

# Lithostratigraphy of the Comox and Trent River Formations in the Comox Coalfield, Vancouver Island (92F/7, 10, 11, 14)

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## INTRODUCTION

This report is part of an ongoing study, begun in 1987, to establish the distribution, sedimentology and resource stratigraphy of the Vancouver Island coalfields. Knowledge of the extent and quality of the coal deposits and associated natural gas resources is essential to land-use planning along the increasingly-urbanised western shores of Georgia Strait.

Results of this study have included five fieldwork papers (Bickford and Kenyon, 1988; Kenyon and Bickford, 1989, Bickford, *et al.*, 1989 and 1990; Cathyl-Bickford, 1992), one stand-alone paper (Kenyon, Bickford and Hoffman, 1991) and a set of fourteen maps (Cathyl-Bickford and Hoffman, 1998). In the course of this work, 21 stratigraphic sections were measured, and four of the sections were published (in Kenyon, *et al.*, 1991). Although new lithostratigraphic units were introduced and used in some of these publications as well as Mustard (1994), no type-sections have yet been described for the new rock-units and their definitions have therefore remained incomplete by modern standards.

In this year's field programme, additional stratigraphic sections have been measured, allowing the formal proposal of type-sections for six of the members within the coal-measures and overlying marine strata of the Comox sub-basin. Four measured stratigraphic sections are presented in this report, in the expectation that they will prove useful to exploration geologists working in the Comox sub-basin, as well as providing a much-needed lithostratigraphic context for amateur and professional paleontological collectors.

## LOCATION AND ACCESS

The study area covers the east-central coastal plain of Vancouver Island, extending southeastward from Headquarters Creek (in 92F/14) to Cougarsmith Creek (in 92F/7). A dense network of public and private roads affords access to the area, with the exception of the river and stream canyons which must be traversed on foot. Some of the smaller streams are choked with logging de-

bris, requiring an exhausting combination of wading, swimming and burrowing between wet logs and clumps of devils-club. Rivers and streams within the study area are subject to winter and spring freshets, and are best accessed for geological purposes during their seasonal low flows in August and September. Fieldwork is virtually impossible during January and February, owing to torrential rains relieved only by occasional heavy wet snows. Outside of the canyons, slopes are gentle to moderate, and much of the study area is blanketed by unconsolidated glacial, glaciofluvial and glaciomarine sediments. Courtenay and Comox are the major population centres in the study area.

## Fieldwork

In contrast to previous years' programmes, only a modest amount of geological mapping was undertaken in 2000, mainly along the newly-constructed subgrade of the Vancouver Island Highway. Geological stations were located by reference to construction stakes along the highway, and positions marked on grading plans provided by the Ministry of Transportation and Highways. Outside of the area covered by the highway plans, forest cover maps provided by Weyerhaeuser Canada were used for station-keeping alongside logging roads and within cutblocks. Orthophotos provided by the Regional District of Comox-Strathcona were used to select and locate sites for outcrop sections along the stream and river canyons.

## Geological Setting

The study area comprises the central third of the Comox sub-basin of the Late Cretaceous Georgia Basin. Coal measures occur within the non-marine portions of the Comox Formation (Bickford and Kenyon, 1988). The Comox Formation dips gently to moderately eastward, and is overlain by the Cretaceous marine rocks of the Trent River Formation, and unconsolidated Pleistocene sediments. Sills and laccoliths of probable Tertiary age cut the Comox Formation between Puntledge and Browns Rivers, northwest of Courtenay. Economic basement within the study area is formed by Triassic volcanic and volcanoclastic rocks of the Karmutsen Formation.

## STRATIGRAPHY

Cretaceous rocks of the study area have been the target of considerable mapping, drilling and mining for more than 125 years (Richardson, 1878; McKenzie, 1922), and the basics of their lithostratigraphy have been established since 1911 (Clapp, 1912). Nevertheless, type and reference sections of the rocks have not been formalised beyond preliminary studies in the 1960's and 1970's (Muller and Jeletzky, 1970; Muller and Atchison, 1971; Atchison, 1968), and the depiction of section locations on regional geological maps (Cathyl-Bickford and Hoffman, 1998).

Type sections and surface reference sections for most of the members of the Comox and Trent River formations are proposed below. Measured sections accompanying this paper are designated as No.5 through No.8, following the previously-published sections No.1 through No.4 (Kenyon *et al.*, 1991). Only the basal portion of the Trent River Formation has been included in the present discussion, since its poorly-exposed upper portion requires further study before its subdivision can be confidently and fully documented.

### Comox Formation

The Comox Formation was introduced by Clapp (1912) for a dominantly sandy succession of coals and clastic sedimentary rocks exposed in the vicinity of the Comox coal mines, southwest of Comox Harbour. Clapp did not report a detailed section of the formation, and he did not specify its type locality beyond the most general terms. Bickford and Kenyon (1988) proposed three subdivisions of the formation within the Comox sub-basin: the basal Benson conglomerate, overlying Cumberland coal measures, and uppermost Dunsmuir sandstone, but specified type sections for none of them. In the present study, sections have been measured of the coal-bearing Cumberland and Dunsmuir members. The basal, dominantly-conglomeratic Benson Member has not been studied in detail owing to its lack of significant coal beds, and the general inaccessibility of its outcrops.

#### *Cumberland Member*

The Cumberland Member is named for the Cumberland coal-mining district (Bickford and Kenyon, 1988). Its proposed type-section is in the western part of the middle canyon of Browns River [*see* GeoFile 2001-1 ([www.em.gov.bc.ca/mining/geosurv/publications/catalog/cat\\_geof](http://www.em.gov.bc.ca/mining/geosurv/publications/catalog/cat_geof)), measured section No.5], where it is 73.1 metres thick, exclusive of a dacite sill 0.75 metres thick. The type-section may be reached by walking westward along the canyon floor from the Duncan Bay Main logging road, or by descending the north wall of the canyon from the western end of the mostly-overgrown Browns River Main logging road.

The Cumberland Member interfingers with the underlying Benson Member (where present); in most of the basin, the Benson is absent and the Cumberland unconformably overlies the Karmutsen Formation. The

sub-Comox unconformity is irregular in detail, marked by considerable local relief (McKenzie, 1922; Graham, 1924; Muller and Atchison, 1971). Paleoscarps up to 10 metres high are visible in some outcrops. In a few localities, such as in the middle canyon of the Tsalie River near the old mine pumphouse, the Karmutsen paleosurface is mantled by a few metres of grey volcanoclastic sandstones and possible tuffs, which may be of older Cretaceous age.

The Cumberland Member is abruptly (and locally erosionally) overlain by the Dunsmuir Member of the Comox Formation. Channel-filling sandstone, and blankets of siltstone, variably-carbonaceous mudstone and coal are the dominant lithologies of the Cumberland Member. The Comox No.2 coal bed and its associated splits, the Comox No.2 Rider and Comox No.2A, form the best stratigraphic markers within the Cumberland Member. The Cumberland ranges in thickness from 0.2 to 160.4 metres, with a median thickness of 65 metres.

The Cumberland thickens to the southeast, and thins to the north and west of its type locality. Thickness of the Cumberland is controlled mainly by basement paleotopography, and to a lesser extent by erosion of its uppermost beds; geophysical correlations of coal beds suggest that up to 20 metres of the uppermost Cumberland (including the Comox No.2 Rider coal bed) is locally absent due to the sub-Dunsmuir disconformity. Probable depositional environments of the Cumberland include meandering streams, alluvial plains and mires within a low-energy deltaic system.

The Cumberland contains numerous well-preserved plant fossils, mainly in the immediate roofs and floors of coal beds; these indicate a general Late Cretaceous, possibly Santonian, age. Outside of the Quinsam coalfield, where abundant shell fossils are presented in Cumberland siltstones (as reported by Kenyon, Bickford and Hoffman, 1991), the Cumberland Member does not appear to contain body fossils other than occasional fish, one of which is on display in the Cumberland Museum.

#### *Dunsmuir Member*

The Dunsmuir Member is named for the Dunsmuir coal mines at Cumberland (Bickford and Kenyon, 1988). Its proposed type-section is located in the eastern part of the middle canyon of Browns River [*see* GeoFile 2001-1, measured section No.5], where it is 115.27 metres thick. The proposed type-section of the Dunsmuir Member is accessible on foot from the west end of a dirt road which follows the south bank of Browns River westward from TimberWest's Duncan Bay Main logging road.

The Dunsmuir Member is abruptly (and locally erosionally) overlain by the Cougarsmith or Puntledge members of the Trent River Formation. Blankets of medium- to coarse-grained sandstone and lenses of siltstone, mudstone and coal are the dominant lithologies of the Dunsmuir Member. Oil shale forms a minor but distinctive part of the Dunsmuir, mostly as a series of lenses in between the Comox No.1 and Comox No.1 Rider coal beds; some of the oil shales are relatively highly radioactive, producing spectacular responses on gamma-ray

logs. The Dunsmuir ranges in thickness from 11.5 to 356 metres, with a median thickness of 107.8 metres. The Dunsmuir thickens to the northeast, and thins to the south and west. Figure 1 shows details of the Dunsmuir's thickness variation southwest of Courtenay, where logs of numerous boreholes are in the public domain (CX-series borehole records in Kenyon, 1987).

Thickness of the Dunsmuir appears to be mainly controlled by gradual southwestward thinning of its constituent sandstone beds, and to a lesser extent by erosion of its uppermost beds.

Probable depositional environments of the Dunsmuir include tidal inlets, submerged lobate tidal deltas above wave base, sheltered back-barrier lagoons and barrier bars or barrier islands, within a high-energy, southwestward-prograding deltaic system. The Dunsmuir contains locally-abundant plant fossils, mainly in the immediate roofs of coal beds; these indicate a general Late Cretaceous, possibly Santonian or Campanian, age (Bell, 1957). The Dunsmuir also locally contains non-diagnostic thick-shelled pelecypod fossils within its sandstones, and possible vertebrate trackways in the immediate roof of the Comox No.1 coal bed.

## Trent River Formation

The Trent River Formation was introduced by Clapp (1912) for a thick unit of shales overlying the Comox Formation, southwest of Comox Harbour. Clapp did not report a detailed section of the formation, and he did not specify its type locality. McKenzie (1922) produced a graphic section of the formation, probably based on borehole records from the north side of the Tsable River; he recognised a fairly persistent sandstone band near the base of the formation, but otherwise did not attempt its subdivision.

Bickford and Kenyon (1988), Cathyl-Bickford (1992) and England (1989, 1990) proposed nine subdivisions of the Trent River Formation within the Comox sub-basin: the basal Cougarsmith shale, overlying Cowie sandstone, Puntledge shale, Browns sandstone, Tsable conglomerate, Royston shale, Oyster River coal-measures, Baynes Sound sandstone, and uppermost Willow Point shale, but specified type-sections for none of them.

In the present study, sections have been measured of the basal four units: the Cougarsmith, Cowie, Puntledge and Browns members. The Oyster River Member is not interpreted to be present within the study area, being recognised only within the coastal lowland between Oyster River and the city of Campbell River. The Tsable,

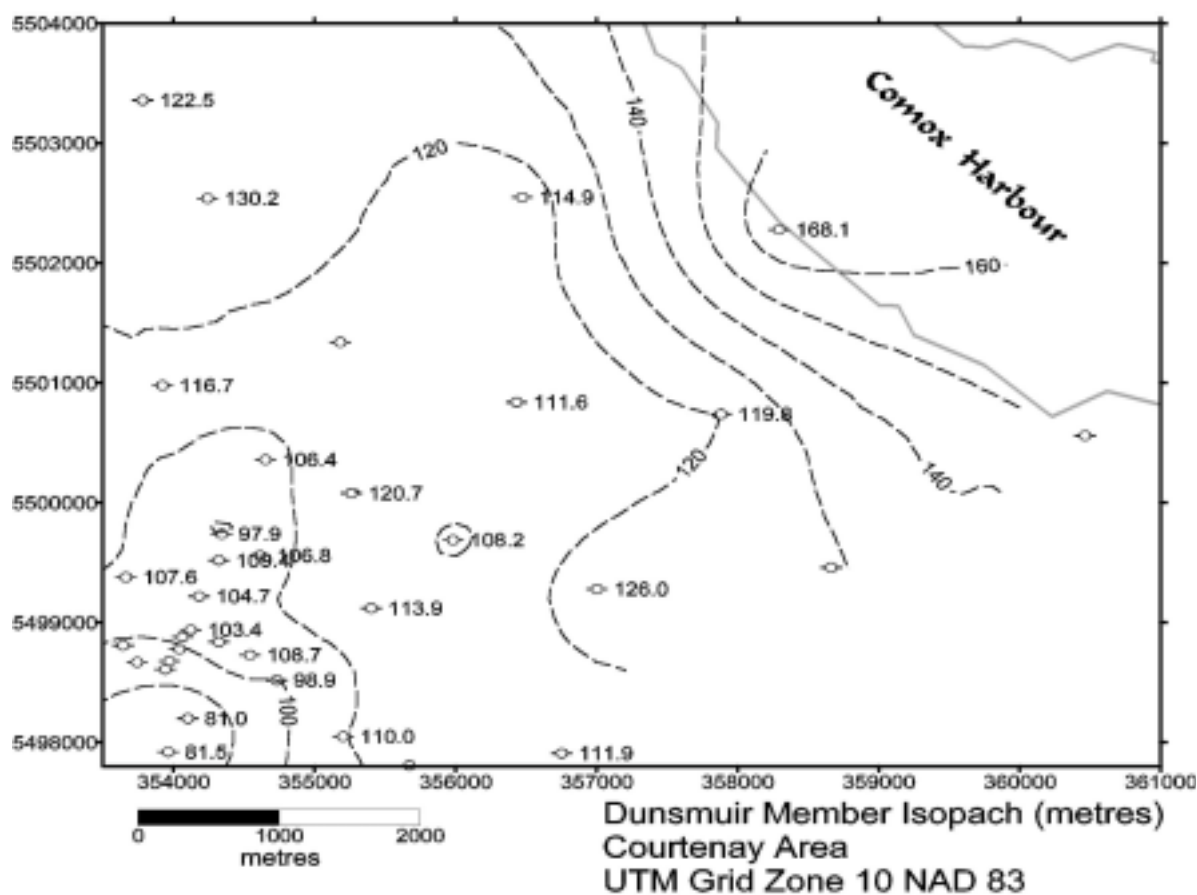


Figure 1. Dunsmuir Member isopach map.

