.T. Westover; Ministry of Environment

Winter (January 27 - March 31, 1992) Creel Survey of the Elk River from Elko to the East Fernie Bridge (Jan 1994) Author: W.T. Westover

East Kootenay - 68 Report(s) Found

2008 Westslope Cutthroat Trout Population
Abundance Monitoring of Classified Waters in the
East Kootenay Region of British Columbia (Feb 2009)This monitoring study was initiated by the Brit
Columbia Ministry of Environment in respons
concern that mortality or injury resulting from
catch-and-release angling may begin to advert

The present (1999) creel survey was restricted to the lower Elk River and the Wigwam River downstream of Lodgepole Creek.

This report describes the winter whitefish fishery on a small portion of the Elk River and compares results (where possible) to a more intensive survey conducted by Martin (1983) on the Elk River in 1982/83.

This monitoring study was initiated by the British Columbia Ministry of Environment in response to concern that mortality or injury resulting from catch-and-release angling may begin to adversely affect westslope cutthroat trout populations and degrade the angling experience. In August and September, 2008, westslope cutthroat trout abundance in index sections of the Wigwam River, Michel Creek, and St. Mary River were assessed using snorkeling surveys.

Bighorn Creek Case Study - Combining Established and Innovative Approaches to In-Stream Restoration

Bighorn Creek is located in the Wigwam River drainage of the East Kootenays, which



(Dec 2002) Author: Andrew Wilson and Herb Tepper

subsequently flows into the Elk River.

Biophysical Habitats of the Purcell Mountains (Central Portion) - Vegetation Zonation and Vegetation Landscapes for the Purcell Biophysical Area (Jan 1989) Author: Clement, C.J.E.; Shearwater Ecological Services; Demarchi, D.A.; Lea, E.C.& Maxwell, R.C.; B.C. Ministry of Environment; Surveys and Mapping Branch, Department of Energy, Mines and Resources	Biophysical Ecosystem Mapping (1:50,000) was done for the Central Purcell Mountains, located in the southeastern portion of British Columbia, along the eastern flank of the Columbia Mountains. The project identifies biophysical features and provides the ecological framework for ungulate capability mapping, wildlife interpretations and vegetation and terrain interpretations for recreational and other resource management planning concerns.
<u>Bull Mountain - Power Plant Habitat Mapping</u> Author: JMJ Holdings Inc.	Habitat Mapping was done for the Bull Mountain - Power Plant study area.
Canal Flats Operating Area Predictive Ecosystem Mapping (Mar 2001) Author: JMJ Holdings Inc. Ketcheson M. V., Dool, T., Kernaghan G., Lessard, K. and Burns, G.; Wilson, S.; Geosense Ltd. Smith, G.;	Predictive Ecosystem Mapping (1:20000 scale) was initiated in TEMBEC's Canal Flats Operating Area near Cranbrook. The study area covered 497,000 ha. Information provided describes the study area, objectives, methods and results.
Characterization of High Elevation Grasslands in the Upper Elk Valley (Mar 2005) Author: EBA Engineering Consultants Ltd.	BAPID# 4793 FIA# 4384001: High elevation grasslands in the upper Elk River and Fording River valleys are unique in the Front Ranges of the Rocky Mtns in the E. Kootenays. This study commenced because these areas have high conservation value. Objectives: Identification and digital delineation of grasslands in the Fording and Elk River watersheds- A literature review/summary of biological information on the plants, vertebrates and invertebrates in area- development of a plant/butterfly survey.
<u>Columbia River Wetlands: Summary Report</u>	This is a proposal for the Columbia Wetlands. The area is located from Canal Flats to the Mica Reservoir in the East Kootenay region. The wetlands cover approximately 26,000 ha. in area. The reports contains a description of the study area and a strategic plan and recommendations.
<u>Creel census summary kootenay district</u> (Feb 1964) Author: H. Sparrow	Six small lakes in the East Kootenay were in most cases, sampled five days a month for the May to September period. Kootenay Lake was also sampled.
Draft: Irrigation Feasibility Study of East Kootenay Valley (Libby Reservoir) (Jan 1975) Author: Cheng, J.D.	Irrigation feasibility study of East Kootenay Valley (Libby Reservoir), January 1975. Includes background, site description, detailed analysis of historic streamflow and precipitation data, field investigation observations and measured



