DRAINAGE COMMITTEE

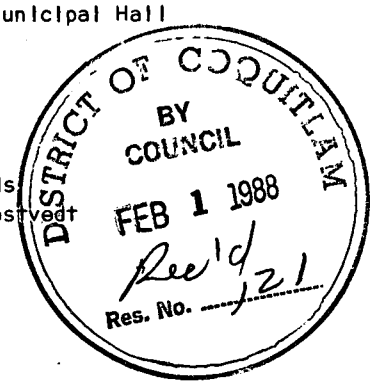
Item # 41

AGENDA NO. ~~503~~

File: 01 03 06

To: Executive Committee

Minutes of a Meeting of the Drainage Committee held at Coquitlam Municipal Hall at 1215 hrs, Wednesday, 1987 January 20.



Attending:

Alderman W. LeClair, Chairman
Alerman B. Robinson
Alderman D. White
J. L. Tonn

Neil Nyberg
Tony Edwards
Sever Rondestvedt

Call to Order

The chairman called the meeting to order at 1220h.

Ditch Elimination Program

The Committee received Engineering Report 01 03 09 d 1988 January 18 regarding planning options for the Ditch Elimination Program. The Chairman requested that further options for financing be investigated, including:

completion of all phases within 7,10,13 year horizons;
completion of all phases without spending principle;
completion of all phases drawing down the principle; and
completing all phases by transferring $1 million per annum to the fund.

The Committee agreed that the 1988 program should be advanced to the approval stage before final adoption of the 1988 budget bylaw.

Moved by Alderman Robinson
Seconded by Alderman White

COUNCIL ACTION REQUIRED

503.1.01 **That the 1988 Ditch Elimination Program be approved in advance of the 1988 Budget Bylaw, as follows:**

1988 Ditch Elimination Program

533055-023	**Area Four Ditch Enclosure Edgar/Richard Construction**	**$ 77,000**
533055-024	**Area Five Ditch Enclosure Maillardville Area Construction**	**$363,000**

Approved Council 1/27/88

503.1.02 **That Council authorize staff to prepare and present a bylaw to approve up to $440,000 of the Drainage Capital Reserve Fund for the 1988 program.**

CARRIED

Status Report: The Town Centre Drainage Program

The Committee considered Engineering memo 05 02 88/10 d 1988 January 18 regarding the proposed 1988 projects for the Town Centre Drainage program.

Moved by Alderman Robinson
Seconded by Alderman White

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COUNCIL ACTION REQUIRED **503.2.01** **That the 1988 Municipal Drainage Trunk Program be approved in advance of the 1988 Budget Bylaw as follows:**

Account #	Description	Budget
533054-031	Hoy Creek Interceptor	$ 150,000
533054-033	Heffley Trunk Extension	$ 152,000
533054-034	Guildford Storm Main - West of Johnson Street	$ 95,000
		$ 397,000

COUNCIL ACTION REQUIRED **503.2.01** **That a bylaw to withdraw $397,000 from the Drainage Development Cost Charge Reserve Fund be drafted and presented to Council by 1988 February 15.**

CARRIED

Greater Vancouver Liquid Waste Management Plan

The Committee reviewed Engineering memo 01 03 06 d 1988 January 14 and concluded that the report should be received.

Fraser River Flood Control Program

The Committee considered Engineering memo 01 03 06 d 1988 January 14.

Moved by Alderman Robinson
Seconded by Alderman White

COUNCIL ACTION REQUIRED **503.4.01** **That the Drainage Committee recommend that Council endorse the bank protection, dyking and flood box project for the Coquitlam River proposed under the Fraser River Flood Control Program for 1990 to 1993; and**

503.4.02 **That the endorsement be sent to the Hon. Bruce Strachan, Minister of Environment and Parks, and Federal Member of Parliament G. St. Germain.**

The Municipal Engineer requested that the minutes be brought forward in Executive to protect the confidentiality of budget before tenders were called for the Town Centre Drainage system and Ditch Elimination Programs.

The Committee briefly discussed the timing and format of the financial 'sensitivity analysis for the Ditch Elimination program and requested that reports be prepared prior to February 07. It was confirmed that a report will be available to committee members on 1988 February 03. A short meeting will be held at 1215h to receive the report.

The Chairman adjourned the meeting at 1320h.

A J Edwards

Minutes by: A. J. Edwards, P.Eng.
Assistant Municipal Engineer

DISTRICT OF COQUITLAM

AGENDA ITEM 503.1

Inter-Office Communication

TO: J.L.Tonn, Municipal Manager DEPARTMENT: Administration DATE: 1988 January 18

FROM: Neil Nyberg DEPARTMENT: Engineering YOUR FILE:

SUBJECT: DITCH ELIMINATION PROGRAM OUR FILE: 01 03 06

FOR DRAINAGE COMMITTEE

1.00 BACKGROUND

1.01 In Mayor Sekora's inaugural speech, reference was made to examing Coquitlam's ditch elimination program as to the term and scope of work. The program has completed four cycles from 1984 to 1987 inclusive, and has accomplished the following:

	1984	1985	1986	1987
Ditch Eliminations	1,200 m	3,893 m	2,720 m	1,850 m
Expenditure	$185,000	$470,000	$439,900	$314,000
Unit Costs	$154/m	$121/m	$162/m	$170/m

1.02 Program Objectives. The original objectives of the program are:

- to provide enclosed street drainage to approximately 8,200 lots in SW Coquitlam.
- to improve public safety and convenience for pedestrians and motorists;
- to reduce operations and maintenance costs associated with open ditches; and
- to collect and convey runoff from a 10 year storm event and to direct larger storms to flood routes.

1.03 Program Implementation. Major drainage areas have been identified and priorized in consideration of flooding potential, roadside hazard, effectiveness of existing ditch systems and excessivemaintenance costs. Annual programs are grouped by geographical area and drainage catchment area, since localized improvements often cause problems with adjoining segments of the system. Larger flows (and deeper ditches) are associated with lower elevations, so work often progresses from the 'bottom' of a system to the 'top'.

1.04 Program Funding. Each year the Capital Fund for Drainage Improvements accumulates interest proceeds and these proceeds are applied to the cost of the annual program. In 1987, the drainage 'heritage' fund was increased from $4 million to $5 million. The dynamic of the program funding is evident from the summary of the program achievements to date; the interests proceeds vary roughly as the prime rate of interest, while construction costs tend to inflate. As a result, where interest rates are moderate, the program is unable to carry forward with the same momentum.

1.05 This memorandum explores some alternatives in funding the Ditch Elimination Program.

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2.00 PROGRAM DIMENSIONS

2.01 The proposed 1988 Ditch Elimination Program is described in Appendix B to this report. Financing will be drawn from the 5.6 million Drainage Capital Reserve. Preliminary designs for the proposed 1988 and 1989 program have been prepared.

STREET	FROM	TO	LENGTH (M)	ESTIMATED COST ($)
Area 4 Completion				
Edgar Avenue	LeClair Creek	Richard Street	124	27,000
Richard Street	Edgar Avenue	Lane S. Rochester	250	50,000
AREA 4 TOTAL:				$77,000
Area 5A (1988)				
Nelson Street	N. Lougheed	S. Brunette	170	20,000
Adair Avenue	W. Woolridge	E. Woolridge	155	40,000
LeBleu	Alderson	Brunette	210	45,000
Roderick	Blue Mountain	Lane W. Allard	180	38,000
Bolleau	Brunette	Harris	150	30,000
Allard Street	#234	Brunette	220	42,000
Harris Avenue	#915	Bolleau	210	40,000
Alderson	LeBleu	Nelson	135	30,000
Alderson	#917	LeBleu	260	55,000
King Street	Quadling	Alderson	50	23,000
AREA 5A TOTAL:				$363,000

2.02 The 1989 program has been identified as follows:

Area 5B (1989)				
James/Nelson	1057 Nelson	Brunette	250	44,154
Nelson	Alderson	Quadling	100	13,964
Alderson	Nelson	Marmont	200	36,222
Quadling	Nelson	Marmont	200	33,596
Delestre	Nelson	Marmont	200	31,303
Thomas	Nelson	Marmont	200	36,735
Stewart	Nelson	Marmont	200	33,263
Walls	Nelson	Marmont	200	34,203
Rochester	Nelson	Marmont	200	33,117
Madore	Nelson	Marmont	200	32,007
Dansey	Nelson	Marmont	200	33,516
Charland	Nelson	Marmont	200	33,693
AREA 5B TOTAL:				$395,773

2.03 There are four methods of financing ditch elimination:

- municipal ditch elimination program (proceeds from capital reserve fund);
- local improvement or specified area plan;
- 'third party' work orders; and
- direct financing from municipal tax revenues or Land Sale Reserve Fund.

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2.04 Potential interest proceeds from the Capital Reserve Fund were analyzed to determine how the existing 25 year 'base line' program could be sustained or expedited. This analyses used an 8 per cent average rate of return on the balance in the Drainage Capital Reserve Fund. The returns were measured against two hypothetical cash flows; a 21 year plan (remaining work in the base line plan) and a 'year 2000' plan which accelerates the completion of ditch elimination in 28 areas,

- **the 'base line plan' completes the program in 2008, at a cost of about $16,452,933 (Appendix C)**

- **the expedited plan (year 2000) completes the program in 12 years at a cost of $15,566,188 (Appendix D).**

2.05 Section 674 of the Municipal Act allows property owners to petition Council to construct improvements adjacent their properties and to assess special frontage or parcel taxes to defray the cost. Alternatively, Council may initiate such improvement projects (termed the "initiative plan"), and unless 60 per cent of propety owners object, the works may be carried out and the levies assessed against benefiting properties. This plan was used extensively in the 1970s as residential neighbourhoods sought to acquire amenities such as sidewalks, curb and gutter, street lighting and enclosed storm drainage. By 1979, however, the frontage costs per annum had reached excessive levels and the plan fell into disfavour.

2.06 Under the 'Local Improvement' or 'Specified Area' plan, Council may pay a proportion of the frontage costs from general revenue. For instance, Council could elect to pay 50 per cent of the cost of ditch enclosure in any neighbourhood where a majority of property owners were willing to assume responsibility for the balance ofd the cost over a period of years. This approach, while administratively cumbersome, has several advantages:

- the property owners who benefit, pay part of the cost;
- property owners have collective choice over timing and extent of the project; and
- the borrowing power of the Municipality is mobilized for the benefit of the taxpayers.