Royston, Baynes Sound and Willow Point members were not studied in detail, owing to their structural and stratigraphic complexity; resolution of their stratigraphic relationships and thickness trends may have to await future deep drilling into their largely drift-covered outcrop belts.

### ***Cougarsmith Member***

The Cougarsmith Member was introduced by Cathyl-Bickford (1992) for a thin but laterally-persistent unit of mudstones and siltstones immediately overlying the Comox Formation, first noted in outcrop along Cougarsmith Creek south of Tsable River. Its proposed type-section is located in the lower canyon of the creek [Appendix 2 (*see* GeoFile 2001-1), measured section No.8], where it is 20.15 metres thick. This locality is accessible on foot by descending the north wall of the canyon, starting from the southwestern corner of a gravel pit on the south side of Weyerhaeuser's TR-33 logging road. The Cougarsmith Member is incompletely exposed in its type locality, and an additional reference section in the middle canyon of Browns River is hereby proposed [Appendix 1 (*see* GeoFile 2001-1), measured section No.5].

The Cougarsmith Member is abruptly overlain by the Cowie Member of the Trent River Formation. Blankets of dark grey to brownish-grey siltstone and mudstone form

the bulk of the Cougarsmith Member, accompanied by thin lenticular interbeds of fine-grained sandstone. The Cougarsmith ranges in thickness from 0.6 to 36 metres, with a median thickness of 8.7 metres. The Cougarsmith thickens to the northeast, and thins to the northwest, west and south. Figure 2 shows details of the Cougarsmith's thickness variation southwest of Courtenay.

Probable depositional environments of the Cougarsmith Member include sheltered lagoons and bays, lying seaward (southwestward) of the Dunsmuir delta-front and landward (northeastward) of offshore bars. The Cougarsmith contains a sparse fauna of thin-shelled bivalves, none of which have thus far been determinable as to age.

### ***Cowie Member***

The Cowie Member was introduced by Cathyl-Bickford (1992) for a laterally-persistent unit of thick-bedded to massive sandstones overlying the Cougarsmith shales near Cowie Creek, south of Tsable River. Its proposed type-section is located in the lower canyon of Cougarsmith Creek [Appendix 2 (*see* GeoFile 2001-1), measured section No.8], where it is 11.20 metres thick. This locality is accessible on foot by descending the north wall of the canyon, starting from the southwestern

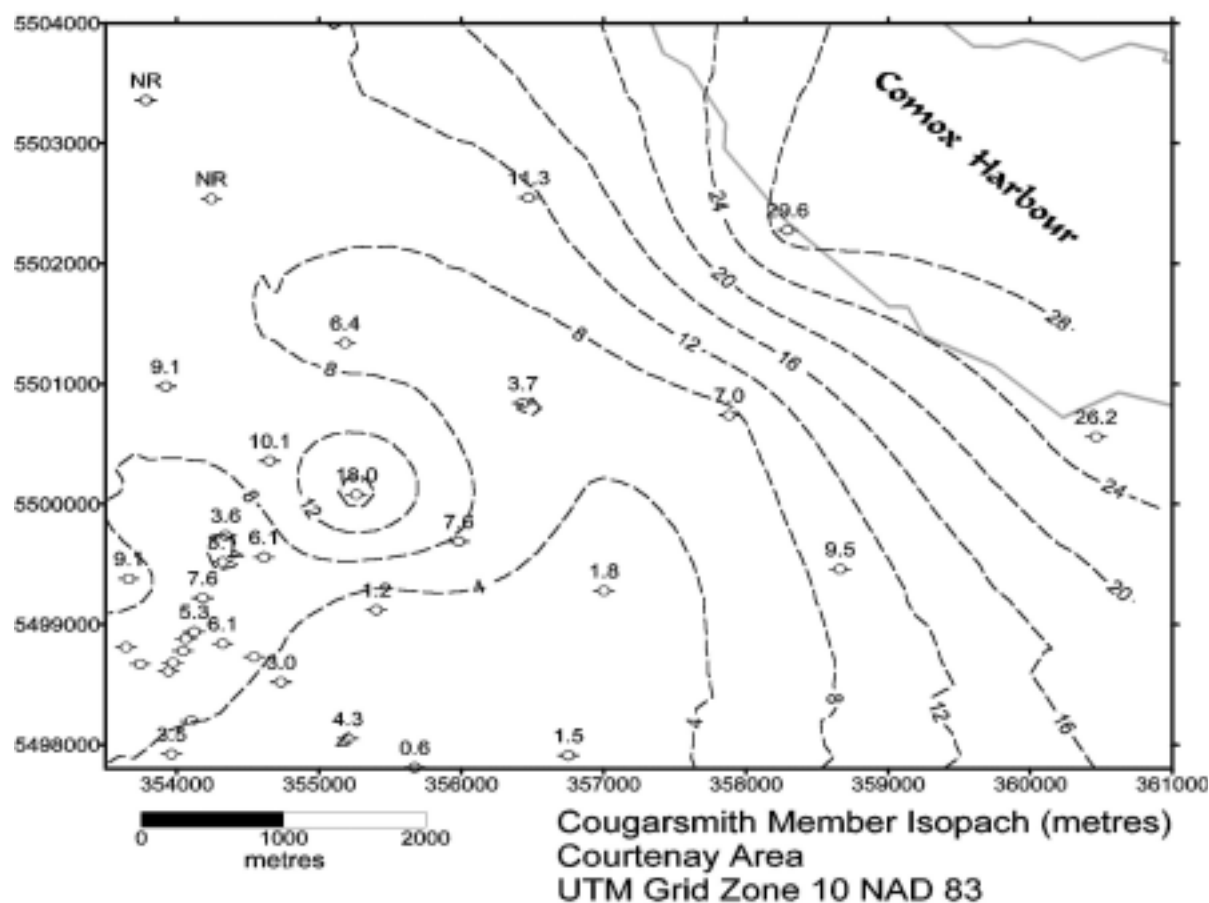


Figure 2. Cougarsmith Member isopach map.

corner of a gravel pit on the south side of Weyerhaeuser's TR-26 logging road. Additional sections of the Cowie Member are exposed on Tsable River downstream from the old Baynes Sound Mine, on Trent River upstream of the former site of the Van Logging bridge, on Puntledge River downstream from Nymph Falls [9.26 metres thick - Appendix 3 (*see* GeoFile 2001-1), measured section No.6] and on Browns River upstream from the Inland Island Highway bridge [2.24 metres thick - Appendix 1 (*see* GeoFile 2001-1), measured section No.5]. Sandstones, probably correlative to the Cowie Member, are also exposed in road cuts on the west side of the Inland Island Highway, between the Duncan Bay Main logging road overpass and the Dove Creek bridge.

The Cowie Member is overlain by the Puntledge Member of the Trent River Formation. In most outcrops this is an abrupt contact, but borehole records suggest that the Cowie/Puntledge contact is interfingering or intertonguing in some parts of the study area, particularly north of Dove Creek. Fine to coarse-grained sandstone forms the bulk of the Cowie Member, but thin to medium interbeds of dark grey to black, moderately to intensely bioturbated siltstone are also locally present. The Cowie ranges in thickness from 0.5 to 24.4 metres, with a median thickness of 5.8 metres. Figure 3 shows details of the Cowie's thickness variation southwest of Courtenay.

The Cowie Member is absent altogether in approximately 20% of the boreholes between Courtenay and Tsable River; this absence may be due to lateral pinch-out of the sandstones, or to postdepositional erosion. Where the Cowie Member is absent, and there is no other obvious lithological break near the base of the Trent River Formation, the Puntledge Member is mapped as directly overlying the Dunsmuir Member.

Probable depositional environments of the Cowie Member include barrier islands or submerged and emergent offshore bars (Cathyl-Bickford, 1992), with a slight tendency to southeastward elongation. The Cowie Member locally contains heavy-mineral bands and *Thalassinoides* and *Ophiomorpha* burrows, suggestive of deposition in a high-energy setting. Abundant pelecypod fossils are present in the Cowie sandstone at Browns River (in bed 193 of measured section No.8), but these fossils are not yet known to have been collected or identified.

### **Puntledge Member**

The Puntledge Member was introduced by Bickford *et al.* (1990) for a thick unit of dark grey to black mudstones and siltstones overlying the Dunsmuir sandstones near Puntledge River. No formal type-section was established at that time. As originally envisaged, the

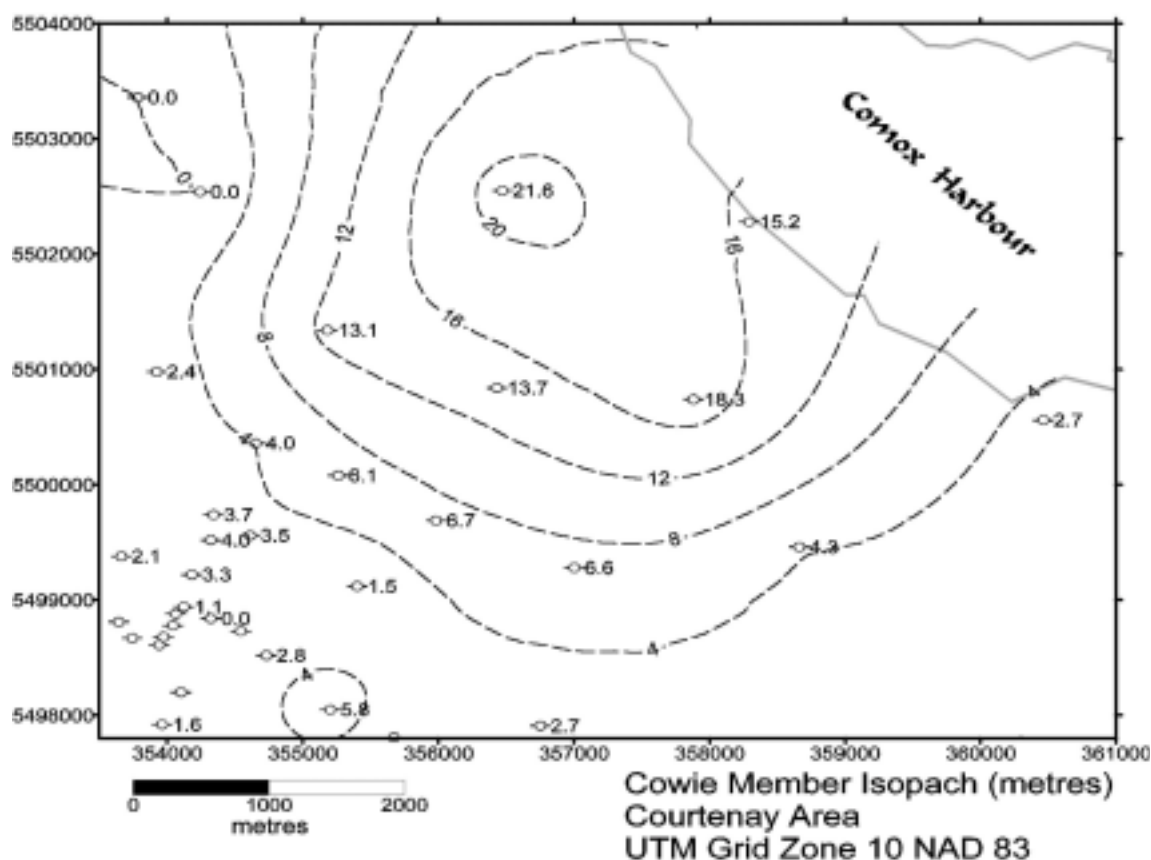


Figure 3. Cowie Member isopach map.

Puntledge Member included all beds between the Browns and Dunsmuir sandstones, but following the recognition of the Cougarsmith and Cowie members the Puntledge Member was implicitly redefined to consist solely of the mudstones, siltstones and minor sandstones overlying the Cowie Member (Cathyl-Bickford, 1992, Table 4-4-1). The proposed type-section of the Puntledge Member, as currently understood, is located along the course of Puntledge River, extending downstream from the prominent point formed by the Cowie sandstones to the overhanging ledge formed by the Browns sandstones on the south bank of the river east of Stotan Falls [139.42 metres thick - Appendix 4 (*see* GeoFile 2001-1), measured section No.7]. This section is accessible on foot from a dirt road which follows the north side of the steel-pipe penstock serving B.C. Hydro's Puntledge Generating Station. A partial reference section of the Puntledge Member, with more complete exposure of its basal 20 metres, is located along the north bank of Browns River, beneath and upstream of the Inland Island Highway bridge [Appendix 1 (*see* GeoFile 2001-1), measured section No.5].