	discharges, general conclusions of runoff potential, watershed areas in square miles, area- elevation curves for Phillipps Creek watershed, tabulated monthly discharge data, Hydrology Division, 9 pages, NTS Map 082G03
East Columbia Lake Terrestrial Ecosystem Mapping with Wildlife Interpretations (Nov 1998) Author: Ecosystem Mapping - JMJ Holdings Inc.; Marcoux, D.; Terrain Mapping - J.M. Ryder and Associates Terrain Analysis Inc.; Spaeth, D.; Wildlife - Sinclair, B.A.;	Terrestrial Ecosystem Mapping (1:20,000 scale) was done for the East Columbia Study Area. It is situated on the east side of Columbia Lake between Canal Flats and Fairmont Hotsprings. Information provided describes the study area, ecosystem units and wildlife habitat for selected species.
East Kootenay Burbot Population Assessment CB06- 23357 (Mar 2007) Author: Angela Prince; Westslope Fisheries Ltd.	Due to concerns over declining burbot populations in the Kootenay Region, a study was initiated by the BC Ministry of Environment to provide better information on which to base regulations. The purpose of the study was to assess the population abundance and biological characteristics of burbot in four East Kootenay Lakes: Moyie, St. Mary, Columbia and Windermere. This work builds upon initiatives by Ministry of Environment staff in September 2005 on St. Mary and Moyie Lake burbot populations.
Ecosystem Representation in the East Kootenay Conservation Program Study Area (FIA # 4281007 and 4214004 (Nov 2004) Author: Wells, R.W.; Haag, D.; Braumandl, T.; Bradfield, G.; Moy, A.	To support sustainable forest management (SFM) efforts in the East Kootenay region of British Columbia, we undertook an ecosystem representation analysis for the East Kootenay Conservation Program (EKCP) study area. This project is an extension of a pilot project undertaken for the Invermere Timber Supply Area (TSA; Wells et al. 2003b).
Effects of a 2.5 Year Closure of the Cutthroat Fishery on the Upper St. Mary River: Management Implications of Implementing an Alternate Year Closure on East Kootenay Trout Streams (Dec 1984) Author: A.D. Martin and J.M. Bell	A creel census was conducted in 1979 and 1982 on the Upper St. Mary River in southeastern British Columbia to examine angler effort, and catch distribution within one watershed, and to analyze the size and age structure of cutthroat trout prior to and following a 2.5 year angling closure.
Fish Passage Restoration at Culverts in 2000: As-Built Report (Mar 2001) Author: Gerry Naito	The objective of this part of the project was to describe the fish passage restoration works that were undertaken, including detailed material, equipment, and cost breakdown for each site. Three of the sites were on tributaries of Frances Creek in the Columbia River drainage, while the other two were in the Kootenay River drainage on tributaries of the Middle White and Palliser rivers.



<u>Fish and Fish Habitat Assessment in an unlogged,</u> <u>headwater stream in the East Kootenay</u> (Jun 1997) Author: Interior Reforestation Co. Ltd.; Oliver, G.; Colombo, R.; Pennington, B.	This is a fish and fish habitat assessment, undertaken in Baribeau Creek, a fourth order tributary within the upper Kootenay River drainage, during August through October, 1996. The intent of the project was to document fish and fish habitat conditions in an unlogged watershed and evaluate the rating criteria relative to natural conditions in an interior system.
Fish and Fish Habitat Inventory within Unlogged Watersheds - Upper Flathead River (Apr 1997) Author: Interior Reforestation Co. Ltd.	The long-term (10 plus years) objectives of this study were to determine baseline environmental conditions in an unlogged watershed and to evaluate the effectiveness of BC's Forest Practices Code (FPC) in sustaining aquatic ecosystems. The second objective of the study reflects the need to evaluate the adequacy of present FPC regulations and ensure that resource values are not compromised.
<u>Fish and Fish Habitat Inventory within an Unlogged</u> <u>Watershed - Baribeau Creek</u> (Feb 1997) Author: Interior Reforestation Co. Ltd.	The purpose of this study (Phase I: Biophysical Overview, Fish and Fish Habitat Inventory) was to identify the distribution and diversity of fish species, specific habitat components and assign stream-riparian classes in the Baribeau and Brokencup Creeks and their tributaries.
<u>Forest Zonation and Landscape Units for the East</u> <u>Kootenay Map Area (</u> Jan 1980) Author: Lea, E.C.	Biophysical Habitat (Vegetation) and Wildlife Capability Mapping (1:50,000) was done for the East Kootenay map area, covering approximately 1,652,166 hectares. A vegetation map shows forest regions, zones, subzones, and vegetation landscape units. Vegetation maps form a necessary input towards determining management alternatives, constraints, use and productivity.
Galton Range Bioterrain and Ecosystem Mapping with Wildlife Habitat Ratings Project (Aug 1999) Author: Wildlands Ecological Consulting Ltd - Riddell, R.N.; Genesis Environmental Ltd Riddel, M.; and GVM Geological Consultants Ltd. - Minning, G.;	Bioterrain and Terrestrial Ecosystem Mapping (1:20000 scale) of the Galton Range consisted of a 15,000 ha study area south of the Elk River located approximately 5 km south of Elko. Information provided describes the study area, methods, digital maps and results.
<u>Goat River Biophysical Mapping</u> (Jan 1981) Author: Surveys and Mapping Branch , Department of Energy, Mines and Resources	Biophysical Habitat Mapping (1:50,000 scale) was done for the Goat River study area. Ungulate and Grizzly Bear Capability mapping was also done. The study area is located in the East Kootenays with Goat River flowing into the Kootenay River, west of Creston.
Habitat Units for the Sheep Mountain Wildlife Area Author: Wildlife Branch, BC Ministry of the	Mapping (1:20,000) was done for the Sheep Mountain study area. This project provided an

assessment of ungulate wintering habitats and an ecological framework for maintaining or enhancing available forage and cover for a variety of ungulate species. The information presented also provides a framework for assessing habitat use by other wildlife species. The Sheep Mountain Wildlife Area is located in the Southern Rocky Mountain Trench of the East Kootenay region of British Columbia.

BAPID# 5465 FIA# 4891002: This project was

undertaken in partnership with the Canadian

Wildlife Service to address incidental take of

(MBCA). The objectives of the project were to develop and evaluate an approach to identify and

nests, under the Migratory Birds Convention Act

Incidental Take and Protecting Habitat for Migratory Birds in the East Kootenay Region, BC. (Mar 2009) Author: Wells, R.; Stuart-Smith, K.; Mahony, N.; Norris, A.; De Groot, K.

Inlet Creek Water Resource Inventory Report - 2001 (Mar 2002) Author: Nanrich Water Management Consultants Ltd.