2.07 A third avenue for property owners wishing ditch elimination is to pay the cost directly. Municipal crews will carry out temporary enclosures of lot frontages for actual cost (commonly in the $1,500 to $2,500 range). The improvements are termed 'temporary' owing to the presumption that at some future date all these 'temporary' installations will be incorporated into one overall municipal facility. In practice, these 'temporary' enclosures are permanent solutions to the aesthetic problem of open ditches. The 'third party' approach has some advantages:

- an individual who benefits pays the entire cost;
- individual property owners have absolute control over the timing of the work, since neighbours need not be consulted;
- the Municipality is a 'reputable' contractor and gives good value for money; and
- the cost is moderate.

2.08 In past years, Council has been responsive to appeals for isolated ditch enclosures to meet site specific flooding problems. This method of financing has a theoretical problem of equity: is it fair to confer a benefit on a single property owner while charging the cost to the generality? The problem has not arisen lately because of the prevailing taxation/expenditure squeeze; this option of financing drainage has 'dried up'.

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3.00 EXPEDITED VS BASE LINE PROGRAMS

3.01 Council has direct control over the implementation of the program only where they control the purse strings. Available sources include:

- general revenue funds (from taxation);
- land sale reserve fund proceeds; and
- capital reserve fund interest proceeds.

3.02 The inaugural speech by Mayor Sekora identified the goal of 'speeding up' the Ditch Elimination Program. Appendices E and F show that under the assumptions of an 8 per cent average interest rate and 3 per cent average inflation of construction cost:

- **investment of $1 million is required in 1988 and 1989 to sustain the 'Base Line' plan to the year 2008; and**
- **investment of $1 million is required in 1988, 1989, 1990 and 1991, ($4 million total) to achieve completion by the year 2000.**

3.03 There are some practical limitations to the size of an annual Ditch Elimination Program. We think that projects exceeding 1.5 million dollars of construction will be very disruptive of transportation because of the extent of the work. Jobs of this magnitude may also exceed the bonding capacity or management capability of smaller local firms that often submit the most competitive bids.

3.04 Given that the most likely source of funds for possible augmentation of the Drainage Capital Reserve fund is the Land Sale Reserve (LSR) fund, then there is also a practical limit to the amount that can be drawn from the LSR in any given year. Land Sales tend to be cyclical and the inventory of saleable land held by Coquitlam is not inexhaustible. Therefore, to accommodate other possible priorities for the fund, and in recognition of the limits of relying on the real estate market for revenue, we think that a maximum investment transfer of one million dollaars per year is a responsible guideline.

3.05 We believe that the 1988 and 1989 working plans are too far advanced to make significant changes without affecting the economy of construction. Consequently, although investment decisions should be made by Council in 1988, the effects of those decisions will not be apparent until the third year of the program. The two investment strategies (base line and year 2000) share a common requirement to invest one million dollars in the Drainage Capital Reserve fund in 1988 and one million dollars in 1989. Council will, therefore, have an opportunity to review the marginal value of investing an additional two million dollars to expedite the program.

3.06 The third alternative of making no adjustment to the current reserve level, was also examined. The affect of inflation extends the final completion of the program well into the 21st century. Although very long-range forecasts are perilous, we think the program, at present levels, could extend another thirty-five years to completion in 2023.

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4.00 CONCLUSIONS

4.01 The traditional methods of financing ditch enclosure are:

- individual taxpayers initiative;
- local improvement taxation (with or without cost sharing);
- general revenue; and
- interest proceeds from the Drainage Capital Reserve Fund.

To present these alternatives effectively to taxpayers, there should be a short article on ditch enclosure policy in the municipal newsletter. Prior to that article, Council might wish to examine these policy questions:

- Should local improvement projects be cost shared?
- Should individual ditch enclosure projects be cost shared?
- Should there be further investment in the Ditch Elimination Reserve?

4.02 If cost sharing is adopted as a Council policy, then the Drainage Capital Reserve Bylaw could be amended to allow cost sharing payments to be drawn from the interest proceeds of the reserve fund. This would have the affect of providing a variety of options for taxpayers, without affecting general tax revenues:

- homeowners may 'wait their turn' for the 'free' program;
- homeowners may organize their neighbours and qualify for some cost sharing;
- homeowners may proceed anytime at their own expense.

4.03 Some increase in the Drainage Capital Reserve fund is required to offset inflation. If Council selects the twenty-one year alternative, two million dollars must be invested; however, if the 'program 2000' option is selected, at least four million dollars must be withdrawn from the Land Sale Reserve fund over the period 1988 to 1991.

4.04 Given many competing alternatives for funding from the Land Sale Reserve source, a possible one year limit of one million dollars of drainage investment should be considered. This limit is one assumption used in our calculations.

5.00 RECOMMENDATIONS

5.01 That the 1988 Ditch Elimination Program be approved in advance of the 1988 Budget Bylaw, as follows:

1988 Ditch Elimination Program

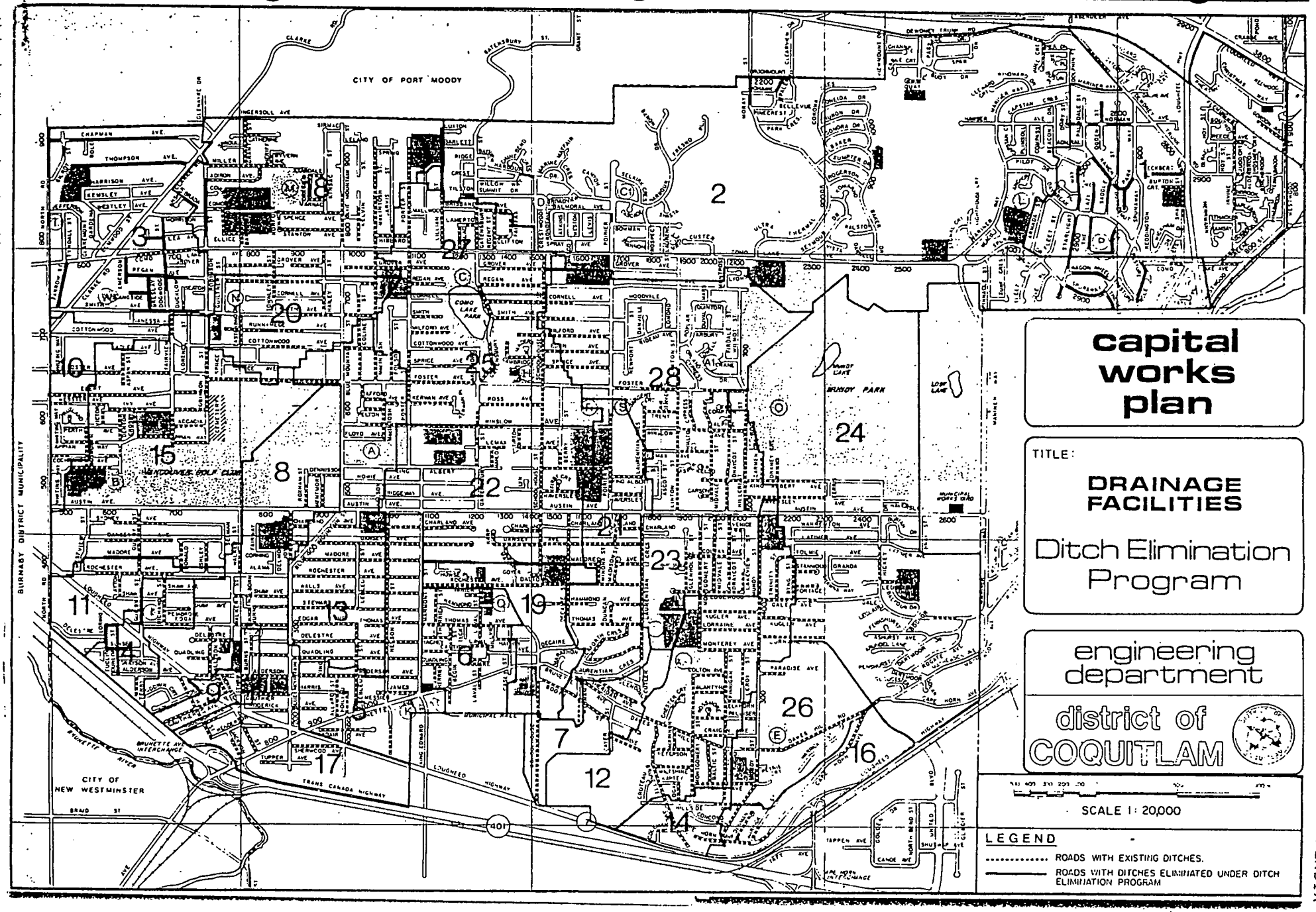
533055-023	Area Four Ditch Enclosure Edgar/Richard Construction	$77,000
533055-024	Area Five Ditch Enclosure Maillardville Area Construction	$363,000

5.02 That Council authorize staff to prepare and present a bylaw to approve up to $440,000 of the Drainage Capital Reserve Fund for the 1988 program.

Neil Nyberg

Neil Nyberg, P. Eng.
Municipal Engineer

NWN/mw
Attach.


CITY OF PORT MOODY
BURNABY DISTRICT MUNICIPALITY
CITY OF NEW WESTMINSTER
TRANS CANADA HIGHWAY
LOUGHEED HIGHWAY
BRUNETTE RIVER
MUNICIPAL HALL
BRUNDY PARK
COMO LAKE PARK
capital works plan
TITLE:
DRAINAGE FACILITIES
Ditch Elimination Program
engineering department
district of COQUITLAM
SCALE 1: 20,000
LEGEND
ROADS WITH EXISTING DITCHES.
ROADS WITH DITCHES ELIMINATED UNDER DITCH ELIMINATION PROGRAM

APPENDIX A

APPENDIX B

PROJECT DESCRIPTION
1987 December 21

Item: 1988 DITCH ELIMINATION PROGRAM - AREA 4/5

File No. 05 02 88

Account No. 533055-

Finance: Interest proceeds from Drainage Reserve Fund

Schedule: Engineering - April 1987 - January 1988
Construction - July - October 1988

PROJECT OBJECTIVES:

In the context of the long-term Council objective to eliminate all ditches in urban residential streets in SE Coquitlam, this project will complete enclosure of existing roadside ditches in the Dunlop/Richard area (Drainage Area No.4), and part of the Marmont/Lougheed area (Drainage Area No.5).