The Puntledge Member is abruptly or locally erosionally overlain by the sandstones of the Browns Member, or by the conglomerates of the younger Tsable Member. This contact is readily recognised on lithological and geophysical logs of boreholes, and constitutes a useful marker for subsurface mapping. The Puntledge Member consists of thin to medium, generally fining-upwards interbeds of siltstone, very fine to fine-grained sandstone and mudstone; in outcrop the Puntledge presents a distinctively ribbed appearance owing to the relative erosional resistance of its sandstone bands. Subsurface lithological logs generally describe the Puntledge as consisting of thick, monotonous beds of shale or 'sandy shale'; this contrast in scale of lithological variation between outcrops and borehole records may be an artefact of the lower level of interest given by coal geologists to non-coal-bearing strata.

A distinctive feature of the Puntledge Member in outcrop, most notably along Puntledge River near Stotan Falls, is the occurrence of hard, erosionally resistant 'biscuit bands' of silty glauconitic sandstone, which weather into light-coloured, polygonally jointed layers. Some of the biscuit bands are intensely bioturbated, and they may represent hardgrounds formed at the sea floor during periods of reduced terrigenous clastic sediment influx, perhaps maximum flooding surfaces (as defined by Walker, 1992). These biscuit bands may eventually be of some value in regional correlations, as similar beds are known in outcrop from the Puntledge Member along Englishman River, southwest of the town of Parksville.

The Puntledge Member ranges in thickness from 1.8 to 128.3 metres, with a median thickness of 73 metres. The wide variation in thickness is due at least in part to post-depositional erosion of the Puntledge Member. Boreholes situated between Royston and Maple Lake indicate considerable erosional relief at the sub-Tsable unconformity, and in nearly all cases where the Puntledge

Member is directly overlain by the Tsable Member, the Puntledge is less than 39 metres thick.

Possible depositional environments of the Puntledge Member include delta-front bays and deeper prodeltaic slopes. The Puntledge contains a rich vertebrate and invertebrate fauna, including plesiosaurs, ammonites, inoceramid and other bivalves, and corals (Trask, 1997), referred to the *Polyptychoceras vancouverense* zone of the Santonian by Ludvigsen and Trask (1991).

### **Browns Member**

The Browns Member was introduced by Bickford *et al.*, (1990) for ledge-forming sandstones exposed in the beds of the Browns, Puntledge and Tsable Rivers. No type-section was originally suggested, and the outcrop trace of the Browns Member was at first poorly defined. Further mapping since 1990 has allowed a better definition of the Browns outcrop (Cathyl-Bickford and Hoffman, 1998), and a type-section is now proposed along the lower canyon of the Browns River, between a waterfall and rapids lying upstream of B.C. Hydro's transmission-lines [8.99 metres thick - Appendix 3 (*see* GeoFile 2001-1), measured section No.6]. The type-section of the Browns Member is accessible on foot by wading upstream from the southeast end of the powerline access road which runs between Piercy Road and the river. An additional reference section, 4.57 metres thick, is situated on the south bank of Puntledge River, downstream from Stotan Falls (*see* measured section No.7 for details). The Browns Member is either absent or represented only by sandy siltstone at Trent River (Trask, 1997).

In the northern part of the study area, north of the Courtenay Parkway, the Browns Member is overlain by the silty shales of the Royston Member. The contact is locally abrupt, but more often marked by a zone of interbedded sandstone, siltstone and shale. In such areas, the contact is arbitrarily drawn as the upward limit of the beds where sandstone comprises at least 50 percent of the section. South of the Comox Parkway, the Browns Member is locally erosionally overlain, or altogether truncated by, the conglomerates of the Tsable Member. The southward limits of the zone of sub-Tsable erosion are not well-defined owing to poor bedrock exposure and wide drill spacing; further study or exploration may disclose more than one belt of Tsable channel-fills.

The Browns Member consists mainly of mixed granitic-basaltic sandstone and siltstone which is moderately to intensely bioturbated (Bickford *et al.*, 1990). The Browns Member ranges in thickness from 0.6 to 50 metres, with a median thickness of 28.7 metres within the study area. The Browns thickens to the north and southeast of its type locality; its northward thickening appears to be at the expense of the underlying Puntledge Member, and its southeastward thickening appears to be part of a general wedging-up as it approaches the zone of channeling associated with the thicker sections of the Tsable Member. The Browns Member of the Courtenay area may have been deposited on a shallow to moderately-deep marine shelf, perhaps by current-driven redistribution of

coarse-grained proximal turbidite sediments. At its type locality, the Browns Member contains a rich fauna of ammonites, referred to the basal part of the *Eupachydiscus perplicatus* zone of the early Campanian (Ludvigsen and Trask, 1991; Trask, 1997).

## ECONOMIC GEOLOGY

Coal is the most abundant known mineral resource within the Cretaceous rocks of the study area. All known coal beds are contained within the Cumberland and Dunsmuir members of the Comox Formation. The Cumberland Member has been extensively drilled during the course of 130 years of coal exploration; to date, at least 250 boreholes have intersected the member within the study area, and it contains at least 94 million tonnes of coal resources of immediate interest (Gardner, 1999). The Dunsmuir Member has also been extensively drilled in search of coal. Approximately 110 boreholes have intersected substantially complete sections of the Dunsmuir, the bulk of these boreholes are in the Tsable River area or between Cumberland and Royston area of the Comox coalfield. Resources of immediate interest are probably confined to the Comox No.1 coal bed, near the base of the member.

The coals of the Comox Formation are known to be gassy within the study area (Cathyl-Bickford, 1991; Ryan, 2000), and several shows of gas have been reported from coal exploration boreholes in the Cumberland and Tsable River areas (CX-series and TR-series boreholes, collected by Kenyon, 1987). Unlicensed gas production for agricultural or domestic use has been taken from at least two of these old boreholes. Coal beds and sandstones within the Comox Formation (Dawson *et al.*, 2000), and sandstones of the Cowie Member (Cathyl-Bickford, 1992) could serve as reservoirs for natural gas. Being surrounded by organic-rich shale, the Cowie Member may be of particular interest as a hydrocarbon reservoir, provided that a viable migration pathway has extended into it. Critical risks in all conceptual gas plays would include timing of gas generation relative to formation of structural traps (England *et al.*, 1989), lack of assured reservoir quality (Gordy, 1988; Hannigan *et al.*, 1998) and the possible existence of internal barriers between porous sand bodies.

Stone for building construction has been quarried from a locality near the old Number Five Mine at Cumberland, and used in the construction of the Cumberland Post Office in 1907-1909 (Barr, 1997). The stratigraphic position of this sandstone is unknown, but it is most likely either in the uppermost Dunsmuir Member or in the Cowie Member. Cowie sandstones have also been quarried for riprap and drain-rock from outcrops along the Inland Island Highway north of Browns River. The potential of the Dunsmuir, Cowie and Browns sandstones for building stones has not been studied in detail, but of the three units, the Dunsmuir sandstone may be the most accessible for quarrying near Cumberland since it forms

prominent ledges and bluffs to the west and south of the village, and it appears to be relatively free from joints.

Refractory clays associated with the seatearths beneath the Comox No.3A and No.4 coal beds have been produced on a limited scale for pottery- and tile-making, basically as a co-product of underground coal mining in the Number Four Mine of Comox Colliery. Although these rocks were described by the miners as 'fireclays', they are unlikely to be true fireclays owing to their generally high content of organic matter.

Shales and siltstones of the Trent River Formation have been quarried on a small scale near Trent River and Bloedel Creek, for production of road-surfacing material. Their performance in this use appears to have been adequate, as demonstrated by the stability of logging roads built from these rocks.

## FURTHER WORK

Although lithostratigraphic fieldwork in outcrop sections of the Comox Formation is now essentially complete, most of the results remain unpublished. An open-file report documenting the surface and subsurface lithostratigraphy and coal content of the Comox Formation is in preparation, for anticipated release in the spring or summer of 2001. The Trent River Formation requires further fieldwork, notably in its sparsely drilled and poorly exposed upper portion. Although all major outcrop areas have been mapped for their structure and for stratigraphic contacts, sections of the Trent River have been completed only in the canyons of the Oyster River and Puntledge River. In the summer of 2001, stratigraphic sections of the upper Trent River Formation will be measured along the lower canyons of the Trent and Tsable rivers, and attempts will be made to tie known vertebrate and invertebrate fossil localities into measured sections within these structurally complex areas.

Subsurface correlation studies of the Comox coals are complete in the Cumberland, Royston and Tsable River areas, except for the most recent boreholes at Tsable River, whose geophysical logs are not yet available for examination. Surface and subsurface sections throughout the Comox sub-basin will be tied together by examination of geophysical logs of boreholes which have been drilled 'behind the outcrop' near Trent River and Dove Creek. Results of these further studies will be published as open file reports.

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## Appendix 1

### Measured section No. 5

#### Comox and Trent River formations - Browns River

Top of section: on north bank of Browns River, at UTM (Zone 10, NAD 83) 347960 E., 5506675 N.

Base of section: on north bank of Browns River, at UTM (Zone 10, NAD 83) 346600 E., 5506482 N.

NTS 92F/11. TRIM 92F.065.

Measured by: C.G. Cathyl-Bickford and G.L. Hoffman, 1980-1990 and 2000; assisted by B. Marten, G. Ockert, J. Stobernack, C. Day and E. Lobb. Note: units 85 through 87 are as measured by J.D. McKenzie for the Geological Survey of Canada in 1921, at his field locality 10.VI.5x5; these beds are now concealed by gravel, boulders and brush.

Petrographic sampling of coals by C.E. Kenyon, 1988. Vitritine reflectance determinations are reported by Kenyon and Bickford (1989).

Unit	Description	Thickness (m)	Height (m)
<b>Trent River Formation: Puntledge Member (incomplete):</b>			
236	Mudstone - dark grey, rusty weathering, silty, platy; gradational base. Top of unit covered by river gravel.	0.35	222.85
235	Siltstone - dark grey, sandy, intensely bioturbated, rubbly weathering; gradational base.	0.85	222.50
234	Sandstone - very fine-grained, medium grey, silty, intensely bioturbated, platy to rubbly weathering; abrupt base.	0.70	221.65
233	Siltstone - dark grey, sandy, intensely bioturbated, rubbly weathering; gradational base.	0.30	220.95
----- Fault, established; normal extensional displacement of 1.05 m down to northeast; attitude: 160/68 NE; beds matched across fault. -----			
232	Sandstone - fine-grained, light brown weathering, clean, massive; abrupt base; attitude: 155/13 NE.	0.44	220.65
231	Sandstone - very fine-grained, very silty, intensely bioturbated, platy to rubbly-weathering, with abundant small concretions; gradational base.	1.02	220.21
230	Sandstone - fine-grained, brown weathering, flaggy; erosional base.	0.38	219.19
229	Siltstone - dark grey, sandy, very thin-bedded, moderately bioturbated; abundant small pelecypods; rubbly weathering, with incipient spheroidal weathering habit; abrupt base.	1.54	218.81
228	Mudstone - dark grey, silty, platy; gradational base.	0.25	217.27
227	Sandstone - very fine-grained, brown weathering, silty, intensely bioturbated; abrupt base.	0.08	217.02
226	Siltstone - dark grey, sandy, intensely bioturbated; spheroidal weathering; abrupt base.	1.10	216.94
225	Sandstone - very fine-grained, dark grey, silty, intensely bioturbated; abrupt base.	0.07	215.84
224	Siltstone - dark grey, sandy, intensely bioturbated, platy to rubbly weathering; gradational base.	0.80	215.77
223	Sandstone - fine-grained, buff weathering, moderately bioturbated; erosional base, scouring down into underlying beds; thickness varies from 10 to 50 cm	0.35	214.97
222	Siltstone - dark grey, sandy, intensely bioturbated, with occasional large concretions; massive; gradational base; thickness varies from 1.30 to 1.70 m	1.45	214.62
221	Sandstone - fine-grained, buff weathering, flaggy at top, trough cross-laminated at base; abrupt base.	0.97	213.17
220	Mudstone - dark grey, rusty weathering, sheared, soft; a persistent recessive band; abrupt base.	0.01	212.20
219	Siltstone - dark grey, very sandy, intensely bioturbated, platy to rubbly-weathering, with occasional large ellipsoidal concretions; abrupt base.	0.80	212.19
218	Mudstone - dark grey, silty, platy; gradational base.	0.23	211.39
217	Sandstone - very fine-grained, dark grey, silty, moderately bioturbated; platy-weathering; abrupt base.	0.27	211.16