Invermere Timber Supply Area Predictive Ecosystem Mapping (PEM) (Jan 2004)

T., Bradley, L., Kernaghan G. and Lessard, K.; Landmapper Environmental Solutions Inc -MacMillan, B.

Kootenay Region Small Lakes Stocking Assessment: 2003 (Feb 2004) Author: G. G. Oliver, M.Sc., R.P.Bio.

Kootenay Region Small Lakes Stocking Assessment: 2002 (Jan 2003) Author: G. G. Oliver

protect habitat for migratory bird species identified under the federal Migratory Birds Convention Act (MBCA). Collection of baseline chemical properties in Inlet Creek Watershed, a high value spawning stream

that feeds White Swan Lake in the East Kootenays.

Predictive Ecosystem Mapping (1:20000 scale) of the Invermere TSA PEM covered an area of Author: JMJ Holdings Inc - Ketcheson M.V., Dool approximately 1,113,513 ha in the south east corner of British Columbia by the city of Invermere. Information provided describes the study area, methods, budget restraints and the results of the project.

> Twelve small lakes in the Kootenay Region were investigated September through October 2003 to assess the performance of rainbow trout stocks outplanted in monoculture systems or lakes having a coarsefish presence.(Province Wide)

> The purpose of the present study is to evaluate rainbow trout stocks across variable stocking densities and assess rainbow trout growth relative to physical, chemical and biological (single/multiple species) conditions. Stock evaluations examine age and growth and lengthweight relationships and compare condition factors across lake environments and management regimes.

Marbled Murrelet Nesting Habitat, Bonanza LU, Lowlevel Heli Assess (Jan 2009) Author: Ecologic Consulting; Leigh-Spencer, S.

BAPID#_5434_FIA#_6762005: Marbled Murrelets (Brachyramphus marmoratus) are federally listed as Threatened by the Committee on the Status of



	Endangered Wildlife in Canada (COSEWIC) and are provincially Red-listed in British Columbia (legally designated or being considered for designation as Extirpated, Endangered or Threatened) (BC Species and Ecosystems Explorer 2008).
Matthew Creek Water Resource Inventory, Final Report - 2006 (Dec 2006) Author: Nanrich Water Management Consultants Ltd.	This is the ninth annual report relating to the water quantity/quality program for Matthew Creek. This monitoring program is administered by Tembec Industries Inc. and funded by the Forest Investment Account. Nanrich Water Management Consultants Ltd. (on behalf of Tembec) has implemented the water quality and water quantity program in Matthew Creek since 1998.
McNeil Substrate Sampling Program: 2003-2008 Summary Report (Jun 2008) Author: K.D. Heidt; Ministry of Environment	Substrate core samples were taken at seven sites from five streams in the East Kootenay Region of British Columbia over a six year period from 2003-2008. The purpose of this project was to collect and analyze stream substrate materials in order to produce trend data valuable in monitoring the condition of stream reaches identified as critical for Bull Trout spawning. This project expands, and was based on, a similar study on the Wigwam River carried out from 1998-2002 (Tepper, 2002).
<u>Memo: Groundwater Survey - Meadowbrook (</u> Jan 1994) Author: Gallo, Michael A.	November 1993 groundwater survey of water wells in Meadowbrook for Regional District of East Kootenay to update groundwater database and identify areas for possible observation well. Includes background, water well survey results, potential observation wells, conclusions and recommendations, site map, property boundary site map, well record summary, Groundwater Section , 12 pages, NTS Map 082G12
Memo: Irrigation Feasibility Study, East Kootenay Valley (Libby Reservoir) (Jun 1974) Author: Harris, R.G.	Progress report on developing irrigation feasibility study of East Kootenay Valley (Libby Reservoir), June 1974. Includes summary of progress, potential sources of water supply, summary of irrigable areas, estimated costs of installing domestic and irrigation supply system, proposed terms of reference and outline for study including water source and groundwater investigations, power supply, design criteria, Water Supply and Investigations Division, 6 pages, NTS Map 082G03
Mount Broadwood Mapping Author: JMJ Holdings Inc.	Ecosystem Mapping (1:20,000 scale) of the Mount Broadwood study area covered



	approximately 12,295 ha. The study area is located in the Kootenay region and south of Fernie.
Mountain goats in the East Kootenay: evaluation of habitat use, wintering strategies, and potential impacts of high-elevation logging; Interim progress report 2004-05 (FIA # 4388002) (Mar 2005) Author: Poole, K.G.; Stuart-Smith, K.; Teske, I.	Mountain goats (Oreamnos americanus) are widespread in the East Kootenay of southern British Columbia, but populations throughout much of the region are thought to have declined in recent years and little is known about their habitat requirements and the impacts of disturbance on populations. The overall goal of this project is to improve the management and conservation of goats within the East Kootenay. See FIA # 4443003 for final reports.
Moyie Lake Burbot Program 2008-09: Sport Fishery, Juvenile Sampling and Conservation Aquaculture/Spawning Surveys (Oct 2009) Author: Matthew D. Neufeld and Colin R. Spence; MOE	A cursory creel survey was conducted during the burbot fishery on North Moyie Lake in late winter, 2009. The survey was undertaken to track trends in effort and catch related to implementation of a new, zero quota burbot angling regulation implemented to prevent overharvests at this popular, East Kootenay site.
Notes on a Preliminary Groundwater Assessment For the East Kootenay Valley (Libby Reservoir) (Sep 1974) Author: Foweraker, J.C.	Preliminary assessment of possibility of obtaining groundwater supplies for irrigation in East Kootenay Valley (Libby Reservoir), September 1974. Includes review of available data and existing reports, local surficial geology, groundwater potential, proposed test hole drilling and monitoring well program, drilling program cost estimates, Bouguer gravity profiles, composite columnar section figure, Groundwater Section, 14 pages, NTS Map 082G03
Noxious Weed Monitoring and Control on Rocky Mountain Bighorn Sheep Winter Range at Wigwam Flats (Dec 2009) Author: T.J. Ross: Ross Range and Reclamation Services	To improve the quality of bighorn sheep winter range an intensive noxious weed control and monitoring program has been implemented at Wigwam Flats.
Preliminary Assessment of Irrigation Possibilities in the East Kootenay Valley (Apr 1977) Author: Ngai, J.W. ; Harris, R.G.	Draft report on preliminary assessment of irrigation possibilities in the East Kootenay Valley, April 1977. Includes synopsis, introduction, description of area, irrigation water demand, potential crop production, sources of water supply, power requirements and supply, water supply proposals, capital and annual costs, summary and recommendations, Water Investigations Branch, 102 pages, NTS Map 082G03
Preliminary Groundwater Assessment For the	Preliminary groundwater assessment for the