SCOPE OF WORK:

Based on available funding twelve sections totalling 2100 metres of existing ditches, will be enclosed. (See project list attached). Work includes ditch cleaning, laying of PVC or concrete pipe, backfilling and resurfacing with gravel or sod. Driveways are repaired to match existing surface. Asphalt curbs are placed where grades are greater than 3% or where special drainage problems exist. Boulevards are restored with gravel or sod, depending on function and erosion potential. A 1.5m gravel strip is provided for parking. Boulevard drainage is confined to a sod lined swale leading to lawn basins or catch basins.

JUSTIFICATION:

Ditch elimination programming is established by drainage areas and considers erosion potential, flooding potential, vehicle and pedestrian hazard, maintenance cost and appearance factors. The program normally operates within one or more drainage basins, concentrating on the lower reaches at the outset, and progressing towards the upstream streets as funding permits.

COST ESTIMATE:

Engineering	Complete
Construction	400,000
Contingency	40,000
	$440,000

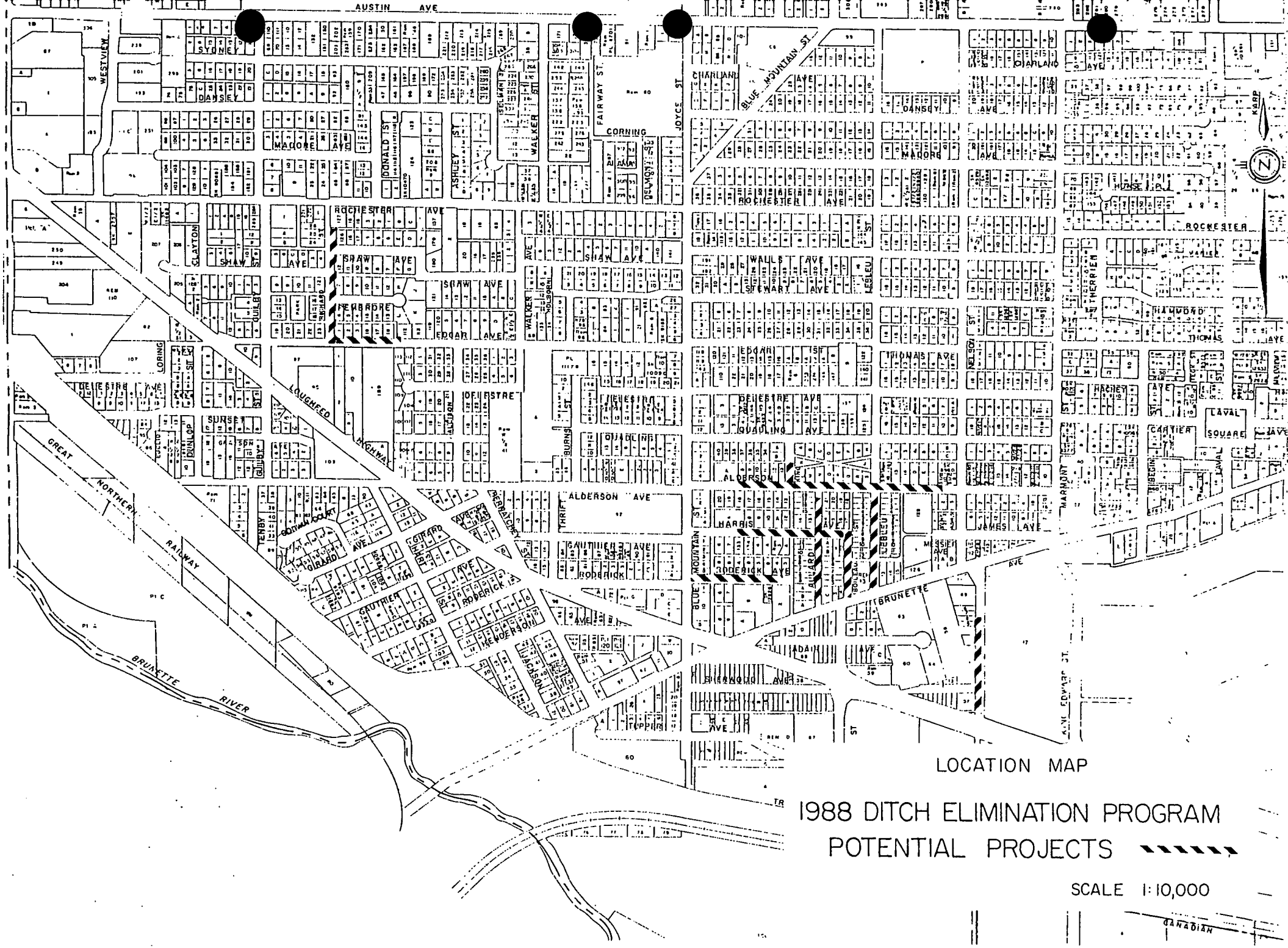
PROJECT DESCRIPTION APPROVED BY: Neil Nyberg

Item 5
88.4

87/12/22

SUBJECT: 1988 DITCH ELIMINATION PROGRAM - LIST OF LOCATIONS

STREET AREA 4 COMPLETION	FROM	TO	LENGTH (m)	ESTIMATED (COST) ($)
Edgar Avenue	LeClair Creek	Richard St.	124	27,000
Richard Street	Edgar Avenue	Lane S. Rochester	250	50,000
AREA 4 TOTAL:			374	77,000
AREA 5 (PARTIAL)				
Nelson Street	N. Lougheed	S. Brunette	170	20,000
Adair Avenue	W. Woolridge	E. Woolridge	155	40,000
LeBleu	Alderson	Brunette	210	45,000
Roderick	Blue Mountain	Lane W. Allard	180	38,000
Boileau	Brunette	Harris	150	30,000
Allard Street	# 234	Brunette	220	42,000
Harris Avenue	# 915	Boileau	210	40,000
Alderson	LeBleu	Nelson	135	30,000
Alderson	# 917	LeBleu	260	55,000
King Street	Quadling	Alderson	50	23,000
AREA 5 TOTAL			1,740	363,000



LOCATION MAP

1988 DITCH ELIMINATION PROGRAM
POTENTIAL PROJECTS

SCALE 1:10,000

APPENDIX C

BASE LINE PLAN

Year	Area	Description	Length (m)	Cost $	Unit Cost Increase 3%/year $/m
1984	1	Ranch Park	1,200	185,000	154
1985	2	Harbour Chines	3,893	470,000	121
1986	3	Clarke Road	2,720	439,000	162
1987	4	Dunlop/Richard	1,850	314,000	170
Subtotal:			9,663	1,408,00	
1988	4 & 5	Dunlop/Richard	2,114	363,000	172
1989	5	Marmont/Lougheed	2,350	395,773	168
1990	6	Laval	3,900	507,500	175
1991	7 & 8	Schoolhouse and Walker	3,150	567,000	180
1992	9,10,11,12	Whiting, Gauthier and Dawes Hill	3,200	592,000	185
1993	12	Brunette/Dawes Hill	4,000	764,000	191
1994	12	Finnigan/Monterey	4,000	788,000	197
1995	13	LeBleu/Delestre	3,150	639,450	203
1996	13	Blue Mountain/Winslow	3,150	658,350	209
1997	14 & 15	Coleman	3,320	713,800	215
1998	15 & 16	Austin/Fairview and Cape Horn	3,460	764,660	221
1999	17 & 18	Sherwood and Banting	3,300	752,400	228
2000	19,20,21	Rochester and Smith	3,320	780,200	235
2001	21 & 22	Poirier and Gatensbury	3,900	943,800	242
2002	23 & 24	Colfax and Hickey	3,000	747,000	249
2003	25	Como Lake	3,000	771,000	257
2004	25 & 26	Dawes Hill/Mundy	3,400	897,600	264
2005	27	Porter/Regan	3,700	1,006,400	272
2006	28	Austin/Linton	3,000	840,000	280
2007	28	Winslow/Cypress	3,000	867,000	289
2008	28	Foster/Poirier	2,300	685,000	298
TOTAL:			77,377m	$16,451,933	$215/m Average

APPENDIX D

EXPEDITED

Year	Area	Description	Length (m)	Cost $	Unit Cost Increase 3$/year $/m year
1984	1	Ranch Park	1,200	185,000	154
1985	2	Harbour Chines	3,893	470,000	121
1986	3	Clarke Road	2,720	439,000	161
1987	4	Dunlop/Richard	1,850	314,000	170
Subtotal			9,663	1,408,000	606
1988	4 & 5	Dunlop/Richard	2,114	363,000	172
1989	4, 5 & 6	Laval	6,600	1,188,000	180
1990	6,7,8,9,10,11	Schoolhouse	6,600	1,221,000	185
1991	11 & 12	Dawes Hill/Brunette	6,600	1,260,600	191
1992	12 & 13	Blue Mountain	6,600	1,300,200	197
1993	13, 14 & 15	Blue Mountain	6,600	1,339,800	203
1994	15,16,17,18,19,20	Austin/Fairview	6,600	1,379,400	209
1995	20,21,22, & 23	Rochester and Smith	6,600	1,419,000	215
1996	23,24 & 25	Colfax	6,600	1,458,600	221
1997	25,26,27 & 28	Dawes Hill/Mundy	6,600	1,504,800	228
1998	28	Austin/Linton	6,600	1,551,000	235
1999	28	Foster/Poirier	714	172,788	242
TOTAL			78,491	$15,566,188	$199/m Average