216	Siltstone - dark grey, rusty weathering, sandy, intensely bioturbated, platy to rubbly weathering, gradational base.	0.30	210.89
215	Sandstone - fine-grained, buff weathering, with small ripples at top; moderately bioturbated towards base; blocky weathering; erosional base; thickness varies from 10 to 32 cm.	0.20	210.59
214	Siltstone - dark grey, very sandy, intensely bioturbated, with occasional spheroidal concretions; thickness varies from 50 to 72 cm.	0.62	210.39
213	Sandstone - very fine to fine-grained, medium grey, drab weathering, thin-bedded, with thick planar laminae; slightly bioturbated, with occasional dark-rimmed circular burrows; abrupt base.	0.37	209.77
212	Siltstone - dark grey, very sandy, moderately bioturbated; platy weathering; gradational base.	1.10	209.40
211	Sandstone - fine-grained, buff weathering, clean, swaly-bedded (indicated paleoflow 240), slightly bioturbated (possible <i>Thalassinoides</i> ); flaggy-weathering; erosional base; thickness varies from 65 to 85 cm; attitude: 165/8 NE; forms prominent ledge jutting out from north bank.	0.75	208.30
210	Sandstone - very fine-grained, dark grey, very silty, intensely bioturbated, rubbly weathering; gradational base; thickness varies from 5 to 25 cm.	0.15	207.55
209	Sandstone - fine-grained, buff weathering, slightly silty, intensely bioturbated; abrupt base.	0.12	207.41
208	Siltstone - dark grey, very sandy, intensely bioturbated; platy weathering; abrupt base.	0.55	207.29
207	Mudstone - medium grey, rusty weathering, sandy, platy weathering; probable ash band; abrupt base.	0.05	206.74
206	Siltstone - dark grey, sandy, intensely bioturbated, platy weathering, gradational base.	0.49	206.69
205	Sandstone - very fine-grained, medium grey, moderately bioturbated, with abundant large silt-filled burrows (possible <i>Pelecypodichnus</i> ); abrupt base.	0.10	206.20
204	Siltstone - dark grey, sandy, intensely bioturbated; gradational base.	0.45	206.10
203	Sandstone - very fine-grained, dark grey, silty, intensely bioturbated; abrupt base.	0.15	205.65
202	Siltstone - dark grey, rusty weathering, sandy, moderately bioturbated; platy-weathering, abrupt base.	0.25	205.50
201	Siltstone - dark grey, finer than above, moderately bioturbated, platy weathering, with occasional small ellipsoidal concretions; gradational base.	0.70	205.25
200	Sandstone - very fine to fine-grained, dark grey, silty, hummocky-bedded at top, intensely bioturbated, concretionary; abrupt base.	0.10	204.55
199	Siltstone - dark grey, rusty at base; sandy, intensely bioturbated, platy-weathering; gradational base.	0.15	204.45
198	Sandstone - very fine-grained, medium grey, patchy rusty weathering; very silty, intensely bioturbated; abrupt base.	0.26	204.30
197	Siltstone - dark grey, sandy, moderately bioturbated, with occasional small irregular concretions; recessive weathering; gradational base.	0.55	204.04
196	Sandstone - very fine-grained, dark grey, very silty, intensely bioturbated; abrupt base.	0.09	203.49
195	Siltstone - dark grey, sandy, intensely bioturbated, rubbly weathering, gradational base.	0.88	203.40

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**Trent River Formation: Cowie Member (2.24 m - complete):**

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194	Sandstone - fine-grained, buff weathering, clean, with small trough cross-sets at base (indicated paleoflow 085); otherwise massive; abrupt base.	0.48	202.52
193	Sandstone - fine-grained, white, strongly calcareous, with abundant concentrically-ribbed pelecypods; gradational base.	0.10	202.04
192	Sandstone - fine-grained, silty, rippled, moderately bioturbated, platy weathering; gradational base.	0.23	201.94
191	Sandstone - fine-grained, medium grey, very silty, intensely bioturbated; gradational base.	0.82	201.71
190	Sandstone - fine-grained, light grey, slightly silty, cleaner than above; moderately bioturbated; abrupt base.	0.19	200.89
189	Sandstone - very fine-grained, dark grey, very silty, intensely bioturbated; gradational base.	0.29	200.70
188	Sandstone - very fine-grained, medium grey, cleaner than above; blocky-weathering; abrupt base.	0.13	200.41

**Trent River Formation: Cougarsmith Member (11.16 m - complete):**

187	Siltstone - dark grey, patchy rusty weathering, sandy, moderately bioturbated; platy to blocky weathering; gradational base.	0.63	200.28
186	Sandstone - very fine-grained, medium grey, silty, intensely bioturbated; abrupt base.	0.22	199.65
185	Siltstone - dark grey, sandy, moderately bioturbated, platy weathering; gradational base.	0.23	199.43
184	Sandstone - very fine-grained, brown weathering, slightly bioturbated; abrupt base.	0.12	199.20
183	Siltstone - dark grey, slightly sandy, intensely bioturbated; gradational base.	0.39	199.08
182	Sandstone - very fine-grained, dark grey, very silty, moderately bioturbated; abrupt base.	0.25	198.69
181	Siltstone - dark grey, sandy, moderately bioturbated; gradational base.	0.10	198.44
180	Sandstone - very fine-grained, light grey, cleaner than above; slightly bioturbated; abrupt base.	0.03	198.34
179	Mudstone - dark grey, rusty weathering, very silty, moderately bioturbated; abrupt base.	0.34	198.31
178	Sandstone - fine-grained, light grey, orange-brown weathering, calcareous, with linguoid ripples (indicated paleoflow 220); intensely bioturbated at top; abrupt base.	0.08	197.97
177	Siltstone - dark grey, patchy rusty weathering, very sandy, moderately bioturbated; abundant small pelecypods with fine concentric ribs (perhaps <i>Sphenoceramus naumanni</i> ); gradational base.	0.62	197.89
176	Sandstone - fine-grained, brown weathering, slightly silty, moderately bioturbated, concretionary; abrupt base.	0.21	197.27
175	Siltstone - dark grey, sandy, moderately to intensely bioturbated, platy-weathering, gradational base.	0.85	197.06
174	Sandstone - very fine-grained, medium grey, silty, intensely bioturbated; abrupt base.	0.14	196.21
173	Mudstone - dark grey, silty, moderately bioturbated, platy to rubbly weathering; gradational base.	0.48	196.07
172	Siltstone - dark grey, massive; gradational base.	0.62	195.59
171	Siltstone - medium grey, very sandy, intensely bioturbated, with occasional very large ellipsoidal concretions; otherwise massive; abrupt base.	0.58	194.97
170	Sandstone - very fine to fine-grained, medium grey, buff weathering, silty, with occasional large ellipsoidal concretions; hummocky at top; abrupt base.	0.54	194.37
169	Siltstone - dark grey, sandy, intensely bioturbated; gradational base.	0.17	193.83
168	Sandstone - fine-grained, buff weathering, moderately bioturbated; abrupt base.	0.07	193.66
167	Siltstone - dark grey, sandy, intensely bioturbated, with occasional coalified logs; gradational base.	0.40	193.61
166	Sandstone - very fine-grained, dark grey, silty, moderately bioturbated; thin-bedded; abrupt base.	0.48	193.21
165	Siltstone - dark grey, rusty weathering at base; very sandy, intensely bioturbated, with occasional small concretions; gradational base.	0.83	192.73
164	Siltstone - dark grey, sandy, intensely bioturbated, platy weathering; gradational base.	0.78	191.90
163	Sandstone - very fine-grained, medium grey, very silty, moderately bioturbated, platy weathering; abrupt base.	0.32	191.12
162	Siltstone - dark grey, sandy at base; intensely bioturbated, platy to rubbly-weathering; abrupt base.	0.45	190.80
161	Mudstone - dark grey, silty, with occasional sandy lenses; moderately bioturbated; abrupt base.	0.07	190.35
160	Sandstone - very fine-grained, medium grey, silty, platy, moderately bioturbated; abrupt base.	0.10	190.28
159	Siltstone - dark grey, very thin-bedded, moderately bioturbated; abrupt base.	1.06	190.18

**Comox Formation: Dunsmuir Member (115.27 m - complete):**

158	Sandstone - very fine-grained, medium grey, silty, intensely bioturbated; gradational base.	0.56	189.12
157	Sandstone - fine-grained, buff weathering, clean, swaly-bedded, flaggy; erosional base; thickness varies from 56 to 71 cm.	0.65	188.56

156	Sandstone - very fine-grained, medium grey, silty, intensely bioturbated at top, moderately bioturbated below, very thin-bedded, platy to rubbly weathering, recessive; gradational base; thickness varies from 90 to 105 cm.	0.96	187.91
155	Sandstone - fine-grained, light grey, clean, with heavy-mineral streaks, platy-weathering; abrupt base.	0.28	186.95
154	Sandstone - fine to medium-grained, light grey, clean, trough cross-bedded, with occasional shell fragments and some large dark-rimmed burrows; on the whole only sparsely bioturbated; locally-abundant finely-broken plant debris near top; erosional base; thickness varies from 1.23 to 1.33 m. (Note: diversion dam, now demolished, for Courtenay waterworks was founded on this bed, which forms a prominent ledge crossing river).	1.28	186.67
153	Sandstone - very fine to fine-grained, very silty, intensely bioturbated, with occasional curving burrows; gradational base.	0.50	185.39
152	Sandstone - fine-grained, light grey, clean, thin to medium-bedded, planar-laminated, with abundant worm burrows and scattered plant debris.	1.00	184.89
151	Sandstone - fine-grained; alternating clean, trough cross-bedded and silty, shaly-weathering, intensely-bioturbated beds; thin to medium-bedded.	5.50	183.89
150	Sandstone - fine-grained, light to medium greenish-grey, consisting of alternating clean and silty zones; clean zones are sparsely-bioturbated and flaggy- to blocky weathering; silty zones are intensely-bioturbated, concretionary, and platy- to rubbly weathering; swaly-bedded at top; abrupt base.	9.60	178.39
149	Sandstone / Siltstone (80:20 at top, grading down to 60:40 at base) - very thinly-interbedded, fining-upward couplets of very fine-grained, light grey silty sandstone and dark grey muddy siltstone; moderately- to intensely-bioturbated; gradational base.	1.86	168.79
148	Sandstone - very fine-grained, dark grey, very silty, very thin-bedded, sparsely- to intensely-bioturbated, with some small discoidal concretions; gradational base.	0.85	166.93
147	Siltstone - dark grey, sandy, very thin irregular beds; intensely-bioturbated, soft; abrupt base.	0.95	166.08
146	Sandstone - fine-grained, grey weathering, silty, shaly weathering; moderately- to intensely-bioturbated, with abundant large ellipsoidal concretions; gradational base.	1.55	165.13
145	Sandstone - fine- to medium-grained, dark grey, silty, thoroughly bioturbated; with shells of inoceramids and oysters at top, and with horseshoe-shaped to circular worm trails at top and base, about 1 cm wide, with 4 to 6 cm radii of curvature; possibly <i>Spirophycus</i> sp.; occasional concretions; abrupt base.	1.70	163.58
----- Roof of Comox X coal bed -----			
144	COAL - dull and bright, blocky, with blocky, with lenses of medium-grained sandstone. ) Channel sample: ) CK 88/70	0.06	161.88
143	COAL - dull and bright, blocky; gradational base; face cleat: 036/80 NW (0.8 to 2 cm spacing); ) (of coals only) butt cleat: 112/84 SW (rough surfaces; 1 to 1.5 cm )		
	spacing); both cleat sets carry white sulphate bloom. )	0.10	161.82
142	Mudstone - dark brown to black, coaly, platy. )	0.27	161.72
141	COAL - dull and bright, blocky, with ferroan calcite ) on cleats; face cleat: 022/70 NW (0.6 to 1.2 cm ) spacing); butt cleat: 116/83 SW (1 to 1.5 cm ) spacing); third cleat: 151/85 SW (1.5 to 4 cm ) spacing. )	0.42	161.45
----- Floor of Comox X coal bed -----			
140	Mudstone - dark brownish-grey to black, carbonaceous, with occasional thin bright coal bands; gradational base.	0.27	161.03
139	Sandstone - medium-grained, dark grey, carbonaceous; gradational base.	0.15	160.76
138	Sandstone - medium to coarse-grained, light greenish-grey, grey weathering; steep planar cross-sets in middle, low-angle cross-bedded and flaggy weathering in top 1.5 m; locally-abundant heavy-mineral bands from 4.5 to 5 m below top; sparsely- to moderately-bioturbated, with occasional small spheroidal concretions; very thick-bedded to massive; abrupt, undulating base.	5.10	160.61

137	Sandstone - fine-grained, hematitic weathering, thin to medium planar beds, flaggy- to blocky weathering, moderately-bioturbated; a recessive band; abrupt base.	0.40	155.51
----- Fault, established; normal extensional displacement of 1.65 m down to northeast and possible dextral strike-slip shear; attitude: 055/70 SE; beds matched across fault -----			
136	Sandstone - coarse-grained, light grey, orange-brown weathering; very thick-bedded, large-scale trough cross-bedded; abundant laminae of finely-broken carbonised plant debris at top; erosional base; thickness varies from 3.80 to 4.20 m.	4.00	155.11
135	Sandstone - medium-grained, light grey, clean, thin to medium planar beds; sparsely-bioturbated, with occasional small concretions; abrupt base; thickness varies from 1.40 to 1.80 m.	1.60	151.11
134	Sandstone - fine-grained, light greenish-grey to white, flaggy, medium to thick-bedded, with low-angle and swaley cross-lamination; moderately to intensely bioturbated throughout, with <i>Ophiomorpha</i> in basal 0.3 m; silty, thin-bedded, concretionary and rusty weathering in top 35 cm, with abundant heavy-mineral bands; prominent flaggy weathering habit in top 1.9 m; erosional base.	10.00	149.51
133	Mudstone - dark brown, carbonaceous, with abundant large sand-filled burrows and coalified plant stems; abrupt base.	0.17	139.51
132	Mudstone - black, coaly; abrupt base.	0.04	139.34
----- Roof of Comox Y coal bed -----			
131	COAL - dull and bright, dirty, with sandy lenses and ferroan calcite veinlets; face cleat: 046/80 NW (0.6 to 1.2 cm spacing); butt cleat: 120/85 SW (1.2 to 2.0 cm spacing); abrupt base; this bed appears to pinch out to west.	0.07	139.30
----- Floor of Comox Y coal bed -----			
130	Sandstone - fine-grained, dark grey, carbonaceous, rooty, moderately-bioturbated; gradational base.	0.03	139.23
129	Sandstone - medium-grained, light grey, buff weathering, clean, medium to thick-bedded, with very thick planar and low-angle cross-lamination; moderately to intensely bioturbated; with locally-abundant <i>Macaronichnus</i> burrows in middle and <i>Teredolites</i> -bored logs at top; abrupt base.	2.34	139.20
128	Sandstone - medium-grained, light grey to white, well-sorted, thick-bedded to massive, some low-angle cross-lamination and swaley cross-stratification; herringbone cross-lamination dipping to 045 and 225; occasional laminae rich in finely-broken plant debris; moderately bioturbated; gradational base.	4.85	136.83
127	Sandstone - medium-grained, light grey to white, clean, with large concretions (up to 1.5 m diameter); gradational base.	6.29	131.98
126	Sandstone - coarse-grained, light grey, rusty orange weathering, massive; generally well-sorted, with patchy intergranular porosity; tends to exfoliate into thin slabs; contains scattered <i>Teredolites</i> -bored logs; ripples striking 168 (indicated paleocurrent 078) at base; erosional, undulating, disconformable base which progressively truncates beds 103 through 125, as exposed in a westward-dipping sequence beneath this bed.	4.20	137.08
125	Sandstone - fine-grained, orange weathering, silty, medium-bedded; intensely-bioturbated; erosional base.	0.35	132.88
124	Mudstone - dark grey, silty, hard; abrupt base.	0.10	132.53
123	Sandstone - fine-grained, orange weathering, silty, thin-bedded, flaggy-weathering; intensely-bioturbated; abrupt base.	0.70	132.43
122	Siltstone - dark grey, carbonaceous, very sandy, moderately- to intensely-bioturbated; platy weathering; abrupt base.	0.92	131.73
121	Sandstone - very fine- to fine-grained, light grey, brown weathering, thin- to medium-bedded, with abundant carbonaceous laminae; sparsely- to moderately-bioturbated; erosional base.	1.08	130.81
120	Mudstone - black, carbonaceous, with occasional thick bright coal bands and pyritic nodules; abrupt base.	0.21	129.73
119	COAL - bright banded, hard; abrupt base.	0.10	129.52
118	Sandstone - fine to medium-grained, light grey, orange weathering, with abundant carbonaceous laminae and occasional small subangular silty intraclasts; sparsely-bioturbated at base, increasing to moderately-bioturbated at top; rooty at top; erosional base.	0.55	129.42