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<u>Grasmere Valley East Kootenay District</u> (Mar 1975) Author: Petrie, J.M.	Grasmere Valley East Kootenay Irrigation District, March 1975. Includes site description, water balance equation, groundwater loss to ground, potential recharge and aquifer yield calculations, geology, groundwater production, groundwater requirements, groundwater exploration and recommendations, Phillips Creek monthly discharge data, watershed area summary sheet, Groundwater Section, 10 pages, NTS Map 082G03
Premier Lake Terrestrial Ecosystem Mapping Author: Ecosystem - Kernaghan, G. of JMJ Holdings Inc.; Terrain - Robertson, T. of JMJ Holdings Inc.	Terrestrial Ecosystem Mapping (1:10,000 scale) was done for the Premier Lake study area. The study area is located east of the Kootenay River at Skookumchuk.
Premier Ridge - Diorite Terrestrial Ecosystem Mapping (TEM) Project with Preliminary Species Habitat Models (Apr 2000) Author: JMJ Holdings Inc Kernaghan, G., Lessard, K. and Ketcheson M.V.	Terrestrial Ecosystem Mapping (1:20,000 scale) for the Premier Ridge - Diorite study area covered approximately 36,900 ha and was located just east of the Kootenay River, between Canal Flats and Wasa Lake, BC. Information provided describes the study area, methods and results of the project.
<u>A Reconnaissance Survey of Fish Lake: East Kootenays</u> <u>1974 00568SMAR</u> (Jul 1974) Author: Parkin; Gunville	This report includes information on geography, temperature series, obstructions and pollutions, misc., resort and campsite, habitation, access and oxygen.
Region 4E - Kootenay Aerial Boat Counts (2003 to 2005) (Nov 2005) Author: Herb Tepper	Aerial boat counts were conducted at 45 lakes on the Kootenay flight line in the East Kootenays over a three year period (2003 to 2005). The objectives of the counts were to determine if significant changes in angler effort had occurred due to management changes and to identify lakes with potential management issues where more detailed lake assessments may be required.
Regional Habitat Maps (Jan 1989) Author: Wildlife Branch, BC Ministry of Environment	1:500,000 scale habitat mapping for the following Regions: Cariboo, East Kootenay, Okanagan, Thompson-Nicola, West Kootenay, Skeena, Omineca, Peace, Queen Charlotte Islands, Lower Mainland and Vancouver Island.(Province Wide)
<u>The Relation of the Redside Shiner to Production of</u> <u>Trout in British Columbia</u> (Dec 1950) Author: Lindsey, C. C.	During the investigation information was also obtained concerning the effect of conditions prior t o hatching on the structure of adult shiners. It may be possible, from this and similar investigations, t o distinguish hatchery-reared from wild game fish by examination of variable characters in the adults, as an aid in assessing and planning management policy of sports



fisheries.