DITCH ELIMINATION PROGRAM: BASE LINE PLAN

DURATION: 21 Years

TERMINATION: 2008

INVESTMENT: One million in 1988, 1989 INTEREST PROCEEDS: $8,597,054

RESIDUAL IN 2008: 1,075,721

Year of Construction	Capital Reserve Fund Level	less	Construction Expenditure	plus	Interest Proceeds @ 8%	plus	Additional Investment	=	New Capital Reserve Fund Level at Year End
1988	$ 5,600,000	-	440,000	+	412,800	+	1,000,000	=	$ 6,572,800
1989	6,572,800	-	395,773	+	494,162	+	1,000,000	=	7,671,189
1990	7,671,189	-	507,500	+	573,095		-	=	7,736,784
1991	7,736,784	-	567,000	+	573,583		-	=	7,743,367
1992	7,743,367	-	592,000	+	572,109		-	=	7,723,476
1993	7,723,476	-	764,000	+	556,758		-	=	7,516,234
1994	7,516,234	-	788,000	+	538,259		-	=	7,266,493
1995	7,266,493	-	639,450	+	530,163		-	=	7,157,206
1996	7,157,206	-	658,350	+	519,909		-	=	7,018,765
1997	7,018,765	-	713,800	+	504,397		-	=	6,809,362
1998	6,809,362	-	764,660	+	483,576		-	=	6,528,278
1999	6,528,578	-	752,400	+	462,070		-	=	6,237,948
2000	6,237,948	-	780,200	+	436,620		-	=	5,894,368
2001	5,894,368	-	943,800	+	396,045		-	=	5,346,613
2002	5,346,613	-	747,000	+	367,969		-	=	4,967,582
2003	4,967,582	-	771,000	+	335,727		-	=	4,532,309
2004	4,532,309	-	897,600	+	290,776		-	=	3,925,485
2005	3,925,485	-	1,006,400	+	233,527		-	=	3,152,612
2006	3,152,612	-	840,000	+	185,009		-	=	2,497,621
2007	2,497,621	-	867,000	+	130,500		-	=	1,761,121
2008	1,761,121	-	685,400	-			1,075,721	=	- 0 -

Estimated Interest Proceeds: $8,597,054

APPENDIX E

DITCH ELIMINATION PROGRAM: 'YEAR 2000' PLAN

DURATION: 12 Years

TERMINATION: 2000

INVESTMENT: One million in 1988, 1989, 1990, 1991

RESIDUAL IN 2000: $367,465 INTEREST PROCEEDS: $4,213,827

Year of Construction	Capital Reserve Fund Level	less	Construction Expenditure	plus	Interest Proceeds @ 8%	plus	Additional Investment	=	New Capital Reserve Fund Level at Year End
1988	$ 5,600,000	-	440,000	+	412,800	+	1,000,000	=	$ 6,572,800
1989	6,572,800	-	395,773	+	494,162	+	1,000,000	=	7,671,189
1990	7,671,189	-	1,221,000	+	516,015	+	1,000,000	=	7,966,204
1991	7,966,204	-	1,260,000	+	536,496	+	1,000,000	=	8,238,700
1992	8,238,700	-	1,300,200	+	555,080			=	7,493,580
1993	7,493,580	-	1,339,800	+	492,302			=	6,646,082
1994	6,646,082	-	1,379,400	+	421,335			=	5,688,016
1995	5,688,016	-	1,419,000	+	341,521			=	4,610,537
1996	4,610,537	-	1,458,600	+	252,155			=	3,404,092
1997	3,404,092	-	1,504,800	+	151,943			=	2,051,235
1998	2,051,235	-	1,551,000	+	40,018			=	540,253
1999	540,253	-	172,788		_____	-	367,465	=	- 0 -

Estimated Interest Proceeds: 4,213,827

APPENDIX F

DISTRICT OF COQUITLAM

AGENDA ITEM 503.2

Inter-Office Communication

TO: J.L.Tonn, Municipal Manager DEPARTMENT: Administration DATE: 1988 January 18

FROM: Neil Nyberg DEPARTMENT: Engineering YOUR FILE:

SUBJECT: STATUS REPORT: THE TOWN CENTRE DRAINAGE PROGRAM OUR FILE: 05 02 88/10

FOR DRAINAGE COMMITTEE

1.00 BACKGROUND

1.01 Bylaw 988, 1979 as amended by Bylaw 1124, 1980, authorizes collection of development cost charges from various sectors of the Town Centre to assist in financing the cost of municipal trunk storm sewers. As of 1987 March 16, the Development Cost Charge Reserves contained an unappropriated balance of $752,830. Bylaw 1716, 1987 for $155,000 was drawn on that balance leaving an unappropriated balance of $597,830. Developer contributions and interest have increased the fund during 1987 but an estimated year end balance is not yet available.

1.02 The 1987 Town Centre Drainage Program consisted of the Lincoln/Heffley drainage trunk and oversizing payments to developers, all funded from Bylaw 1716. The Lafarge Lake Dyke project was deferred as detailed design is dependent on the proposed relocation of Pinetree Way. Project status is summarized below.

Account #	Description	Bylaw	Budget	1987 Actual Cost	Status
533054-023	Ponderosa Trunk Main 1986 carryover	#1535	$ 5,189	$ 5,189	Complete
533054-026	Lafarge Lake Dyke	# 960	$ 80,000	$ 0	Deferred
		#1535	$ 170,000	$ 0	Deferred
533054-028	Lincoln/Heffley Drainage Trunk	#1716	$ 105,000	$ 71,000	Complete
533054-054	Oversizing payments to developers	#1716	$ 50,000	$ 23,042	$24,741 Payable

1.03 The projects which are required to extend or improve the municipal drainage system in 1988 are as follows (see attached location sketch).

Account #	Description	Estimated Cost	Funding
533054-031	Hoy Creek Interceptor	$ 150,000	Development Cost Charge Fund
533054-033	Heffley Trunk Extension	$ 152,000	Development Cost Charge Fund
533054-034	Guildford Storm Main - West of Johnson Street	$ 95,000	Development Cost Charge Fund
		$ 397,000	

...2

FOR DRAINAGE COMMITTEE

1.04 The Hoy Creek Interceptor is intended to consolidate existing and proposed outfalls into Hoy Creek for monitoring and pollution control purposes. A detailed functional design study is needed to determine the most cost effective method of dealing with the heavily polluted 'first flush' of storm runoff. The first phase of the project would extend to an existing trunk on Johnson Street. Other segments would extend down the Hoy Creek right-of-way to its confluence with Scott Creek. Appendix A is the detailed project description.

1.05 The Heffley Trunk Extension will extend the Pinetree Drainage Trunk System to Glen Drive, thus allowing and encouraging development. Appendix B is the detailed project description.

1.06 The Guildford Storm Main, west of Johnson Street, will drain lands north of Guildford Way and west of Johnson Street, including municipal lands scheduled for subdivision development in early 1989. Appendix C is the detailed project description.

1.07 Drainage projects funded from the Drainage Development Cost Charge Reserve are routinely presented to the committee in advance of the normal budget review procedure, because:

- the special funding for these projects is independent of the annual tax levy or other municipal funds;
- extensive lead time for design and tendering is required so as to complete the projects before the fall rainy season; and
- better tender prices are often obtained when contracts are tendered in the off-peak construction season.

1.08 A bylaw is required to approve withdrawal of funds from the Drainage Development Cost Charge Reserve Fund.

2.00 RECOMMENDATIONS

2.01 That the 1988 Municipal Drainage Trunk Program be approved in advance of the 1988 Budget Bylaw as follows:

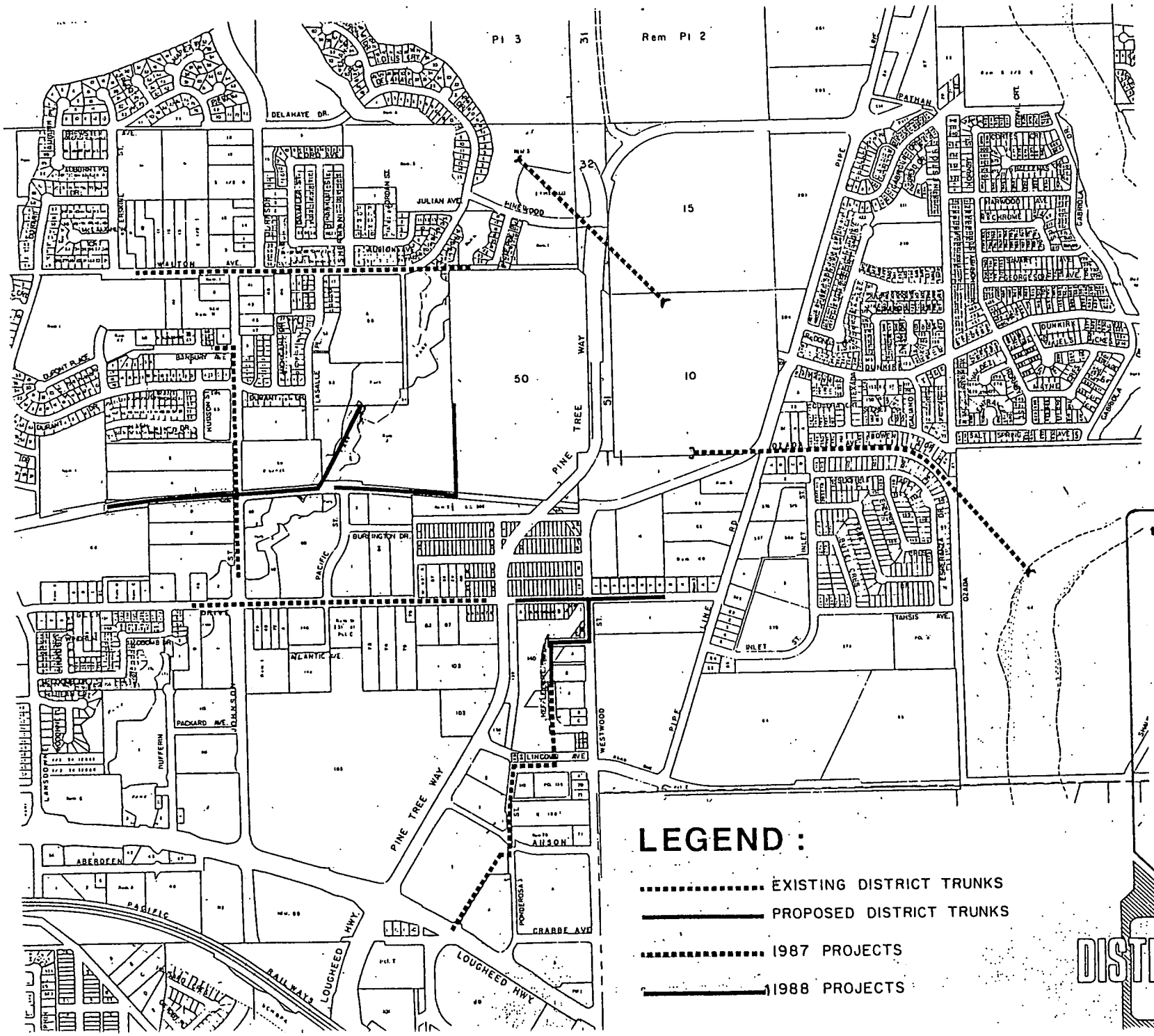
Account #	Description	Budget
533054-031	Hoy Creek Interceptor	$ 150,000
533054-033	Heffley Trunk Extension	$ 152,000
533054-034	Guildford Storm Main - West of Johnson Street	$ 95,000
		$ 397,000

2.02 That a bylaw to withdraw $397,000 from the Drainage Development Cost Charge Reserve Fund be drafted and presented to Council by 1988 February 15.