117	Sandstone - fine-grained, brown weathering, with occasional silty carbonaceous streaks, but on the whole cleaner than underlying beds; very thin to thin planar beds; sparsely-bioturbated; gradational base.	0.82	128.87
116	Sandstone / Siltstone Laminite (80:20) - interlaminated, fining-upward, sparsely-bioturbated light grey, very fine-grained sandstone and dark grey, muddy, slightly-carbonaceous siltstone; abrupt base.	0.62	128.05
115	Siltstone / Sandstone Laminite (60:40) - interlaminated medium grey, sandy siltstone and light grey, very fine-grained, flaseroid-rippled sandstone; moderately-bioturbated, with occasional <i>Pelecypodichnus</i> burrows; abrupt base.	0.22	127.43
114	Sandstone - very fine-grained, light brown weathering, silty, with abundant finely-broken plant debris; oversteepened ripples indicate paleoflow 200; abrupt base.	0.13	127.21
113	Sandstone / Siltstone (50:50) - very thin fining-upwards interbeds of sparsely- to moderately-bioturbated light grey, very fine-grained sandstone and dark grey siltstone; platy weathering; gradational base.	0.32	127.08
112	Siltstone - dark grey, with abundant very thin rippled streaks of sandstone; moderately-bioturbated, spheroidal weathering; gradational base.	0.64	126.75
111	Siltstone - conspicuously-striped alternating thin to medium beds of medium grey, sandy siltstone and dark grey, muddy siltstone; intensely-bioturbated throughout; abrupt base.	0.95	126.11
110	Mudstone - dark grey to black, carbonaceous, with occasional thin bright coal bands; gradational base.	0.75	125.16
109	Siltstone - dark grey, sandy, with abundant finely-broken plant debris; intensely-bioturbated, hard; abrupt base.	0.70	124.41
108	Siltstone - medium grey, sandy, moderately-bioturbated, soft; abrupt base.	0.30	123.71
107	Mudstone - black, coaly; gradational base.	0.10	123.41
106	Mudstone - dark grey, silty, moderately-bioturbated; gradational base.	0.30	123.31
105	COAL - bright banded; abrupt base.	0.20	123.01
104	Mudstone - dark grey, carbonaceous, with occasional thick bright coal bands; rooty at top; abrupt base.	1.20	122.81
103	Mudstone - dark brownish-grey, silty, with alternating light, sandy and dark, carbonaceous to canneloid bands. Delicately laminated, with abundant well-preserved leaves. Where directly overlain by massive sandstone, top 0.05 m contains many large, horizontal, sand-filled burrows; abrupt base; thickness varies from 0.17 to 0.40 m due to erosional by overlying sandstone; abrupt base.	0.29	121.61
----- Roof of Comox Z Rider coal bed -----			
102	COAL - dull and bright, lustrous, hard, with abundant pyrite along cleat; sulphurous odour when broken; abrupt base. ) Channel sample: ) CK 88/73.	0.21	121.32
101	COAL - dirty, sheared, with listric surfaces; recessive; abrupt base.	0.24	121.11
----- Floor of Comox Z Rider coal bed -----			
100	Mudstone - black, canneloid, with abundant thin bright coal bands; abrupt base.	0.12	120.87
99	Mudstone - black, carbonaceous; gradational base.	0.03	120.75
98	Mudstone - brown, light weathering, carbonaceous, ferruginous, silty, blocky, fissile, with delicate colour banding; leaf imprints; abrupt base.	0.24	120.72
----- Roof of Comox Z coal bed -----			
97	COAL - dull banded, lustrous. Thickness varies from 0.05 to 0.11 m; abrupt base.	0.08	120.48
96	Mudstone - black, carbonaceous, with abundant thin bright coal bands; abrupt base.	0.14	120.40
95	COAL - dull and bright, lustrous, blocky, with pyrite along cleats; abrupt base.	0.18	120.26
94	Mudstone - golden brown, soft, with abundant imprints of elongate grass-like leaves; recessive; possible ash band; abrupt base.	0.03	120.08
93	COAL - dull and bright, lustrous; hard; abrupt base.	0.05	120.05
----- Floor of Comox Z coal bed -----			
92	Sandstone - fine to medium-grained, black, very carbonaceous, with abundant log imprints at top; gradational base.	0.15	120.00

91	Sandstone - fine to medium-grained, light grey, orange weathering at top; very thick-bedded to massive, clean, thoroughly burrowed; a few rootlets at top; abrupt base.	6.25	119.85
90	Sandstone - fine to medium-grained, light grey, brown to orange weathering, clean, very thick-bedded to massive, with occasional large concretions; gradational base.	12.80	113.60
----- Fault, established; beds matched across fault. -----			
89	Sandstone, fine-grained / Siltstone - thinly interbedded and inter-laminated, thoroughly bioturbated, rippled silty sandstone and dark brown sandy siltstone; proportion of sand to silt increases upward; abrupt base.	4.42	100.80
88	Sandstone - medium to coarse-grained, light grey, orange weathering, clean, massive, blocky to flaggy; locally-abundant coal spars and large dark-rimmed burrows. Erosional base, with numerous coaly and muddy intraclasts.	3.00	96.38
----- Roof of Comox No.1 coal bed -----			
87	COAL - clean.	0.08	93.38
86	Shale - black, coaly, hard.	0.05	93.30
85	COAL - clean and hard.	0.20	93.25
----- Floor of Comox No.1 coal bed -----			
84	Mudstone - brown, carbonaceous; laminated; abrupt base.	0.60	93.05
83	Sandstone - coarse-grained, white, orange weathering, massive, cross-laminated; undulating, abrupt base; forms prominent cliff.	18.60	92.45
<b>Comox Formation: Cumberland Member ( 31.93 m above sill - complete):</b>			
----- Roof of Comox No.2 Rider coal bed -----			
82	COAL - dull and bright, blocky, hard, pyritic; ) Channel sample: abrupt base. ) CK 87/38 (beds 80	16	73.85
81	COAL - sheared, recessive; abrupt base. ) through 82)	0.03.	73.69
80	COAL - dull banded, lustrous, blocky, hard; abrupt base. )	0.17	73.66
----- Floor of Comox No.2 Rider coal bed -----			
79	Mudstone - dark brown, carbonaceous, tough; abrupt base.	0.12	73.49
78	Siltstone - grey, brownish-grey weathering, hard, blocky, very thin-bedded; locally-abundant laminae of fine-grained sandstone; bioturbated; gradational base.	2.09	73.37
----- Fault, established; normal extensional displacement of 4.5 m down to northeast; beds matched across fault. -----			
77	Mudstone - dark grey, brownish-grey weathering, silty, weak and rubbly; intensely bioturbated; abrupt base.	0.55	71.28
76	Mudstone - dark brown to black, carbonaceous, with occasional thick bright coal bands; gradational base.	0.27	70.73
75	Siltstone - grey, hard, with disrupted blebs of mudstone; abrupt base.	0.32	70.46
----- Roof of Comox No.2 coal bed -----			
74	Mudstone - black, canneloid, hard; gradational base.	0.06	70.14
73	COAL - dull, stony, hard; gradational base. ) Channel sample:	0.06	70.08
72	Mudstone - black, canneloid; abrupt base. ) CK 87/39 (beds 66	0.06	70.02
71	COAL - dull and bright, lustrous, blocky; abrupt base. ) through 73)	0.24	69.96
70	Mudstone - black, carbonaceous, tough; abrupt base. )	0.20	69.72
69	COAL - dull banded, lustrous, blocky, hard; abrupt base. )	0.29	69.52
68	Mudstone - black, canneloid, tough; abrupt base. )	0.08	69.23
67	COAL - bright banded, blocky; abrupt base. )	0.24	69.15
66	COAL - dull lustrous, blocky, hard; abrupt base. )	0.24	68.91
65	Mudstone - black, canneloid; abrupt base.	0.06	68.67
----- Floor of Comox No.2 coal bed -----			



64	Mudstone - brownish-grey, very thin-bedded, soft; abrupt base.	0.20	68.61
63	COAL and Shale - interlaminated bright coal and black canneloid mudstone; listric surfaces; abrupt base.	0.09	68.41
62	Sandstone - medium-grained, light grey, massive, concretionary; abrupt base.	5.50	68.32
61	Mudstone - black, coaly; abrupt base.	0.30	62.82

----- Roof of Comox No.2A coal bed -----

60	COAL - dull and bright, dirty, with occasional thin bands of coaly mudstone; abrupt base. ) Channel sample: ) CK 88/82	1.07	62.52
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----- Floor of Comox No.2A coal bed -----

59	Mudstone - brownish-grey; abrupt base.	0.76	61.45
58	Sandstone - medium to coarse-grained, light grey, yellowish-grey to orange-weathering, clean; thick-bedded, large-scale low-angle cross-laminated, with local minor interbeds (up to 0.3 m thick) of interlaminated, intensely bioturbated, platy, fine-grained sandstone and siltstone. Abundant thin bright coal bands in basal 0.05 m; abrupt base.	2.90	60.69
57	Mudstone - black, coaly, with scattered thick bright coal bands; abrupt base.	0.45	57.79
56	Sandstone - fine-grained, silty, concretionary; abrupt base.	0.60	57.34
55	Mudstone - dark grey, concretionary, with occasional thin bands of sandstone as above; abrupt base.	3.66	56.74
54	Sandstone - coarse-grained, light grey, thick-bedded, with minor thin interbeds of dark grey mudstone; abrupt base.	3.66	53.08
53	COAL - dirty, abrupt base.	0.30	49.42
52	Siltstone - dark grey, sandy; abrupt base.	3.00	49.12
51	Sandstone - coarse-grained, light grey, orange weathering, thick-bedded to massive, large-scale low-angle trough cross-laminated; abrupt base.	3.30	46.12

----- Roof of Comox No.3 coal bed -----

50	COAL - dull, coked, sandy texture, with crude columnar structure; smoothly undulating and abrupt base (intrusive contact).	0.90	42.82
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#### **Mount Washington Intrusions: Unnamed Sill (0.75 m - complete)**

49	Dacite - porphyritic, very fine-grained, greenish-grey, golden weathering, with 10% euhedral phenocrysts of feldspar up to 3 mm long; soft and decomposed. Both the dacite and the enclosing coal tend to pinch and swell. The dacite appears to pinch out along strike to the northwest; smoothly undulating and abrupt base (intrusive contact).	0.75	41.92
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#### **Comox Formation: Cumberland Member ( 41.17 m below sill - complete):**

48	COAL - dull, coked, as above; abrupt base. ) Channel sample: ) CK 88/81.	0.60	41.17
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----- Floor of Comox No.3 coal bed -----

47	Sandstone - fine to medium-grained, light grey, buff weathering, massive; abrupt base.	6.88	40.57
46	COAL - bright banded, clean, blocky; abrupt base. ) Channel sample:	0.10	33.69
45	COAL - dirty, sheared, soft; abrupt base. ) CK 88/80.	0.12	33.59
44	Mudstone - dark grey, carbonaceous, with occasional thick bright coal bands; abrupt base.	0.30	33.47
43	Sandstone - fine-grained, abrupt base.	0.17	33.17
42	Mudstone - dark grey, locally carbonaceous; abrupt base.	1.40	33.00
41	Sandstone - fine to medium-grained, buff weathering; thin-bedded at top, becoming massive below. Abrupt, scoured base.	3.00	31.60
40	COAL - bright banded, lustrous, hard, blocky; abrupt base. ) Channel sample: ) CK 88/78.	0.18	28.60
39	Mudstone - black, carbonaceous, with abundant canneloid bands, almost a coaly mudstone; gradational base.	0.10	28.42
38	Mudstone - dark brownish-grey, rubbly to platy, grading down to siltstone at base; gradational base.	0.61	28.32
37	Sandstone - very fine-grained, medium to dark grey, brown weathering, silty, rubbly; gradational base.	2.44	27.71
36	Sandstone - fine-grained, light grey, massive, large-scale low-angle cross-laminated; abrupt base.	1.50	25.27