River Guardian Compliance Monitoring and Angler Survey on 7 East Kootenay Classified Waters - 2006 Quality Waters Strategy (River Guardian Program) (May 2007) Author: K.D. Heidt; BC Ministry of Environment	A compliance monitoring project and angler survey was conducted over a 106 day period by 3 River Guardians on seven classified streams in the East Kootenay Region from July 1 to October 14, 2006. River Guardians were mandated to provide a fisheries presence for compliance monitoring, public relations and educational purposes.
River Guardian Compliance Monitoring and Angler Survey on East Kootenay Classified Waters - 2007 (River Guardian Program) (Jan 2008) Author: K.D. Heidt	A compliance monitoring project and angler survey were conducted over a 102 day period by 2 River Guardians (RGs) on classified streams in the East Kootenay Region from July 3 to October 12, 2007. Seven streams systems were monitored during the 2007 summer/fall angling season including: Bull River, Elk River, Michel Creek, Skookumchuck Creek, St. Mary River, White River and Wigwam River.
River Guardian Compliance Monitoring and Angler Survey on the Elk River - Winter 2006 Quality Waters Strategy (River Guardian Program) (Jan 2007) Author: K. D. Heidt and B. Stalker	A compliance monitoring project and angler survey were conducted during the winter fishery on the Elk River, in the East Kootenay Region of B.C., from January 13 to March 31, 2006. The survey collected detailed information from anglers including: hours fished, fish caught and released by species, trip length, angling methods, residency, license class details, river access, and quality of angling experience.
<u>River Guardian Compliance Monitoring and Angler</u> <u>Survey on East Kootenay Classified Waters - 2008</u> (<u>River Guardian Program</u>) (Mar 2009) Author: K. D. Heidt; Ministry of Environment	A compliance monitoring project and angler survey were conducted over a 107 day period by 2 River Guardians (RGs) on classified streams in the East Kootenay Region from July 2 to October 17, 2008. Seven stream systems were monitored during the 2008 summer/fall angling season including: Bull River, Elk River, Michel Creek, Skookumchuck Creek, St. Mary River, White River and Wigwam River.
River Guardian Compliance Monitoring and Angler Survey on the Elk and Upper Kootenay Rivers - Winter 2007 (River Guardian Program) (Jan 2008) Author: K.D. Heidt	A compliance monitoring project and angler survey were conducted on the Elk and Upper Kootenay Rivers, in the East Kootenay Region of B.C., from January 29 to March 30, 2007. The project was carried out over a 61 day period during the winter fishery by a River Guardian (RG).
<u>River Guardian Compliance Monitoring and Angler</u> <u>Survey on the Upper Kootenay River - Winter 2008</u> (River Guardian Program) (Feb 2009)	A compliance monitoring project and angler survey was conducted on the Upper Kootenay River, in the East Kootenay Region of B.C., from

Author: K.D. Heidt; Ministry of Environment	February 12 to March 30, 2008. The project was carried out over a 48 day period during the winter fishery by two River Guardians (RGs).
Rocky Mountain Bighorn Sheep Habitat and Population Assessment for the East Kootenay Trench (Mar 2007) Author: Trevor A. Kinley; Sylvan Consulting Ltd.	To better understand current, herd-specific conditions for Rocky Mountain bighorn sheep wintering in the Rocky Mountain Trench, the East Kootenay Wildlife Association embarked on a 5- year project to investigate habitat use, habitat selection, range condition and mortality for 3 herds and 4 winter ranges along the eastern edge of the Rocky Mountain Trench.
Russell Creek Water Resource Inventory Final Report - 2002 (Mar 2003) Author: Nanrich Water Management Consultants, F.Westcott, R.P. Bio.	Annual summary of water quality and quantity baseline data collected in Russell Creek watershed in 2002.
Sage Creek Channel Conditions Prescriptions and Assessment (CCPA) (Mar 1999) Author: Dillon Consulting Limited	The Channel Conditions Prescriptions and Assessment (CCPA) is one component of an integrated watershed restoration project conducted for the B.C. Ministry of Environment, Lands and Parks (MoELP) by Dillon Consulting Limited (Dillon) in the Sage Creek watershed. Sage Creek is located in the extreme southeast corner of the province (East Kootenays) in both the Engleman-Spruce and Montane-Spruce Biogeoclimatic Zones.
Sage Creek Fish Habitat Assessment Procedure (FHAP) (Mar 1999) Author: Dillon Consulting Limited	The Sage Creek FHAP was conducted in two phases - the Overview Assessment Phase and the Level 1 Field Assessment Phase.
Springbrook Project: an Approach to Evaluating Multiple Resource Use Alternatives (Aug 1975) Author: Environment and Land Use Committee (ELUC) Secretariat	The main objective is to advance knowledge of the type of data and analytical techniques required to undertake integrated resource planning. Biophysical Mapping (1:50,000 scale) was done for the Springbrook study area. Springbrook is located in the East Kootenays just north of Fort Steele Heritage Town.
<u>St. Mary River</u> (Jan 1973)	Logging road access development has rapidly increased in the East Kootenay since the Crestbrook pulp mill started operations in 1968.
Steamboat Mountain Terrestrial Ecosystem Mapping with Wildlife Interpretations (Jun 1998) Author: JMJ Holdings Inc Kernaghan, G., Sinclair B.A., Lessard, K., Spaeth, D. and Ketcheson, M.V.	Terrestrial Ecosystem Mapping (1:20,000 scale) with wildlife interpretations was done for the Steamboat Mountain study area. The study area is located northwest of Radium Hot Springs, BC and is approximately 75 000 ha. in size. Information provided describes the study area, methods and results.



Summer Recreation Use: 1974 Springbrook Wildlife Management Area: East Kootenays, British Columbia: <u>A Pilot Project.</u> (Dec 1974) Author: James Duncan and Laura Duncan

Survey on 7 East Kootenay Streams - 2004 Quality Waters Strategy (River Guardian Program) (Dec 2004) Author: K.D. Heidt; Ministry of Environment

Survey on 7 East Kootenay Streams - 2005 Quality Waters Strategy (River Guardian Program) (Dec 2005) Author: K.D. Heidt; Ministry of Environment

Terrestrial Ecosystem Mapping (TEM) with Wildlife Suitability/Capability Interpretation of Slocan Forest Products Ltd. Radium Division (Feb 2001) Author: JMJ Holdings Inc. - Kernaghan, G., Lessard, K., Sinclairm B., McKay, R., Burns, G. and Ketcheson M.V. The following report documents a pilot project undertaken to gain insight about the kinds of people that make use of the Springbrook Wildlife Management unit as a recreation resource and how they spend their time within the Springbrook boundaries during July and August.

A creel survey was conducted on seven streams in the East Kootenay Region from July 1 to September 18, 2004. Seven streams were monitored during the 2004 summer/fall angling season: Bull River, Elk River, Michel Creek, Skookumchuck Creek, St. Mary River, White River and Wigwam River.