Neil Nyberg

Neil Nyberg, P. Eng.
Municipal Engineer

NWN/mw
Attach.



title:

TOWN CENTRE DRAINAGE TRUNKS PROGRAM

LEGEND :

- EXISTING DISTRICT TRUNKS
- PROPOSED DISTRICT TRUNKS
- 1987 PROJECTS
- 1988 PROJECTS

DISTRICT OF COQUITLAM

APPENDIX 'A'

PROJECT DESCRIPTION
1987 December 29

Item: GUILDFORD WAY/HOY CREEK DRAINAGE INTERCEPTOR TRUNK

File No. 05 02 88/10

Account No. 533054-031

Finance: Development Cost Charge Reserve

Schedule: Engineering: March - May 1988
Construction: July - September 1988

PROJECT OBJECTIVES:

To provide drainage facilities for properties located north of Guildford Way, east of Johnson Street, south of Walton Avenue and west of Hoy Creek.

To reduce operating and maintenance costs by consolidating drainage outfalls to Hoy Creek.

SCOPE OF WORK:

The project includes approximately 180m of 750mm Ø storm sewer from an existing trunk on Johnson Street east along Guildford Way, 70m of 600 mm Ø and 200m of 450mm Ø storm sewer along westerly edge of the green strip adjacent Hoy Creek (sizes subject to verification).

DESIGN FACTORS:

- The Guildford Way section must allow for ultimate road drainage.
- The Sherman Street storm sewer must connect into the proposed interceptor.
- The alignment and method of construction must be approved by the Ministry of Environment.
- Construction may be limited by Fisheries regulations to between July 15 and September 15.

JUSTIFICATION:

The area drained by the proposed trunk is undergoing extensive development. Presently each site adjacent Hoy Creek would need a separate outfall to Hoy Creek thereby increasing operating and maintenance costs.

COST ESTIMATE:

See attached.

PROJECT APPROVED BY: _____

88/10

DETAILED COST ESTIMATE JOB # HOY INTCPT ACCOUNT # 533054- REVISED : 88-01-04

FILE # 05 02 88/10

TLE : Guildford Way / Hoy Creek Drainage Interceptor

ATION : Guildford Way North, Hoy Creek West
REMARKS : Pre-design Estimate

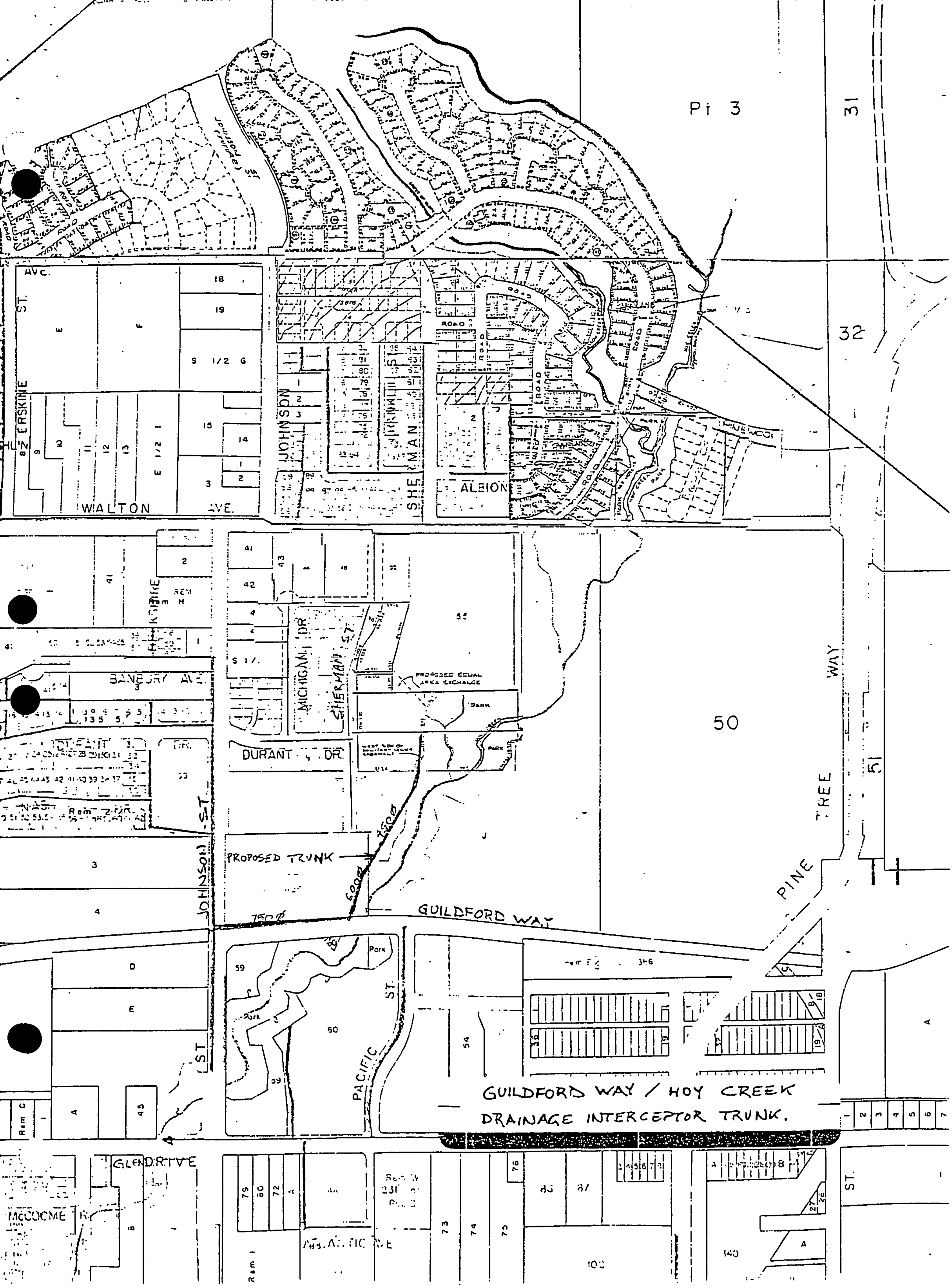
Estimate : John Meisl

CONTINGENCY FACTORS

1. General	1.30	4. Traffic/Access	1.00	Composite	
2. Scale	1.00	5. Weather	1.00	Contingency	
3. Soils Conditions	1.00	6. Site Conditions	1.00	Factor	
		7. Economic Climate	1.00	1.3000	

ITEM #	ITEM DESCRIPTION	UNIT	UNIT COST	QUANTITY	FACTOR	REMARK	SUBTOTAL	30.00% CONTINGENCY	TOTAL
A04	Mobilize & Demobilize	$	1.00	1,500.00	1.00		1,500	450	1,950
B02	Clear Site	$	1.00	5,000.00	1.00		5,000	1,500	6,500
C50	Specific Repairs	$	1.00	4,000.00	1.00	Hoy Creek Rest.	4,000	1,200	5,200
D06A	Import Granular fill	m3	12.00	1,000.00	1.00		12,000	3,600	15,600
G10B	450 mm Ø Storm Sew. - 2 - 3 m	m	118.00	200.00	1.30	Adjacent Creek	30,680	9,204	39,884
G14B	600 mm Ø Storm Sew. - 2 - 3 m	m	135.00	70.00	1.30	Adjacent Creek	12,285	3,686	15,971
G18B	750 mm Ø Storm Sew. - 2 - 3 m	m	150.00	180.00	1.00		27,000	8,100	35,100
G30A	M/H (F-1-7)-base,frame+lid	ea	760.00	5.00	1.00		3,800	1,140	4,940
G30B	M/H (F-1-7) - Barrels	vm	190.00	13.00	1.00		2,470	741	3,211
G42	Side Inlet Catch Basin(F-1-12B)	ea	1,100.00	3.00	1.00	Guildford Way	3,300	990	4,290
G61B	Catch Basin Lead-150mmØ	m	55.00	15.00	1.00		825	248	1,073
G72	Storm Service Connections	m	65.00	10.00	1.00		650	195	845
H04D	ACP Road Restoration-Arterial	m2	26.00	30.00	1.00		780	234	1,014
L10	Soils Investigation & Report	$	1.00	1,500.00	1.00		1,500	0	1,500
P20	Detailed Design-Inclusive	$	1.00	3,500.00	1.00		3,500	0	3,500
P32	Advertising Costs	ea	400.00	1.00	1.00		400	0	400
P34	As-Constructed Drawings	Dwg	300.00	3.00	1.00		900	0	900
							110,590	31,287	141,877

TOTAL : 17 ITEMS



Pt 3
31
32
AVE.
ERSKINE ST.
WALTON AVE.
JOHNSON ST.
SHERMAN ST.
ALBION
PINEWOOD
BANBURY AVE.
MICHIGAN DR.
SHERMAN ST.
PROPOSED EQUAL AREA EXCHANGE
Park
DURANT DR.
50
51
PINE TREE WAY
PROPOSED TRUNK
750Ø
600Ø
750Ø
GUILDFORD WAY
PACIFIC ST.
ST.
GUILDFORD WAY / HOY CREEK
DRAINAGE INTERCEPTOR TRUNK.
GLEN DRIVE
McCOOMBE
ATLANTIC AVE

PROJECT DESCRIPTION
1987 December 29

Item: HEFFLEY TRUNK MAIN EXTENSION

File No. 05 02 88/10

Account No. 533054-033

Finance: Development Cost Charge Reserve

Schedule: Engineering: February - April 1988
Construction: May - August 1988

PROJECT OBJECTIVES:

To extend the Town Centre trunk drainage storm sewer north to Glen Drive. To provide storm drainage trunk access to lands east of Pinetree, south of Guildford and west of Pipeline.