35	Sandstone - fine-grained, dark grey, thin-bedded; abrupt base.	0.30	23.77
----- Roof of Comox No.3A coal bed -----			
34	COAL - dirty, sheared in part, recessive; abrupt base.) Channel sample:	0.08	23.47
33	COAL - bright banded, blocky, hard; abrupt base. ) CK 88/77.	0.43	23.39
----- Floor of Comox No.3A coal bed -----			
32	Sandstone - very fine-grained, black, silty, carbonaceous, rooty; abrupt base.	0.05	22.96
31	Mudstone - dark grey, splintery, rubbly, rooty; minor plant debris; abrupt base.	0.61	22.91
30	Sandstone - very fine to fine-grained, grey, silty, rippled; thickness varies from 0.20 to 0.36 m; abrupt base.	0.28	22.30
29	Sandstone - fine-grained, dark grey, carbonaceous, with small muddy and silty flaseroid lenses; abrupt base.	0.15	22.02
28	Sandstone - fine to medium-grained, buff to light orange weathering, with small ferruginous concretions at top; low-angle cross-laminated; abrupt base.	4.90	21.87
27	COAL and Shale - interlaminated bright coal and ) Channel sample: black carbonaceous mudstone; abrupt base. ) CK 88/76.	0.10	16.97
26	Sandstone - fine-grained, light grey, brown weathering, very thin-bedded and flaggy; large-scale, low-angle, irregular, rippled cross-beds; occasional thin bands of carbonaceous, silty mudstone; abrupt base.	2.00	16.87
25	Sandstone - fine-grained, buff weathering, trough cross-bedded; a resistant bed, forming rapids in river; erosional base.	3.00	14.87
24	Mudstone - dark grey, splintery, silty; gradational base.	0.50	11.87
23	Siltstone - dark grey; gradational base.	0.50	11.37
22	Sandstone - very fine-grained, dark brown to black, thin-bedded, carbonaceous; abrupt, undulating base with over 1 m of local relief, resulting in the local absence of this unit and the one above.	0.50	10.87
21	Sandstone - fine to medium-grained, buff to golden weathering, with a basal lag deposit of pebbles and coalified logs; erosional base.	2.00	10.37
20	Sandstone - very fine-grained, grading downward to fine-grained; brown-weathering, thin to medium-bedded, low-angle cross-bedded; abrupt base.	0.99	8.37
19	Siltstone - dark brown, carbonaceous; becoming sandy at top. Abundant plant debris near base; abrupt base.	0.82	7.38
18	COAL - bright, blocky; abrupt base.	0.02	6.56
17	Sandstone - fine to medium-grained, dark brown at top, becoming lighter below; brown to orange weathering, carbonaceous and rooty; thin irregular beds; abrupt base.	0.30	6.54
----- Roof of Comox No.4 coal bed -----			
16	COAL - dull and bright, blocky, hard; abrupt base.	0.25	6.24
15	Mudstone - dark brown, brown- weathering, slightly carbonaceous; abrupt base.	0.03	5.99
14	COAL - dull and bright, blocky, hard; abrupt base.	0.13	5.96
13	Mudstone - medium brownish-grey, rusty weathering, slightly carbonaceous; abrupt base.	0.08	5.83
12	COAL - dull and bright, lustrous, blocky, hard; abrupt base.	0.10	5.75
11	COAL - dull banded, lustrous, blocky, hard; abrupt base.	0.11	5.65
10	Mudstone - dark grey with vague ferruginous bands; black and carbonaceous at top and base, with plant debris at top; abrupt base.	0.91	5.54
9	COAL - dull and bright, platy; abrupt base. ) Channel sample: ) CK 88/75.	0.81	4.63
----- Floor of Comox No.4 coal bed -----			
8	Mudstone - black, silty, carbonaceous, thin-bedded, flaggy, hard; gradational base.	0.30	3.82
7	Sandstone - very fine to fine-grained, dark grey, orange weathering, silty, with abundant laminae of dark grey, carbonaceous mudstone; thin to medium-bedded, hummocky cross-stratified; abrupt base.	1.50	3.52
6	COAL - dull and bright; abrupt base. ) Channel sample: ) CK 88/74.	0.30	2.02
5	Mudstone - black, carbonaceous, hard; abrupt base.	0.08	1.72
4	Mudstone - light grey to white, orange weathering, very soft; probable seatearth; abrupt base.	0.04	1.64

3	Sandstone - very coarse-grained, dark grey, gritty, composed of quartz and feldspar grains, with scattered coarser quartz granules lending a 'speckled' appearance; abrupt base.	0.10	1.60
2	Sandstone - medium-grained, orange-brown weathering; erosional base.	1.50	1.50

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**Karmutsen Formation (incomplete):**

1	Basalt - light greenish-grey, agglomeratic, intensely weathered.		
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## Appendix 2

### Measured section No. 8

#### Comox and Trent River formations - Cougarsmith Creek

Top of section: at locality A.1614, in centre of creek bed, at UTM (Zone 10, NAD 83) 365100 E., 5485162 N.

Base of section: at locality A.1618, on north bank of creek, at UTM (Zone 10, NAD 83) 364860 E., 5485057 N.

NTS 92F/7. TRIM 92F.046.

Measured by: C.G. Cathyl-Bickford, October 3, 1991; September 3, 2000.

Unit	Description	Thickness (m)	Height (m)
<b>Trent River Formation: Puntledge Member (incomplete):</b>			
25	Siltstone - dark grey, purplish-grey weathering, sandy, rubbly weathering; intensely bioturbated; attitude: 150/25 NE (locality A.1614).	>2.50	77.35
24	(Concealed) - creek gravels with occasional large log-jams.	25.90	74.85
23	Mudstone - dark grey, brown weathering, silty, massive; locally platy- to rubbly weathering; attitude: 145/15 NE (locality A.1615); one 2 cm wide sandstone dyke at 152/80 NE, showing slight dextral crumpling; this unit is well-exposed at top and mostly concealed by creek gravels below.	16.10	48.95
<b>Trent River Formation: Cowie Member (11.20 m - complete):</b>			
22	Sandstone - fine to medium-grained, brown to orange weathering, clean, very thick-bedded to massive; gradational base; at least three minor normal extensional faults at 135/61 NE at downstream end of outcrop; attitude at top: 150/43 NE (locality A.1616).	1.85	32.85
21	Sandstone - fine-grained, light grey, pinkish-grey to orange weathering, quartz-feldspar-basalt, clean, medium to thick-bedded; occasional platy weathering zones with ripple marks; abrupt base.	1.60	31.00
20	Sandstone - medium- to coarse-grained, brown weathering, medium to thick-bedded, large-scale low-angle cross-beds; abrupt base.	3.60	29.40
19	Sandstone - medium-grained, light grey, brown weathering, clean, quartz-feldspar-basalt, with steep planar cross-sets 30 to 60 cm thick; some bedding-plane shears; moderately-bioturbated, including some <i>Macaronichnus</i> ; abrupt base.	1.20	25.80
18	Sandstone - coarse-grained, brown weathering, thick-bedded, with large-scale cut-and-fill structures; abrupt, undulating base.	0.90	24.60
17	Sandstone - medium- to coarse-grained, brown weathering, clean; abrupt base.	2.05	23.70
<b>Trent River Formation: Cougarsmith Member (20.15 m - complete):</b>			
16	Siltstone - dark grey, rubbly weathering; poorly-exposed due to abundant talus of sandstone.	2.50	21.65
15	Siltstone - dark brownish-grey, slightly carbonaceous, platy weathering, soft; abrupt base; attitude: 135/34 NE.	1.30	19.15
14	Siltstone - dark grey, sandy, spheroidal weathering; abrupt base.	0.90	17.85
13	Siltstone - dark grey, massive, hackly fracture, with occasional small concretions near top; abrupt base.	1.40	16.95
12	Siltstone - dark brownish-grey, slightly carbonaceous, massive; abrupt base.	0.50	15.55
11	Mudstone - dark grey, locally rusty weathering, spheroidal weathering; abrupt base.	0.65	15.05
10	Siltstone - dark grey, platy weathering; occasional large concretions; base not seen.	4.00	14.40
9	Mudstone - poorly-exposed rubble of dark grey, platy to rubbly, silty mudstone, mostly covered by talus of sandstone.	4.00	10.40
8	Siltstone - dark grey, purplish-brown weathering, sandy, very thin-bedded, intensely bioturbated at top; occasional shell fragments; abrupt base.	1.50	6.40
7	Mudstone - dark grey, silty, very sandy at top, moderately to intensely bioturbated; here on Brinco survey line 42+00 S, 17+50 E.	0.90	4.90
6	Siltstone - dark grey, very thin-bedded, moderately bioturbated; gradational base.	1.15	4.00

5	Mudstone - dark grey, silty, very thin-bedded, moderately bioturbated; abrupt base.	1.15	2.85
4	Mudstone - dark grey, rusty weathering, intensely sheared; sheared basal contact.	0.05	1.70
3	Ankerite - dark brown, strongly rusty-orange weathering, platy weathering, sheared, slight petroliferous odour; may be a flat vein along fault; attitude: 115/25 NE (locality A.1618); sheared basal contact.	0.05	1.65
----- <i>Listric extensional fault, probable</i> -----			
2	Mudstone - dark brown, slightly silty; moderately sheared at top, decreasing downwards to slightly sheared at base; abrupt base.	0.10	1.60
<b>Comox Formation: Dunsmuir Member (incomplete):</b>			
1	Sandstone - fine-grained, light grey, orange weathering, clean, medium-bedded flaggy weathering, slightly bioturbated at top ( <i>Thalassinoides</i> ); attitude: 107/25 NE; undulating joints: 028/85 NW; base not seen.	>1.50	1.50





## Appendix 3

### Measured section No. 7

#### Comox and Trent River formations - Puntledge River

Top of section: on south bank of Puntledge River, below Stotan Falls, at UTM (Zone 10, NAD 83) 351790 E., 5505227 N.

Base of section: on north bank of Puntledge River, at Nymph Falls, at UTM (Zone 10, NAD 83) 350190 E., 5504132 N.

NTS 92F/11. TRIM 92F.065.

Measured by: C.G. Cathyl-Bickford, July 8, July 10 and August 26, 2000.

Unit	Description Height	Thickness	
	<b>Trent River Formation: Royston Member (incomplete):</b> (m)	(m)	
166	Mudstone - dark grey, silty, rubbly; abrupt base. 190.70	>2.40	
	<b>Trent River Formation: Browns Member (4.57 m - complete):</b>		
165	Sandstone - very fine-grained, medium grey, cherty, clean; flaggy at top, massive below; abrupt base. 188.30	0.55	
164	Siltstone - dark grey, rubbly; gradational base. 187.75	0.10	
163	Sandstone - very fine-grained, blocky, massive; abrupt base. 187.65	0.30	
162	Siltstone - dark grey, rusty weathering, sandy, platy; gradational base. 187.35	0.20	
161	Sandstone - medium-grained, grey weathering, erosional base; attitude: 160/2 SW (locality A.1849); thickness varies from 22 to 40 cm.	0.32	187.15
160	Siltstone - dark grey, rusty weathering, sandy, intensely bioturbated; gradational base; thickness varies from 3 to 7 cm. 186.83	0.05	
159	Sandstone - fine to medium-grained, cherty, clean; thick planar beds; erosional base. 186.78	0.37	
158	Sandstone - very fine-grained, dark grey, hematitic weathering, silty, very thin-bedded, intensely bioturbated; gradational base. 186.41	0.92	
157	Sandstone - fine-grained at top, medium to coarse-grained at base, thin irregular rippled beds; erosional base. 185.49	0.22	
156	Mudstone - dark grey, silty, platy, moderately bioturbated; gradational base. 185.27	0.21	
155	Sandstone - very fine-grained, silty, medium grey, rusty weathering, very thin-bedded, intensely bioturbated; gradational base. 185.06	0.23	
154	Sandstone - medium-grained, medium grey, cherty, moderately bioturbated, erosional base; thickness varies from 8 to 12 cm. 184.83	0.10	
	<b>Trent River Formation: Puntledge Member (139.42 m - complete):</b>		
153	Siltstone - dark grey, slightly sandy, spheroidal weathering, rubbly weathering, thin-bedded, with occasional ellipsoidal concretions; abrupt base. 184.73	2.65	
152	Mudstone - medium grey, light grey weathering, flinty, splintery weathering; abrupt base; possible ash band. 182.08	0.01	