An angler survey was conducted over a 101 day period by 2 River Guardians on seven classified streams in the East Kootenay Region from July 1 to October 9, 2005. The survey collected information from guided and non-guided anglers including: hours fished, fish caught and released by species, trip length, angling methods, place of residence, licence details, river access and guality of angling experience.

Terrestrial Ecosystem Mapping (1:50000 scale) with wildlife suitability/capability interpretation was done for Slocan Forest Products Ltd's Forest Licence A 18979. The study area is located near Radium Hotsprings, BC and is approximately 236,550 ha. in size and occupies several areas on both sides of the East Kootenay Trench. Information provided describes the study area, methods, objectives and results of the project.

Tree Farm Licence 14 - Terrestrial Ecosystem Mapping Terrestrial Ecosystem Mapping (1:20000 scale) of (TEM) Project with Wildlife Habitat Ratings (Apr TFL 14 covered an area of approximately 151,000 ha and is located just east of Parson, 1999) B.C. and south of Golden, BC. Information Author: JMJ Holdings Inc. - Kernaghan, G., provided describes the study area, objectives, Lessard K., Sinclair, B., McKay, R., Burns, G. methods, databases, results and wildlife habitat and Ketcheson M.V. ratings. This report compiles and summarizes the data Upper Kootenay River Juvenile Bull Trout and Fish contained in nine separate juvenile bull trout and Habitat Monitoring Program: 2000-2005 Summary fish habitat monitoring projects that make up the, (Mar 2007)

Author: R.S. Cope; Westslope Fisheries Ltd.

contained in nine separate juvenile bull trout and fish habitat monitoring projects that make up the, "Upper Kootenay juvenile bull trout (Salvelinus confluentus) and fish habitat-monitoring program (2000 - 2005)". The three study watersheds (Wigwam River, Skookumchuck Creek, White River) are considered the three most important bull trout spawning streams in the upper

Kootenay River.

Water Quality Trends Assessment: Matthew and Russell Creeks (Mar 2004) Author: Hugh Hamilton, P. Ag., Susan Stoddart, R.P. Bio., Summit Environmental Consultants Ltd.

<u>Water Resources of the Springbrook Area East</u> <u>Kootenay Region (Jan 1976)</u> Author: D.E. Reksten, J.D. Cheng

<u>Westslope Cutthroat Trout Studies in the Upper Bull</u> <u>River: Preliminary Surveys Conducted in Fall 2003</u> (Mar 2004) Author: James Baxter; BC Hydro

<u>Whiteswan Lake O&M - 2008</u> (Dec 2008) Author: Kevin Heidt; Ministry of Environment A preliminary evaluation of water quality trends based on six years of water quality monitoring data collected in Matthew and Russell Creeks in the East Kootenays.

This report contains assessments of snowpack conditions, runoff regime, water use and water quality. Some general comments regarding the possible effects of logging and other land uses on the hydrology of the study area are made.

This report summarizes the results of westslope cutthroat trout (Oncorhynchus clarki lewisi) monitoring in the upper Bull River in 2003 by BC Hydro. Work conducted included mark-recapture population estimates in a 18 km section of the river from Sulphur Creek to Galbraith Creek, and the collection of life-history data on the population.

Over a period from May 6 to June 21, 2008, a fisheries technician spent approximately 23 field days at Whiteswan Lake, in the East Kootenay Region of British Columbia. During this period, the technician conducted a creel survey, recorded fish lengths from harvested rainbow, conducted weekly rainbow spawner bank counts, installed a fish barrier fence, maintained and adjusted flow regime control structures.

<u>Wigwam River Water Quality and Quantity</u> <u>Monitoring Program 2002 Data Report</u> (Feb 2003) Author: Westslope Fisheries Ltd., Angela Prince M.Sc., R.P. Bio. Annual report of an ongoing Water Quality and Quantity monitoring program on Wigwam River in the East Kootenays.

Sparwood - 12 Report(s) Found

District of Sparwood Source Water Protection Plan Drinking Water Wells (Jan 2008) Author: UMA Engineering Ltd. A Source Water Protection Plan and an Emergency Response Plan was completed for the District of Sparwood. Report includes a preliminary study to determine if the water supplied by the water wells is considered Groundwater Under the Direct Influence of Surface Water. These plans will identify land use activities that may threaten the quality of well water, develop a strategy to avoid or minimize these threats and have a contingency plan. District of Sparwood, 19 pp., NTS Map 082G10