SCOPE OF WORK:

This project installs approximately 300 metres of 900 mm diameter pipe extending from the existing terminus at the north property line of Lot 2 on Heffley Crescent, along Heffley Crescent to Westwood Street, then north on Westwood Street to Glen Drive.

JUSTIFICATION:

Storm sewerage trunks are extended in advance of development. Part of the cost of the system is obtained from the development cost charge reserve fund. This installation is the next phase of the orderly extension of drainage in the Town Centre.

COST ESTIMATE - ENR = 4450

Fixed costs:		$ 1,950
Clearing and Removals		7,207
Earthworks		31,200
Drainage Facilities		101,707
Restorations		5,694
Estimated Contract Price	ST	147,758
Engineering		4,000
Contract Administration		400
TOTAL:		$ 152,158
ROUNDED TOTAL:		$ 152,000

PROJECT DESCRIPTION APPROVED BY: _____

88/10A

TAILED COST ESTIMATE JOB # Heffley ACCOUNT # 533054- REVISED : 87-12-30

FILE # 05 02 89/10

TLE : Heffley Trunk Main Extension

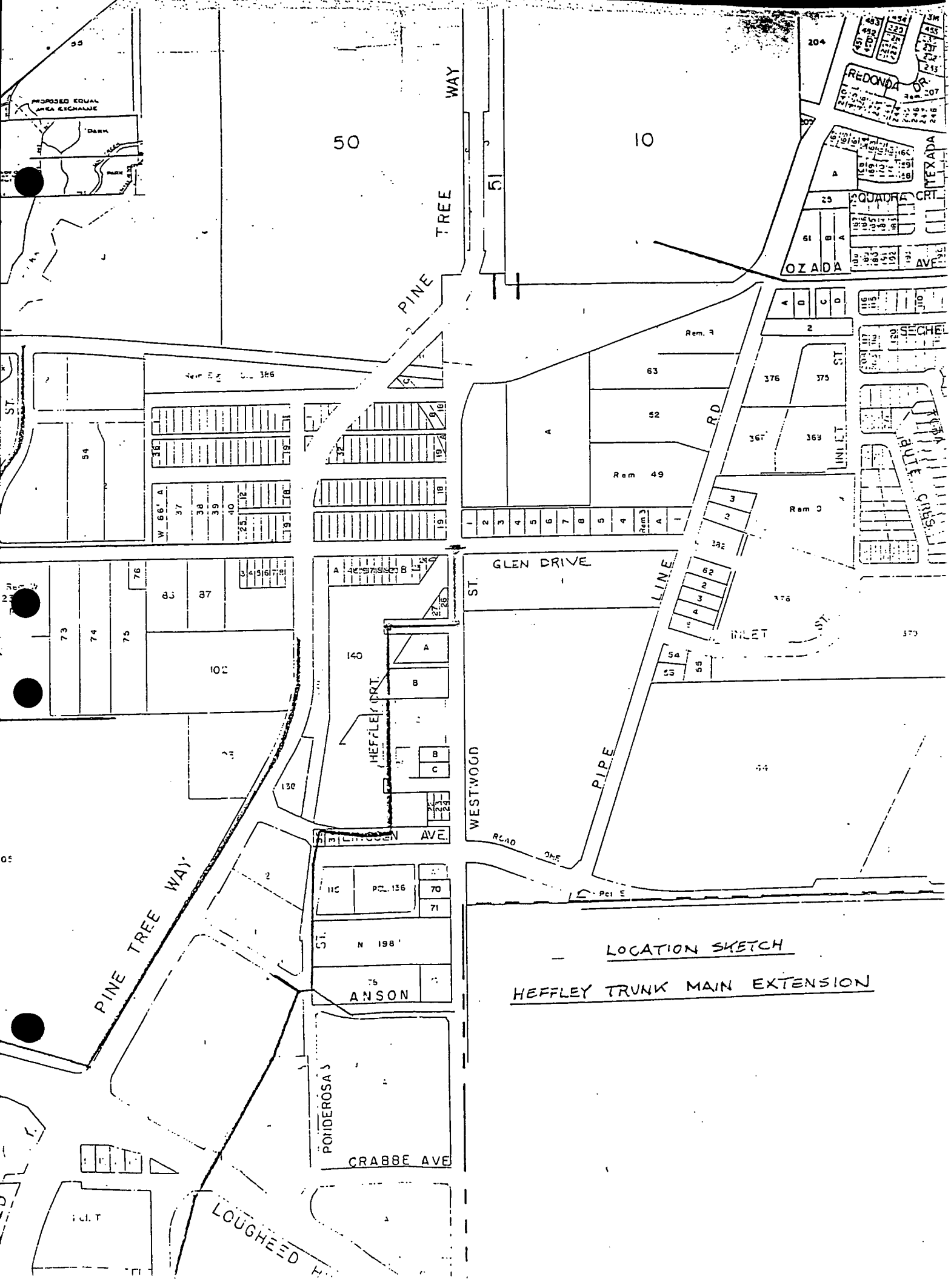
CA : Heffley Crescent / Westwood St.
EMARKS : Pre-Design Estimate

stimate : John Meisl

CONTINGENCY FACTORS

1. General	1.30	4. Traffic/Access	1.00	Composite	
2. Scale	1.00	5. Weather	1.00	Contingency	
3. Soils Conditions	1.00	6. Site Conditions	1.00	Factor	
		7. Economic Climate	1.00	1.3000	

ITEM #	ITEM DESCRIPTION	UNIT	UNIT COST	QUANTITY	FACTOR	REMARK	SUBTOTAL	30.00% CONTINGENCY	TOTAL
04	Mobilize & Demobilize	$	1.00	1,500.00	1.00		1,500	450	1,950
03	Clear & Grub	ha	14,000.00	0.33	1.20	Off-Site Disposal	5,544	1,663	7,207
06A	Import Granular fill	m3	12.00	2,000.00	1.00		24,000	7,200	31,200
16C	675 mm Ø Storm Sew. - 3 - 4 m	m	175.00	2.00	1.00		350	105	455
16D	750 mm Ø Storm Sew. - 3 - 4 m	m	190.00	2.00	1.00		380	114	494
20C	900 mm Ø Storm Sew. - 3 - 4 m	m	215.00	300.00	1.00		64,500	19,350	83,850
22A	M/H(F-1-10)-Base,Frame - Lid	ea	1,200.00	3.00	1.00		3,600	1,080	4,680
22B	M/H (F-1-10)-Barrels	vm	250.00	10.00	1.00		2,500	750	3,250
40)	Catch Basin (F-1-12)	ea	500.00	4.00	1.00		2,000	600	2,600
41B	Catch Basin Lead-150mmØ	m	55.00	22.00	1.00		1,210	363	1,573
52B	Storm Svc. Conn. 200mmØ	m	70.00	44.30	1.20	Extra Depth	3,694	1,109	4,803
90	ACP Road Restoration-Collector	m2	24.00	150.00	1.00		3,600	1,080	4,680
40)	ACP Road Restoration-Arterial	m2	26.00	30.00	1.00		780	234	1,014
	Detailed Design-Inclusive	$	1.00	4,000.00	1.00		4,000	0	4,000
02	Advertising Costs	ad	400.00	1.00	1.00		400	0	400
	TOTAL :	15 ITEMS					118,060	34,098	152,159



LOCATION SKETCH

HEFFLEY TRUNK MAIN EXTENSION

PROJECT DESCRIPTION
1988 January 07

Item: GUILDFORD WAY DRAINAGE TRUNK WEST OF JOHNSON STREET

File No. 05 02 88/10

Account No. 533054-034

Finance: Development Cost Charge Reserve

Schedule: Engineering:
Construction:

PROJECT OBJECTIVES:

To provide trunk drainage service to the area north of Guildford Way, west of Johnson Street and south of Rambler Way in advance of development of municipal lands scheduled for Spring 1989.

SCOPE OF WORK:

Project includes design and construction of approximately 380m of 300-450 mm Ø storm sewer along the north half of the ultimate Guildford Way alignment. Interim ditching may be required to direct runoff from undeveloped lands to catch basins located on the ultimate Guildford Way alignment.

DESIGN FACTORS:

Proposed sewer must account for ultimate Guildford Way construction and be able to drain the lower south lanes of Guildford Way.

Sewer must tie into an existing 600mm Ø stub located on Johnson Street at Guildford Way.

Interim ditching will be required prior to development of drainage area.

Any cut or fill slopes must be suitable protected from erosion.

JUSTIFICATION:

The Municipal Drainage Trunks Program is intended to provide trunk drainage services in advance of development. The proposed trunk will service municipal and private lands. The municipal lands are scheduled for development by Spring 1989. Therefore the proposed trunk must be constructed by or before that time.