151	Sandstone - very fine-grained, silty, platy to rubbly weathering, very thin-bedded, moderately bioturbated; abrupt base. 182.07	0.21	
150	Mudstone - dark greenish-grey, silty, glauconitic; abrupt base. 181.86	0.21	
149	Siltstone - dark greenish-grey, sandy, glauconitic, intensely bioturbated, with concretions at top; gradational base. 181.65	0.21	
148	Mudstone - dark grey, silty, very thin-bedded, moderately bioturbated; gradational base. 181.44	0.52	
147	Sandstone - very fine-grained, medium grey, silty, very thin-bedded, rippled, moderately bioturbated; gradational base. 180.92	0.12	
146	Siltstone - medium grey, sandy, intensely bioturbated; gradational base.	0.14	180.80
145	Mudstone - dark grey, rusty weathering, silty, platy weathering, moderately bioturbated; gradational base. 180.66	0.30	
144	Siltstone - dark grey, slightly rusty weathering, very thin-bedded, platy- to rubbly weathering; abrupt base. 180.36	0.31	
143	Mudstone - dark greenish-grey, hematitic weathering, silty, glauconitic, platy- to rubbly weathering, intensely bioturbated; occasional sandstone dykes; abrupt base. 180.05	0.30	
----- Fault, established; normal extensional displacement of 1.05 m down to northeast; attitude: 132/80 NE; beds matched across fault. -----			
142	Sandstone - very fine- to fine-grained, medium grey, buff weathering, silty, glauconitic, with occasional coalified bark chips and large discoidal concretions; possible hardground, forming prominent 'biscuit bed' downstream of bridge and upstream of Stotan Falls; also exposed at lip of southern side of lower falls, and as isolated patches downstream of falls (on east side of fault), where overlying shale cover has been stripped by erosion; erosional base; thickness varies from 15 to 25 cm. 179.75	0.20	
141	Mudstone - dark grey, rusty weathering, silty, platy- to rubbly weathering, intensely bioturbated, with a few narrow sandstone dykes; gradational base. 179.55	0.20	
140	Siltstone - dark grey, sandy, platy weathering, intensely bioturbated; gradational base; occasional narrow sandstone dykes at 045/75 NW and 105/70 SW (somewhat thicker); attitude: 170/2 NE (locality N.175). 179.35	0.35	
139	Sandstone - very fine-grained, dark grey, silty, platy weathering, intensely bioturbated; abrupt base. 179.00	0.15	
138	Mudstone - dark grey, silty, rubbly weathering, moderately bioturbated; gradational base. Top of this unit is underneath Comox Logging bridge.	0.25	178.85
137	Siltstone - dark grey, sandy, rubbly weathering, intensely bioturbated; gradational base. 178.60	0.87	
136	Sandstone - fine-grained, medium grey, brown weathering, intensely bioturbated and glauconitic at top; abrupt base; forms ledge at downstream end of river pool; attitude: 175/3 NE (locality N.214). 177.73	0.49	
135	Siltstone - dark grey, rusty weathering, sandy, platy weathering; abrupt base. 177.24	0.13	
134	Sandstone - fine-grained, light grey weathering, hummocky top; gradational base; forms ledge beneath river pool. 177.11	0.38	
133	Siltstone - medium grey, sandy, intensely bioturbated, massive; base concealed by water and cobbles.	0.21	176.73
132	(Concealed) - water and cobbles; large log-jam north of island.	6.60	176.52



131	Sandstone - fine- to medium-grained, medium grey to greenish-grey, buff-weathering, silty; hummocky-bedded, moderately bioturbated; gradational base; attitude: 172/10 NE (locality A.1873 and N.215).	0.70	149.92
130	Sandstone - fine-grained, buff weathering, swaly-bedded; abrupt base.	0.70	149.22
129	Siltstone - dark grey, sandy, moderately bioturbated; gradational base.	5.21	148.52
128	Sandstone - very fine-grained, orange weathering, thin-bedded, moderately-bioturbated; abrupt base.	0.80	143.31
127	Siltstone - dark grey, sandy, moderately bioturbated; gradational base.	3.82	142.51
126	Sandstone - very fine-grained, orange weathering, thin-bedded, moderately-bioturbated; abrupt base.	0.60	138.69
125	Siltstone - dark grey, sandy, moderately bioturbated; gradational base.	13.02	138.09
124	Sandstone - very fine- to fine-grained, buff weathering, very thin wavy-bedded, moderately bioturbated; erosional base.	0.22	125.07
123	Siltstone - dark grey, very sandy, moderately bioturbated; gradational base.	0.13	124.85
122	Sandstone / Siltstone (60:40) - thinly-interbedded fine-grained sandstone and dark grey sandy siltstone; convolute-laminated at base (indicated paleoslope 230); abrupt base.	0.24	124.72
121	Mudstone - dark grey, silty; very silty at base; platy weathering; gradational base.	0.65	124.47
120	Siltstone - dark grey, sandy, very thin-bedded, platy weathering; abrupt base.	0.10	123.82
119	Mudstone - dark grey, silty, platy weathering; gradational base.	1.20	123.72
118	Siltstone - dark grey, sandy, intensely-bioturbated; abrupt base.	0.20	122.52
117	Mudstone - dark grey, very silty, platy weathering; gradational base.	0.48	122.32
116	Siltstone - dark grey, thin to medium-bedded; abrupt base.	1.20	121.84
115	Sandstone - very fine- to fine-grained, light buff weathering, moderately-bioturbated, with occasional silty intraclasts and occasional <i>Teredolites</i> -bored wood fragments; polygonal cracks at top (a biscuit bed); abrupt base. This bed lies directly under the north end of the new highway bridge.	0.28	120.64
114	Siltstone / Sandstone (70:30) - very thinly-interbedded dark grey sandy siltstone and medium grey, very fine-grained sandstone; moderately to intensely-bioturbated throughout; abrupt base.	0.55	120.36
113	Siltstone - dark grey, sandy, intensely-bioturbated; gradational base.	0.65	119.81
112	Sandstone - very fine- to fine-grained, dark grey, cherty, thin planar beds; intensely-bioturbated at top and sparsely to moderately-bioturbated (with possible <i>Thalassinoides</i> ?) in middle; abrupt base.	0.33	119.16
111	Siltstone - dark grey, very sandy, intensely-bioturbated; gradational base.	0.38	118.83
110	Sandstone -very fine-grained, very silty, intensely-bioturbated; base concealed by boulders.	0.42	118.45
109	Mudstone - dark grey, silty, intensely-bioturbated; partly concealed by boulders; gradational base.	0.50	118.03
108	Sandstone / Siltstone (60:40) - very thinly-interbedded, buff weathering very fine-grained sandstone and sandy siltstone; moderately- to intensely-bioturbated throughout; abrupt base.	0.27	117.53
107	Mudstone - dark grey, silty, very thin-bedded, platy weathering; partly concealed by boulders; abrupt base.	1.30	117.26
106	Sandstone - very fine-grained, buff weathering, silty, concretionary, intensely-bioturbated, hard; hummocky top; abrupt base.	0.35	115.96
105	Mudstone - dark grey, silty, intensely-bioturbated, very thin-bedded; gradational base.	0.95	115.61
104	Siltstone - dark grey, sandy, intensely-bioturbated, thin-bedded, gradational base.	1.10	114.66
103	Sandstone - very fine- to fine-grained, buff weathering, concretionary; moderately-bioturbated at top; a resistant ledge; abrupt base.	0.31	113.56
102	Siltstone / Sandstone (85:15) - dark grey sandy siltstone with occasional very thin interbeds of very fine-grained sandstone; intensely-bioturbated throughout; abrupt base.	2.85	113.25
101	Sandstone - fine-grained, medium-grey, silty, thin planar beds; moderately-bioturbated, with <i>Pelecypodichnus</i> burrows; forms ledge across river; gradational base; attitude: 155/7 NE (locality N.216).	0.35	110.40
100	Siltstone / Mudstone (80:20) - thin to medium interbeds of dark grey siltstone and mudstone; intensely-bioturbated throughout; base concealed by boulders and water.	1.00	110.05
99	(Concealed) - boulders and water.	4.18	109.05

98	Mudstone - dark grey, silty, platy weathering; top not seen; gradational base; at top of cliff in south bank, 60 metres downstream of locality N.217.	0.10	104.87
97	Siltstone - dark grey, sandy, with occasional lenses of fine-grained sandstone to 4 cm thick; intensely-bioturbated; base concealed by boulders and water in south side-channel of river.	0.35	104.77
96	(Concealed) - boulders and water.	0.20	104.42
95	Siltstone - medium grey, with abundant large intraclastic blocks of mudstone as below; an intraformational soft-sediment breccia; erosional base.	0.20	104.22
94	Mudstone - dark grey, silty, very thin-bedded; abrupt base; thickness varies from 30 to 40 cm.	0.35	104.02
93	Mudstone - dark grey, silty, with large ellipsoidal concretions to bed height; abrupt base.	0.16	103.67
92	Mudstone - dark grey, silty, very thin-bedded; abrupt base.	2.20	103.51
91	Sandstone - fine-grained, light grey weathering, platy weathering; pinches out to east; abrupt base.	0.70	101.31
90	Mudstone / Siltstone (50:50) - very thinly-interbedded, dark grey, hematitic-weathering, platy weathering, with flaseroid sandy ripples; abrupt base.	1.23	100.61
89	Sandstone / Siltstone (60:40) - very thinly-interbedded, medium grey, fine-grained sandstone with trace glauconite and scattered coalified plant debris, and dark grey, hematitic weathering, moderately-bioturbated siltstone; abrupt base; attitude: 143/5 NE (locality N.217).	0.45	99.38
88	Mudstone - dark grey, silty, hematitic weathering, very-thin-bedded, platy-weathering; abrupt base.	1.89	98.93
87	Sandstone - very fine- to fine-grained, buff weathering, moderately-bioturbated; massive; abrupt base; thickness varies from 27 to 31 cm.	0.29	97.04
86	Siltstone - medium grey, sandy, intensely-bioturbated; gradational base.	1.40	96.75
<i>----- Fault, established; normal extensional fault at 115/67 NE, with 3 to 10 cm of breccia and clayey gouge; displacement 1.40 m down to northeast (beds matched across fault); lenses of calcite along fault, but no apparent drag. -----</i>			
85	Sandstone / Siltstone (50:50) - very thin interbeds of medium grey, very fine-grained sandstone and siltstone; sparsely-bioturbated throughout; abrupt base.	0.35	95.35
84	Siltstone - medium grey, very sandy, moderately- to intensely-bioturbated, with occasional large ellipsoidal concretions; abrupt base.	1.33	95.00
83	Sandstone / Siltstone (50:50) - thin planar interbeds of medium grey, very fine-grained sandstone and siltstone; sparsely- bioturbated throughout; abrupt base.	0.45	93.67
82	Siltstone - dark grey, sandy, thin-bedded, concretionary; abrupt base; forms low waterfall (locality N.218).	1.20	93.32
81	Mudstone - dark grey, silty, rubbly weathering, intensely-bioturbated; gradational base.	1.20	92.12
80	Siltstone - dark grey, sandy, very thin-bedded, intensely-bioturbated; partly concealed by boulders in rapids; abrupt base.	1.80	90.92
79	Sandstone - very fine-grained, light grey weathering, with abundant small ellipsoidal concretions; intensely-bioturbated; abrupt base; forms ledge across river.	0.18	89.12
78	Siltstone - brownish-grey weathering, sandy, thin-bedded; abrupt base.	0.90	88.94
77	Sandstone - medium to coarse-grained, brownish-grey, grey- to tan weathering, siliceous, clean; no visible porosity; thick-bedded, swaly cross-laminated; abundant intraclasts at base; abrupt base; attitude: 165/10 NE (locality N.219).	0.72	88.04
76	Sandstone - medium-grained, light brown weathering, with abundant contorted silty intraclasts (a mud-chip breccia); convolute-laminated (indicated paleoslope 210); thickness varies from 10 to 60 cm; erosional base.	0.35	87.32
75	Sandstone - fine to medium-grained, light grey, light brown weathering, quartz-feldspar-basalt, medium-bedded; hummocky, rippled and platy-weathering at top; sparsely-bioturbated at top; thickness varies from 74 to 84 cm; erosional base.	0.79	86.97
74	Siltstone - dark grey, orange weathering, sandy, intensely-bioturbated; abrupt base.	0.55	86.18
73	Mudstone - dark grey, very silty, platy- to rubbly weathering, intensely-bioturbated; abrupt base.	0.40	85.63
72	Sandstone - very fine- to fine-grained, medium grey, buff weathering, intensely-bioturbated; abrupt base.	0.09	85.23