Elk River Creel Survey 2002 Quality Waters Strategy (River Guardian Program) (Mar 2003) Author: K.D. Heidt	A creel survey was conducted on the upper Elk River (Elko to Sparwood) from July 1 to October 31, 2002 to estimate angling effort and catch success. This census consisted of two main components; a roving creel survey and an aerial survey.
<u>Elk River Winter Creel 2005</u> (Mar 2006) Author: Angela Prince; Westslope Fisheries Ltd.	This report describes the winter whitefish fishery on the Elk River, B.C. A creel survey was conducted from 17 January to 31 March 2005 to estimate angling effort and catch success on the Elk River from Elko to Sparwood.
Elk River and Michel Creek at Sparwood Floodplain Mapping (including Cummings Creek) (Sep 1995) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River and Michel Creek at Sparwood Floodplain Mapping (including Cummings Creek) and BC Water Surveys Data
<u>Elk River at Sparwood Floodplain Mapping (</u> Mar 1980) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River at Sparwood Floodplain Mapping and BC Water Surveys Data
Fish Collection Permit Summary Report For Permit No.: CB07-36726 (Mar 2008) Author: North/South Consultants Inc.	BP Canada Energy Company (BP) has proposed a three- to five-year technical appraisal program to assess the feasibility of a coal bed gas (CBG) development in southeast British Columbia (BC). The proposed project (the Project) is located south of the town of the Municipal District of Sparwood and east of the City of Fernie (Figure 1-1).
Fish Population and Riverine Habitat Inventory of the Elk River, Sparwood, British Columbia CB07-34054 (Jul 2007) Author: S. Johnston; Applied Aquatic Research Ltd.	On behalf of UMA Engineering Ltd. (UMA) and at the request of the District of Sparwood, Applied Aquatic Research Ltd. (AAR) was retained to conduct a fish population and riverine habitat inventory of the Elk River at the crossing proposed. This report presents results of field investigations that were conducted on July 5 and 6, 2007. It is also the purpose of this report to describe aquatic characteristics unique to the crossing proposed.
<u>Kootenay Fisheries Field Report Grave Lake</u> <u>Assessment</u> (May 2009) Author: Herb Tepper; Ministry of Environment	Grave Lake is located approximately 15 kilometers northeast of the community of Sparwood. Grave Lake has a surface area of 120.4 hectares, a maximum depth of 28 meters, a mean depth of 17.3 meters and is located at an elevation of 1280 meters (Fish Wizard).



<u>Kootenay Fisheries Field Report Summit Lake</u> (<u>Crowsnest</u>) (Feb 2006) Author: Herb Tepper	Summit Lake is located approximately 21 kilometer southeast of Sparwood, B.C. Summit Lake has a surface area of 20.44 hectares, a maximum depth of 5.0 meters and a mean depth of 3.7 meters, and is located at an elevation of 1364 meters (Fish Wizard).
<u>River Guardian Compliance Monitoring and Angler</u> <u>Survey on the Elk River - Winter 2006 Quality Waters</u> <u>Strategy (River Guardian Program)</u> (Jan 2007) Author: K. D. Heidt and B. Stalker	A compliance monitoring project and angler survey were conducted during the winter fishery on the Elk River, in the East Kootenay Region of B.C., from January 13 to March 31, 2006. The survey collected detailed information from anglers including: hours fished, fish caught and released by species, trip length, angling methods, residency, license class details, river access, and quality of angling experience.
<u>River Guardian Compliance Monitoring and Angler</u> <u>Survey on the Elk and Upper Kootenay Rivers - Winter</u> <u>2007 (River Guardian Program)</u> (Jan 2008) Author: K.D. Heidt	A compliance monitoring project and angler survey were conducted on the Elk and Upper Kootenay Rivers, in the East Kootenay Region of B.C., from January 29 to March 30, 2007. The project was carried out over a 61 day period during the winter fishery by a River Guardian (RG).
Sportfish Population Dynamics In An Intensively Managed River System (Jun 2009) Author: Chad Eric Wilkinson	A Thesis Submitted In Partial Fulfillment Of The Requirements For The Degree Of Master Of Science.
Fernie - 11 Report(s) Found Data Analyses: Long-term Water Quality Monitoring Report for Flathead River at the International Border, 1980-2004. (Aug 2005) Author: L.W. Pommen	This report assesses water quality data and long- term water quality trends in the Flathead River at the international border, in accordance to the Canada- British Columbia Water Quality Monitoring Agreement.
<u>Elk River at Fernie Floodplain Mapping (</u> May 1979) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River at Fernie Floodplain Mapping and BC Water Surveys Data
<u>Fernie Landfill Closure-Blackstone Resort Golf Course</u> <u>Aquatic Field Report 2005-07 Environmental Impact</u> <u>Assessment CB07-34609</u> (Jul 2007) Author: Sharleen Hamm; Gartner Lee Limited	Excel spreadsheets summarizing the results from sampling project.
<u>Fish Collection Permit Summary Report For Permit</u> <u>No.: CB07-36726</u> (Mar 2008) Author: North/South Consultants Inc.	BP Canada Energy Company (BP) has proposed a three- to five-year technical appraisal program to assess the feasibility of a coal bed gas (CBG) development in southeast British Columbia (BC). The proposed project (the Project) is located