COST ESTIMATE: ENR = 4,450

PROJECT DESCRIPTION APPROBED BY: _____

88/10D

DETAILED COST ESTIMATE JOB # G.W.West ACCOUNT # 533054-034 REVISED : 88-01-10

TITLE : Guildford Way Drainage Trunk - West of Johnson St. FILE # 05 02 88/10

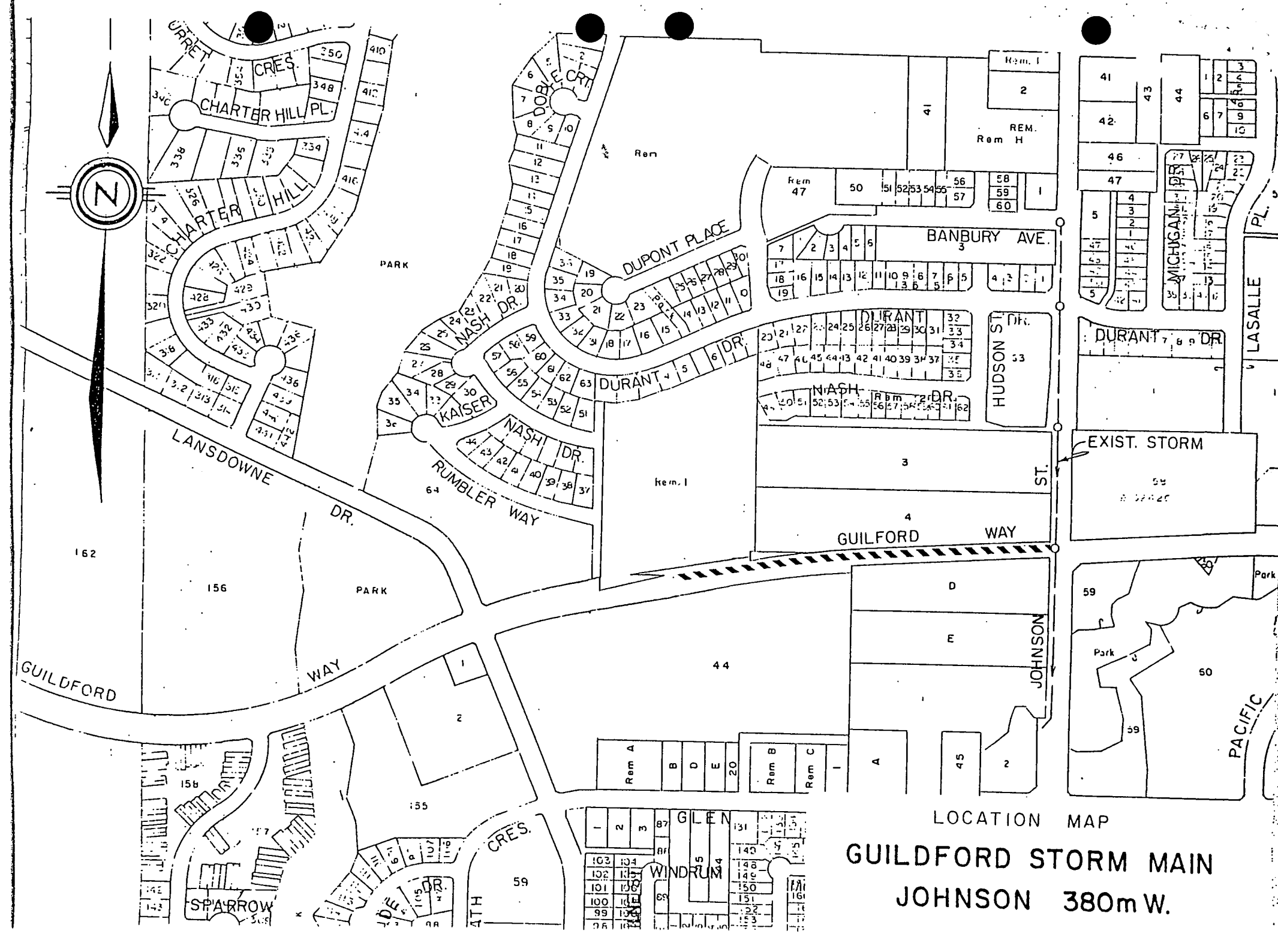
LOCATION : Guildford Way - West of Johnson St.
REMARKS : Pre-Design Estimate

Estimate : John Meisl

CONTINGENCY FACTORS

1. General	1.30	4. Traffic/Access	1.00	Composite	
2. Scale	1.00	5. Weather	1.00	Contingency	
3. Soils Conditions	1.00	6. Site Conditions	1.00	Factor	
		7. Economic Climate	1.00	1.3000	

ITEM #	ITEM DESCRIPTION	UNIT	UNIT COST	QUANTITY	FACTOR	REMARK	SUBTOTAL	30.00% CONTINGENCY	TOTAL
A04	Mobilize & Demobilize	$	1.00	1,000.00	1.00		1,000	300	1,300
B02	Clear Site	$	1.00	2,500.00	1.00		2,500	750	3,250
G06C	300 mm Ø Storm Sew. - 3 - 4 m	m	95.00	180.00	1.00		17,100	5,130	22,230
G10C	450 mm Ø Storm Sew. - 3 - 4 m	m	145.00	200.00	1.00		29,000	8,700	37,700
G30A	M/H (F-1-7)-base,frame+lid	ea	760.00	4.00	1.00		3,040	912	3,952
G30B	M/H (F-1-7) - Barrels	vm	190.00	16.00	1.00		3,040	912	3,952
G41B	Catch Basin Lead-150mmØ	m	55.00	56.00	1.00	Stubs only-South	3,080	924	4,004
G42	Side Inlet Catch Basin(F-1-12B)	ea	1,100.00	7.00	1.00		7,700	2,310	10,010
G62	Rip Rap	m3	20.00	40.00	1.00		800	240	1,040
G64	Ditch	m	5.00	200.00	1.00		1,000	300	1,300
Q20	Hydroseeding	m2	0.40	1,900.00	1.00	5m Width	760	228	988
Z20	Detailed Design-Inclusive	$	1.00	4,000.00	1.00	Soils Report Avail.	4,000	0	4,000
S02	Advertising Costs	ad	200.00	2.00	1.00		400	0	400
)4	As-Constructed Drawings	Dwg	300.00	2.00	1.00		600	0	600
	TOTAL : 12 Items						16,342	20,706	94,726



LOCATION MAP

GUILDFORD STORM MAIN
JOHNSON 380m W.

DISTRICT OF COQUITLAM

AGENDA ITEM 503.3

Inter-Office Communication

TO:	J.L.Tonn, Municipal Manager	DEPARTMENT:	Administration	DATE:	1988 January 14
FROM:	Neil Nyberg	DEPARTMENT:	Engineering	YOUR FILE:	
SUBJECT:	GREATER VANCOUVER LIQUID WASTE MANAGEMENT PLAN			OUR FILE:	01 03 06 01 07 05

FOR DRAINAGE COMMITTEE

Reference: A. Greater Vancouver Receiving Water Quality Conditions: Coastline Environmental Services: July 1987
B. Impact of Pollutants and First Flush Stormwater Quality in Watersheds on Westwood Heights: K. Hall, P. Eng., February 1987

1.00 BACKGROUND

1.01 The Waste Management Act S.B.C. '1982' allows municipal governments to discharge waste under individual permit, related to location; and/or under the auspices of a formal waste management plan. In 1985 December, the GVRD commenced stage one of a two-part process which will culminate in a 'liquid' waste management plan to cover all sanitary and storm waste discharges to receiving waters in the lower mainland area.

1.02 Twenty-one areas within the study area were examined by the consultants (Reference A) over the period December 1985 - July 1987. Where water quality objectives were met, with no restrictions on water uses, the rating was 'good', and six areas achieved this level. Other areas were rated 'fair' (intermittent restriction of water use) or 'poor' (consistent restrictions on water use). The evaluations all summarized in the synopsis to Reference A.

1.03 The following entries in the synopsis table of Reference A relate to Coquitlam area receiving waters:

Port Moody Arm	Fair based on a limited database. Evidence of localized sediment contamination which exceeds ODCA limits. Occasional spills from transportation and industrial activities. (Note: Moody Arm receives runoff from Noon's Creek (Westwood Plateau)
Coquitlam River	Good, upstream of gravel operation. Water quality decreases downstream of gravel operations due to increases in suspended solids which have influenced salmonid spawning. (Note: Coquitlam River receives runoff from Hoy Creek, Scott Creek, Maple Creek, Hockaday Creek and other natural watercourses in Coquitlam.)
Fraser River	Fair: due to occasional high concentration of fecal coliforms and heavy metals. Upstream sources (anthropogenic and natural) are responsible for part of the loadings, however importance relative to other sources is unknown. (Note: Fraser River receives runoff from Mundy Creek, Booth Creek, Nelson Creek and other natural watercourses in Coquitlam.)

...2

1.03 cont'd

Brunette River	Fair. Occasional exceedance of criteria for coliform, copper and lead.
Pitt River	Good, based on pre-1980 data.

1.04 This memorandum recommends that the information be received.

2.00 DISCUSSION

2.01 Considerable study of the effects of urban pollution of storm runoff has been included in the Lower Mainland Liquid Waste Management Plan. As part of the impact analysis of new development in Coquitlam, detailed study of pollutant loadings in Hoy and Hockaday Creek was carried out. The study was made determine the effect of urban development on receiving waters.

2.02 The Hall Study (Reference B) concludes that storage or diversion of the "first flush" component of a storm event, which usually occurs during the first hour, should provide some protection to aquatic biota in Hoy Creek and Hockaday Creek. This is particularly important in drainage tributary to the Westwood Plateau because the relatively steep slopes encourage pollutant transportation. Diversion of low flows (first flush) from the Delahaye Drive outfall at the Hoy Creek Dam has already been anticipated by recent construction. Further development of the low flow diversion concept can be expected in future drainage works in the Westwood Heights development.

2.03 The value of the pollution study of receiving waters surrounding Coquitlam (Reference A) is to provide a benchmark to assess effectiveness of pollution control for urban runoff (Reference B).