71	Siltstone - dark grey, very sandy, platy weathering, intensely-bioturbated; abrupt base.	0.69	85.14
70	Sandstone - very fine-grained, medium grey, intensely-bioturbated, with many silt-filled burrows; abrupt base.	0.06	84.45
69	Siltstone - dark grey, brown weathering, platy weathering, moderately- to intensely-bioturbated; abrupt base.	1.40	84.39
68	Mudstone - light grey, silty, moderately-bioturbated, hard; an ash band; abrupt base.	0.02	82.99
67	Siltstone / Mudstone (80:20) - thin fining-upward sharp-based couplets of dark grey intensely-bioturbated siltstone and mudstone; erosional base.	0.96	82.97
66	Sandstone - fine-grained, buff weathering, concretionary, sparsely-bioturbated; abrupt base.	0.20	82.01
65	Siltstone - medium to dark grey, orange weathering, sandy, concretionary, platy- to rubbly weathering; abrupt base.	1.70	81.81
64	Sandstone - very fine-grained, buff weathering, thin planar beds, moderately-bioturbated at top; abrupt base.	0.52	80.11
----- Fault, established; normal extensional fault at 110/70 NE, displacement down 1.5 metres to northeast; beds matched across fault. -----			
63	Siltstone - medium grey, sandy, very thin-bedded, hackly fracture, moderately- to intensely-bioturbated, rubbly weathering; abrupt base.	4.15	79.59
62	Sandstone - fine-grained, dark greenish-grey, light brown weathering, glauconitic, blocky weathering; top is marked by widely-spaced polygonal cracks (synaeresis cracks?); a biscuit bed; erosional base; thickness varies from nil to 32 cm; attitude: 006/8 SE (locality N.220).	0.16	75.44
61	Siltstone - medium to dark grey, very sandy, very thin-bedded, rubbly-weathering, intensely-bioturbated; abrupt base.	1.30	75.28
60	Sandstone - fine-grained, buff weathering, sparsely-bioturbated; erosional base.	0.25	73.98
59	Siltstone - medium grey, with sand-filled burrows; slightly sheared; abrupt base; possible ash band.	0.06	73.73
58	Sandstone - very fine-grained, buff weathering, sparsely-bioturbated; erosional base.	0.14	73.67
57	Mudstone / Siltstone (60:40) - thin to medium interbeds of dark grey silty mudstone and medium grey, brown weathering sandy siltstone; intensely-bioturbated throughout; abrupt base.	0.80	73.53
56	Siltstone - dark grey, buff weathering, sandy, concretionary, intensely-bioturbated; locally biscuit weathering, but not as well-developed as underlying unit; abrupt base.	0.15	72.73
55	Siltstone - dark grey, sandy, intensely-bioturbated; a biscuit bed; gradational base.	1.85	72.58
54	Sandstone - very fine-grained, buff weathering, intensely-bioturbated, concretionary; biscuit weathering; probable hardground; gradational base; thickness varies from 10 to 40 cm, thickening to north into middle of river channel, where this bed forms a prominent ledge.	0.25	70.73
53	Siltstone / Sandstone (50:50) - thinly-interbedded, intensely-bioturbated dark grey, rusty weathering siltstone and very fine-grained, rippled sandstone, with abundant large limy concretions at top; abrupt base.	0.45	70.48
52	Sandstone - very fine-grained, brown weathering, with abundant irregular concretions; erosional base.	0.35	70.03
51	Siltstone / Sandstone (70:30) - thinly-interbedded, intensely-bioturbated dark grey, rusty weathering, concretionary siltstone and very fine-grained sandstone; gradational base.	1.05	69.68
50	Siltstone - dark grey, sandy, moderately-bioturbated; abrupt base.	1.00	68.63
----- Fault, established; normal extensional fault at 090/70 N, with 5 metre wide zone of closely-spaced joints in hanging wall; displacement down 1.7 metres to north; beds matched across fault. -----			
49	Sandstone - very fine-grained, buff weathering, silty, intensely-bioturbated; gradational base; attitude: 175/8 NE (locality N.221).	0.20	67.63
48	Siltstone - dark grey, sandy, intensely-bioturbated, cut by swarm of closely-spaced joints; abrupt base.	0.35	67.43
47	Sandstone / Siltstone (80:20) - thin fining-upward interbeds of medium grey, light grey weathering, intensely-bioturbated, very fine-grained sandstone and siltstone, with occasional concretions; abrupt base.	1.95	67.08

46	Siltstone / Sandstone (85:15) - thin to very thin interbeds of dark grey, dark brown weathering, intensely-bioturbated, very sandy siltstone and very fine-grained sandstone; gradational base.	0.30	65.13
45	Sandstone - very fine-grained, buff weathering, silty, blocky weathering, intensely-bioturbated; abrupt base.	0.09	64.83
44	Siltstone - dark grey, brown weathering, sandy, intensely-bioturbated, with locally-abundant coaly plant debris; gradational base.	0.68	64.74
43	Sandstone - fine-grained, buff weathering, blocky weathering, intensely-bioturbated, with many silt-filled burrows; forms low ledge crossing river; abrupt base.	0.40	64.06
42	Mudstone - dark grey, dark brownish-grey weathering, silty, with occasional thin fining-upward siltstone interbeds; moderately- to intensely-bioturbated; gradational base.	0.55	63.66
41	Sandstone - very fine-grained, buff weathering, concretionary, sparsely- to moderately-bioturbated; thickness varies from 5 to 32 cm; abrupt base.	0.10	63.11
40	Mudstone - dark grey, dark brownish-grey weathering, silty, with scattered coalified plant debris; gradational base.	0.40	63.01
39	Sandstone - very fine-grained, medium grey, moderately- to intensely-bioturbated; concretionary; abrupt base.	0.29	62.61
38	Siltstone - dark grey to black, sandy in part, thin-bedded, intensely-bioturbated, with scattered small concretions; gradational base.	1.06	62.32
37	Sandstone - very fine-grained, dark grey, intensely-bioturbated, with many silt-filled burrows; abrupt base.	0.05	61.26
36	Siltstone - black, rubbly weathering, intensely-bioturbated; gradational base.	0.65	61.21
35	Sandstone - very fine-grained, dark grey, very silty, rubbly weathering, intensely-bioturbated; abrupt base.	0.15	60.56
34	Siltstone - dark grey, very thin to thin-bedded, rubbly weathering, intensely-bioturbated; gradational base; attitude: 172/9 NE (locality N.222).	0.50	60.41
33	Siltstone - medium grey, sandy, massive; base concealed by boulders.	0.45	59.91
32	(Concealed) - boulders in river bed.	0.60	59.46
31	Siltstone - black, thin- to medium-bedded, rubbly weathering, intensely-bioturbated; base concealed by boulders.	0.67	58.86
30	(Concealed) - boulders in river bed.	12.58	58.19
29	Siltstone - dark grey, sandy, platy- to rubbly weathering, intensely-bioturbated; top concealed by boulders; gradational base.	0.30	45.61

**Trent River Formation: Cowie Member (9.26 m - complete):**

28	Sandstone - fine-grained, grey weathering, slightly silty, thin irregular beds with abundant concretions; moderately- to intensely-bioturbated; abrupt base; attitude: 003/8 SE? (locality N.223).	0.80	45.31
27	Sandstone - very fine- to fine-grained, rusty weathering, silty, very thin planar beds; moderately-bioturbated; some <i>Pelecypodichnus</i> burrows; abrupt base.	0.55	44.51
26	Siltstone - dark grey to black, brownish-grey weathering, sandy, intensely-bioturbated; partly concealed by boulders; abrupt base.	1.20	43.96
25	Sandstone - fine-grained, buff weathering, slightly silty, very thin-bedded, flaggy weathering, moderately bioturbated; gradational base.	0.30	42.76
24	Sandstone - very fine-grained, medium grey, patchy rusty weathering,, intensely bioturbated, with occasional coalified bark chips; abrupt base.	0.47	42.46
23	Siltstone - dark brownish-grey, sandy, intensely bioturbated; gradational base.	0.39	41.99
22	Sandstone - fine to medium-grained, buff weathering, clean, thick-bedded; swaly-bedded at top, slightly bioturbated; gradational base; attitude: 008/7 SE on north bank of river (locality A.1816).	0.58	41.60
21	Sandstone - medium-grained, brown weathering, clean, very thin irregular beds; abrupt base.	0.47	41.02
20	Siltstone - dark grey, medium brown weathering, very thin-bedded, platy-weathering, moderately bioturbated; gradational base.	0.25	40.55
19	Sandstone - very fine-grained, silty, platy weathering; slightly bioturbated; abrupt base.	0.15	40.30
18	Siltstone - dark grey, brown weathering, intensely bioturbated; base concealed by gravel in river bed.	0.20	40.15
17	(Concealed) - gravel and boulders in river bed.	1.80	39.95

16	Siltstone - dark brownish-grey, brown to orange weathering, sandy, with abundant finely-broken plant debris and occasional spheroidal concretions; intensely-bioturbated; flaky weathering; abrupt base.	0.57	38.15
15	Sandstone - medium-grained, brown weathering, clean, quartz-feldspar-basalt; massive at base; hummocky cross-laminated and platy weathering at top; sparsely-bioturbated, with occasional <i>Ophiomorpha</i> burrows; abrupt base; attitude: 175/9 NE on south bank of river (locality N.224).	0.93	37.58
14	Sandstone - medium-grained, dark brown weathering, quartz-feldspar-basalt, thick-bedded; hummocky cross-bedded at top; moderately-bioturbated, with occasional shell debris; base concealed by water.	0.60	36.65
<b>Trent River Formation: Cougarsmith Member (15.55 m - complete):</b>			
13	(Concealed) - deep water and cobbles in river bed.	0.20	36.05
12	Siltstone - medium grey, brown weathering, very sandy, intensely-bioturbated; gradational base.	0.25	35.85
11	Sandstone - fine-grained, light grey weathering, moderately-bioturbated; silty; gradational base.	0.10	35.60
10	Siltstone - dark brown, sandy; poorly-exposed under deep water; base concealed by boulders.	0.15	35.50
9	(Concealed) - boulders in river bed.	14.85	35.35
<b>Comox Formation: Dunsmuir Member (incomplete):</b>			
8	Sandstone - medium-grained, grey weathering, thin to very thin planar beds; linguoid ripples on some bed tops; flaggy weathering; gradational base.	1.41	20.50
7	Sandstone - medium- to coarse-grained, slightly coarser near base with rare quartz grit at base; grey weathering, clean, thin- to medium-bedded; abrupt base.	0.35	19.09
6	Sandstone - fine- to medium-grained, grey weathering, medium to thick planar beds; abrupt, undulating base.	1.01	18.74
5	Sandstone - medium to coarse-grained, light brownish-grey weathering, very thin-bedded, intensely-bioturbated, with abundant <i>Macaronichnus</i> burrows; erosional base.	0.28	17.73
4	Sandstone - fine- to medium-grained, light grey weathering, slightly silty, trough cross-laminated (indicated paleoflow 235); gradational base; attitude: 165/12 NE on north bank of river (locality A.1817); 163/10 NE on south bank of river (locality N.225).	0.70	17.45
3	Sandstone - medium- to coarse-grained, light grey to white, brown weathering, arkosic, clean, thick-bedded; gradational base.	2.40	16.75
2	Sandstone - medium-grained, buff weathering, thick-bedded, with occasional concretionary bands; gradational base.	11.35	14.35
1	Sandstone - medium-grained, grey weathering, low-angle swaly-bedded, hard; attitude: 152/13 NE (locality A.1806); this bed forms a ledge across river, at top of waterchute; base concealed		





## Appendix 4

### Measured section No. 6

#### Trent River Formation - Browns River

Top of section: on southwest bank of Browns River, downstream from rapids, at UTM (Zone 10, NAD 83) 351470 E., 5506257 N.

Base of section: on northeast bank of Browns River, immediately downstream from waterfall, at UTM (Zone 10, NAD 83) 351290 E., 5506422 N.

NTS 92F/11. TRIM 92F.065.

Measured by: C.G. Cathyl-Bickford, August 30, 1989.

Unit	Description Height	Thickness	
	<b>Trent River Formation: Royston Member (incomplete):</b> (m)	(m)	
18	Mudstone - dark grey, silty, rubbly, intensely bioturbated; gradational base. 16.12	>3.00	
17	Siltstone - medium to dark grey, sandy, concretionary at base; thin to medium fining-upwards beds; intensely bioturbated. 13.12	0.75	
	<b>Trent River Formation: Browns Member (8.99 m - complete):</b>		
16	Sandstone - fine-grained, light to medium greenish-grey, cherty, massive, intensely bioturbated, with scattered shell fragments and sparse finely broken plant debris; large <i>Inoceramus</i> at top. Burrows are large (>1 cm), both parallel and normal to bedding, with no ornament; gradational base. 12.37	1.04	
15	Sandstone - as above but very fine-grained, thin-bedded. 11.33	0.88	
14	Siltstone - dark greenish-grey, rusty- weathering, sandy, very thin-bedded, platy, moderately bioturbated, with gently curving trails along bedding.	0.73	10.45
13	Sandstone - very fine-grained, medium greenish-grey, rusty weathering in part; silty at top, becoming fine-grained and cleaner at base; thickly-laminated; intensely bioturbated, with featureless mud-filled oblique burrows, ornamented trails (cf. <i>Bilobites</i> ?) and churned escape burrows ( <i>Pelecypodichnus</i> ). 9.72	1.04	
12	Sandstone - fine-grained, light to medium greenish-grey; massive, discoidal-weathering; gradational base. 8.68	0.64	
11	Sandstone - as above, but thin-bedded and platy; with straight and looping ( <i>Spirophyton</i> ?) trails along bedding, and occasional <i>Inoceramus</i> ; specimen FA.604 (locality A.604); gradational base. 8.04	0.55	
10	Sandstone - very fine-grained, medium greenish-grey, strongly rusty-weathering, thickly-laminated to very thin-bedded, with abundant small <i>Inoceramus</i> cf. <i>I. schmidtii</i> . 7.49	0.55	
9	Sandstone - fine-grained, light greenish- grey, very thin irregular beds, platy; gradational base. 6.94	0.09	
8	Sandstone - very fine-grained, medium to dark greenish-grey, rusty weathering, silty, thickly-laminated; moderately bioturbated. 6.85	0.37	

7	Sandstone - fine-grained, light to medium greenish-grey, trough cross-laminated, intensely bioturbated; erosional base. Thickness varies from nil to 0.49 m.	0.24	
	6.48		
6	Sandstone - very fine-grained, medium to dark greenish-grey, rusty weathering in part; silty, intensely bioturbated, with <i>Inoceramus</i> at top; gradational base. Thickness varies from 0.46 to 0.94 m.	0.70	
	6.24		
5	Sandstone - very fine-grained, medium greenish-grey, slightly silty, intensely bioturbated, very thin-bedded, with 50% thin lenticular channel-filling interbeds of cleaner, fine-grained sandstone; gradational base.	0.67	
	5.54		
4	Siltstone - dark greenish-grey, thickly-laminated, platy to rubbly, with occasional sand-filled burrows; moderately bioturbated, with scattered shell fragments.	0.82	
	4.87		
3	Sandstone - fine-grained, medium greenish-grey, clean, thin-bedded, trough cross-bedded, with 50% thin interbeds of intensely bioturbated, dark grey sandy siltstone. Abundant looping burrows, cf. <i>Spirophyton</i> .	0.67	
	4.05		
<b>Trent River Formation: Puntledge Member (incomplete):</b>			
2	Siltstone - dark greenish-grey, sandy, thin-bedded, rubbly, intensely bioturbated, concretionary; gradational base.	1.58	3.38
1	Mudstone		