	south of the town of the Municipal District of Sparwood and east of the City of Fernie (Figure 1-1).
Fish Habitat Assessment and Prescriptions: Bighorn Creek Reaches 1 & 2 (Nov 2001) Author: Summit Environmental Consultants Ltd.	This report presents an assessment of fish habitat and prescriptions for restoration of Reaches 1 and 2 of Bighorn Creek, located approximately 35 km southeast of Fernie, B.C. The project was undertaken by Tembec Industries Inc. with Forest Renewal B.C. (FRBC) funding and follows a suite of FRBC-funded studies, prescriptions, and construction activities that have been completed to date in the Bighorn Creek watershed.
Hartley Creek Restoration Project-2007 As-built Report (Jan 2008) Author: Interior Reforestation Co Ltd	As requested, we are providing the following interim letter report for Ministry of Transportation (MOT) to provide an update the progress of restorative works at Hartley Creek in south eastern BC, Canada. In 2006, Interior Reforestation Ltd. Co. of Cranbrook, BC was approached by the British Columbia Ministry of Transportation to provide recommendations for improving bedload movement through the Hartley Creek Highway 3 crossing north east of Fernie, BC.
Mount Broadwood Mapping Author: JMJ Holdings Inc.	Ecosystem Mapping (1:20,000 scale) of the Mount Broadwood study area covered approximately 12,295 ha. The study area is located in the Kootenay region and south of Fernie.
Report Review: Water Availability Assessment Boardman Creek at Fernie Snow Valley Ltd. Ski Area by Hardy BBT Ltd. March 15, 1990 (Mar 1990) Author: W. Obedkoff	A collection of Memorandums pertaining to Estimated Low Flows for Boardman Creek.
Revelstoke Fisheries Stream Survey Diary (Sep 1985) Author: H.A. Smith	A highland Helicopter was used during this first phase of the fisheries stream survey.
<u>Riparian/Floodplain Rehabilitation Treatment In</u> <u>Reach 4 of Bighorn Creek</u> (Jan 2002) Author: Ethan Askey, MRM, P.Ag.	Bighorn Creek is a major tributary to the Wigwam River, southeast of Fernie BC. The stream channel near the confluence of these drainages represents highly valued spawning habitat for bull trout in particular, and also valued habitat for Westslope cutthroat.
Winter (January 27 - March 31, 1992) Creel Survey of the Elk River from Elko to the East Fernie Bridge (Jan 1994) Author: W.T. Westover	This report describes the winter whitefish fishery on a small portion of the Elk River and compares results (where possible) to a more intensive survey conducted by Martin (1983) on the Elk

River in 1982/83.

Elkford - 16 Report(s) Found

Elk River near Elkford Floodplain Mapping (Sep 1989) Author: BC Water Surveys Unit and Canada-BC Floodplain Mapping Program	Elk River near Elkford Floodplain Mapping and BC Water Surveys Data
Kootenay Fisheries Field Report Lost Lake Assessment (May 2009) Author: Herb Tepper; Ministry of Environment	Lost Lake is located approximately 2 kilometers east of the community of Elkford. Lost Lake has a surface area of 3.6 hectares, a maximum depth of 7.6 meters and is located at an elevation of 1501 meters.
A PRELIMINARY SURVEY OF MYSTERY LAKE (Aug 1984) Author: ELKFORD ROD AND GUN CLUB	A preliminary survey of Mystery Lake, fish sampling, temperature profile, physical measurements,Chemical characteristic, and bathymetric map of Mystery Lake. Fish species none. Old reference number BCLKS-3849.
<u>A Partial Preliminary Survey of Cumming Creek Lake</u> (Aug 1983) Author: Elkford Rod and Gun Club	This partial report includes information on location, photos.
<u>A Preliminary Survey of Boulder Lake</u> (Sep 1984) Author: Elkford Rod and Gun Club	This report includes information on location, access, physical area, Temperature, Inlets and Outlets, Bathymetric Map and Photos.
<u>A Preliminary Survey of Burl Lake</u> (Jun 1986) Author: Elkford Rod and Gun Club	Data on file for this survey includes: access, physical data, temperature, inlet/outlet, and species present.
<u>A Preliminary Survey of Caverns Lake</u> (Aug 1983) Author: Elkford Rod and Gun Club	Data on file for this survey includes: access, physical, temperature, inlet and outlet information, shrimp present, other aquatic life, and weeds. No fish were observed in this lake.
<u>A Preliminary Survey of Crossing Creek Lakes</u> (Jul 1983) Author: Elkford Rod and Gun Club	This preliminary survey contains information on: access, other comments, and photographs.
<u>A Preliminary Survey of Deep Lake</u> (Jul 1983) Author: Elkford Rod and Gun Club	Data on file for this preliminary survey includes: physical, temperature, inlet and outlet, aquatic life, map, and photography. No fish were observed in this lake.
<u>A Preliminary Survey of Driftwood Lake</u> (Jul 1983) Author: Elkford Rod and Gun Club	This preliminary survey has information on: access, physical, temperature, inlet and outlet flow, fish and other aquatic life, and photographs.

<u>A Preliminary Survey of Duck Lake</u> (Jul 1983) Author: Elkford Rod and Gun Club	This preliminary survey contains information on: access, temperature, inlet and outlet, aquatic invertebrates, and fish netting. Cutthroat Trout were found in this lake.
<u>A Preliminary Survey of Long Bingay Lake</u> (Jul 1983) Author: Elkford Rod and Gun Club	This lake (00086ELKR) is located 35.4 km from Elkford. Data on file for this survey includes: location, physical, access, miscellaneous, drainage, dissolved oxygen and temperature profile, bathymetric sketch, and photography.
<u>A Preliminary Survey of Riverside Lake 00019ELKR</u> (Jul 1983) Author: Elkford Rod and Gun Club	Includes physical data, temperature and oxygen information, flow, outlet stream information, fish presence, aquatic life, and other comments. A lake depth diagram is provided.
<u>A Preliminary Survey of Sunkist Lake</u> (Jun 1985) Author: Elkford Rod and Gun Club	A preliminary survey of Sunkist Lake within the Region completed on June 22, 1985.
<u>A Preliminary Survey of Unnamed Lake 00324ELKR</u> (Mar 1985) Author: Elkford Rod and Gun Club	This lake is located in the Elk River watershed. This brief survey contains drainage information, comments, and a photograph.
A Preliminary Survey of Unnamed Lake Southwest of Hook (Sep 1984) Author: Elkford Rod and Gun Club	This lake (00075BULL) is in the Bull River watershed group. Data on file for this survey includes: access, physical, invertebrates (shrimp), other comments, bathymetric sketch, and photography.

No fish were found in this lake.