3.00 RECOMMENDATION

3.01 That this report be received.

Neil Nyberg

Neil Nyberg, P. Eng.
Municipal Engineer

NWN/pln

Enc

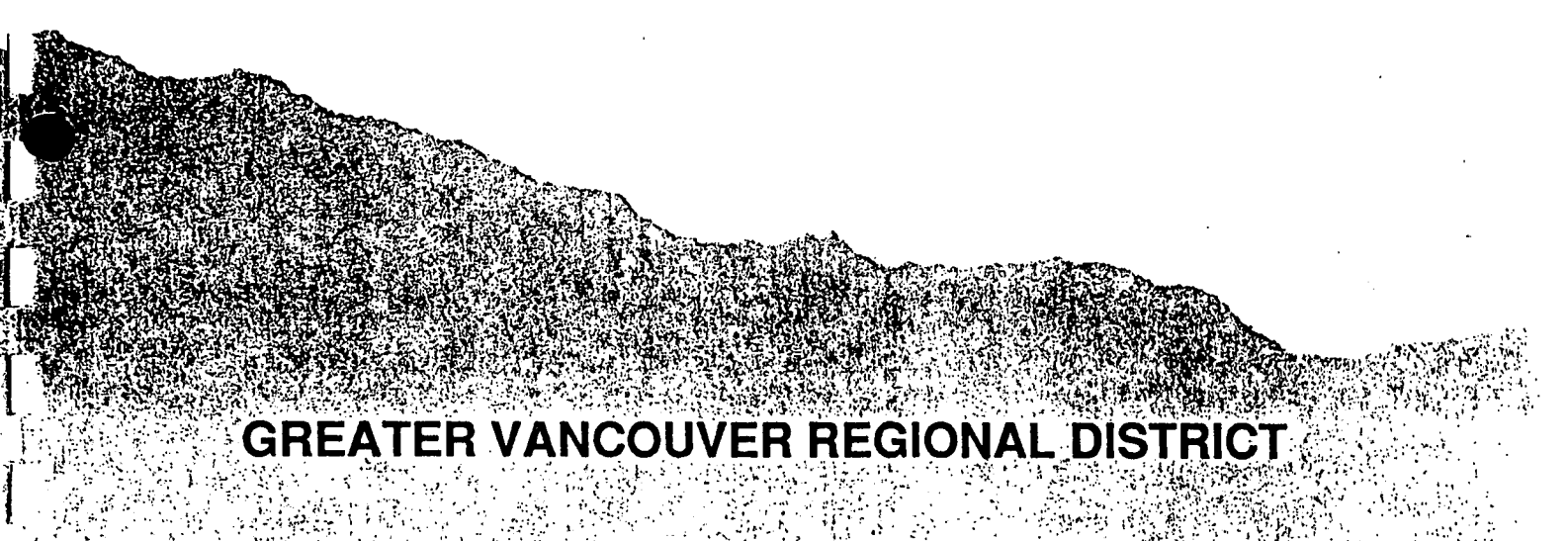
GREATER VANCOUVER LIQUID WASTE MANAGEMENT PLAN

STAGE 1

Greater Vancouver Receiving Water Quality Conditions

Prepared by:
Coastline Environmental Services Ltd.
& Envirochem Services

July 1987



GREATER VANCOUVER REGIONAL DISTRICT

SYNOPSIS

A. Background

Under the 1982 B.C. Waste Management Act, a municipality may discharge waste in accordance with a waste management plan which is approved by the Minister of Environment and Parks. The Province suggests two sages for preparation of a waste management plan: first, the collection of information on the receiving environment and development of waste management options in conceptual form; and second, the development of a fully developed waste management plan which would evaluate the need for and type of improvement alternatives in detail.

In December 1985, the Greater Vancouver Regional District commissioned COASTLINE Environmental Services Ltd. and ENVIROCHEM Services to carry out a part of the first stage recommended in the process: to inventory existing data and to document and evaluate existing water quality conditions (including sediment and biota quality) in the in the wastewater receiving environment located within the Greater Vancouver Sewerage and Drainage District (GVS & DD). The GVS & DD now falls under the umbrella of the GVRD for administrative purposes.

B. Assessment of Environmental Quality

Sixteen separate study areas were defined by the Greater Vancouver Regional District for which environmental data were to be obtained and for which assessments were to be made. For study purposes, a further breakdown into 21 areas was made. Following and inventory and review of the available data, it was concluded that the environmental quality of less than half of the 21 study areas could be ranked as "good", implying water quality objectives were generally met with no known impairment of water uses. The remaining areas were ranked either as "fair" implying that water quality objectives would not always be met resulting in occasional impairment of water uses or as "poor" implying consistent restrictions of water use, documented evidence of biological impact, evidence of potential biological impact on the basis of laboratory studies, and/or frequent exceedance of objectives.

The table beginning on page xiii summarizes conclusions of this review with respect to

the apparent environmental conditions for each of the 21 areas. Although the study team identified gaps in environmental information for some areas, the review team was encouraged to provide preliminary conclusions for all areas whether on the basis of existing data, conclusions of other agencies and/or conclusions based upon discussions with regulatory and research personnel. These preliminary conclusions will be used to formulate options for wastewater management and to determine where further data acquisition should be directed during Stage 2 of the Liquid Waste Management Plan (LWMP).

SYNOPSIS TABLE

OVERVIEW OF ENVIRONMENTAL QUALITY OF LOWER MAINLAND RECEIVING WATERS

Study Area	Apparent Environmental Condition
Georgia Strait	Good, based on 1979 monitoring data and pre-operational monitoring for Iona deep-sea outfalls. No reason to suspect recent changes.
Queen Charlotte Channel (In Howe Sound)	Fair, based on 1985-86 closures of bathing beaches. 1978-79 monitoring data suggested large scale releases of mercury and copper. No new data to evaluate current situation.
Outer Burrard Inlet (e.g. English Bay)	Fair. Fecal coliforms occasionally exceed bathing standards (e.g.in some areas. Subject to combined sewage discharges during storm events and to occasional oil spills.
False Creek	Poor. Sediment quality exceeds Ocean Dumping Criteria. Sewerage improvements have resulted in water quality enhancement in the Western Basin. Poor water exchange in Eastern Basin results in continued poor water quality with respect to fecal coliforms and dissolved oxygen.
Vancouver Harbour (First Narrows to Second Narrows)	Poor. Sediments from localized areas shown to be highly toxic during sediment bioassays. Metal and PCB concentrations judged to be very high in sediments from localized areas relative to concentrations found in other North American harbours. The levels of toxic substances such as organotins as measured in sediments and water in localized areas are of concern. Tidal flushing probably reduces impacts.
Second Narrows to Burns Point	Unknown. Database is very limited. Some localized contamination of sediments is evident. Frequent tidal flushing probably reduces environmental impact. Restrictions on consumption of bivalves from region.

SYNOPSIS TABLE

OVERVIEW OF ENVIRONMENTAL QUALITY OF LOWER MAINLAND RECEIVING WATERS

Study Area	Apparent Environmental Condition
Port Moody Arm	Fair, based on a limited database. Evidence of localized sediment contamination which exceeds ODCA limits. Occasional spills from transportation and industrial activities.
Serpentine River	Poor. Periodic low oxygen levels resulting in fish kills. Fecal contamination. Dissolved cadmium and copper levels frequently do not meet criteria.
Nicomekl River	Poor. Low dissolved oxygen; elevated fecal coliform counts; ammonia, orthophosphate and copper levels in water regularly exceed criteria.
Little Campbell River	Poor. Low oxygen resulted in fish kills as recently as 1985. Elevated fecal coliform counts; concentrations of orthophosphate and copper exceed criteria.
Seymour River	Good, based on limited data. Pollution sources minimal other than urban runoff to lower sections of the river.
Lynn Creek	Unknown. Elevated levels of metals and nutrients due to landfill leachates reported prior to 1985. More recent monitoring data confirming effectiveness of recent remedial measures not available at the time of this study.
Capilano River	Good, based on pre-1979 data. Low level ammonia releases from hatchery. Levels are well within existing criteria.
Coquitlam River	Good, upstream of gravel operation. Water quality decreases downstream of gravel operations due to increases in suspended solids which have influenced salmonid spawning.
Indian Arm	Good, with exception of periodic fecal contamination at Deep Cove.
Boundary Bay	Fair, based on 1979 data. Levels of fecal coliforms remain above limits for shellfish harvesting. Pre-1979 data indicates exceedances of criteria and objectives for dissolved oxygen and copper.

SYNOPSIS TABLE

OVERVIEW OF ENVIRONMENTAL QUALITY OF LOWER MAINLAND RECEIVING WATERS

Study Area	Apparent Environmental Condition
Sturgeon Bank	Fair. Approximately 10% of the bank is degraded due to dissolved oxygen depletion resulting from sewage outfall. Fish kills have been reported during summer months. Remainder of bank appears good based on limited data.
Fraser River	
o Main Stem	Fair, due to occasional high concentrations of fecal coliforms and heavy metals. Upstream sources (anthropogenic and natural) are responsible for part of loadings, however importance relative to other sources is unknown.
o Main Arm	Fair, due to occasional high concentra- (Annacis) tions of fecal coliforms and heavy metals.
o Lower Main Arm	Fair, due to occasional high concentrations of fecal coliforms and occasional depleted oxygen levels in sloughs.
o Upper Main Arm	Fair, due to presence of chlorophenols and elevated concentrations of metals in water (zinc and lead) and in sediments (cadmium).
o Lower North Arm	Fair-Poor, due to chlorophenol concentrations which on occasion exceed known sublethal effect levels, heavy metal contamination in localized areas, and suggested impacts on invertebrate populations.
Brunette Drainage Basin	
o Still Creek	Poor, due to frequent exceedances of criteria for fecal coliforms, copper, lead and cadmium.
o Burnaby Lake	Fair, because Still Creek flows into Burnaby Lake. Occasional exceedance of various criteria.
o Deer Lake	Fair-Good. Occasional exceedance of criteria for coliforms, copper and lead.

SYNOPSIS TABLE

OVERVIEW OF ENVIRONMENTAL QUALITY OF LOWER MAINLAND RECEIVING WATERS

Study Area	Apparent Environmental Condition
Brunette Drainage Basin - cont'd	
o Brunette River	Fair. Occasional exceedance of criteria for coliforms, copper and lead.
Pitt River	Good, based on pre-1980 data.

C. Major Environmental Issues

Fecal Contamination

Since the adoption of the recommendations of the Rawn report in 1953, there has been a steady stream of improvements to control the release of fecal material into the waters of the Lower Mainland and to minimize the potential impacts of existing releases. The efforts have resulted in improvements of water quality in various regions. Nonetheless existing releases still have a widespread effect on water uses through the Lower Mainland. Figure i illustrates the areas where water uses were limited during 1985-86 as a result of fecal contamination. For example, Boundary Bay remains closed to shellfish harvesting, periodic closures of bathing beaches in English Bay, WEst Vancouver and Deep Cove have occurred and the Fraser River water on occasion will not meet regulatory requirements for irrigation use.

With regard to the database for fecal contamination in the Lower Mainland, there are two major unresolved issues of concern: the adequacy of existing test procedures to measure fecal pollution to ensure protection of human health; and, the inadequacy of existing data to determine relative impact of various sources including storm water inputs, combined sewers, boat discharges, sewage plant discharges and agricultural runoff.

Chemical Releases

As in any urban area, there are many sources of chemical releases in the Lower Mainland and these include sewage discharges, surface runoff, transportation spills, industrial discharges and air emissions. Pollutants in sewage discharges and surface runoff have ben quantified and the effects of the releases have been debated extensively on a local basis. It is the opinion of this review that while efforts should be made to reduce chemical releases from all sources, the priorities should be placed on chemical releases from industrial activities and from transportation related spills which are sources of the chemical pollutants identified to be of greatest concern in the Lower Mainland. The chemicals of greatest concern to the Lower Mainland are chlorophenols (penta and tetra), heavy metals in the vicinity of bulk loading areas, marinas and ship repair yards, persistent organics (PCBs, phthalate esters) and

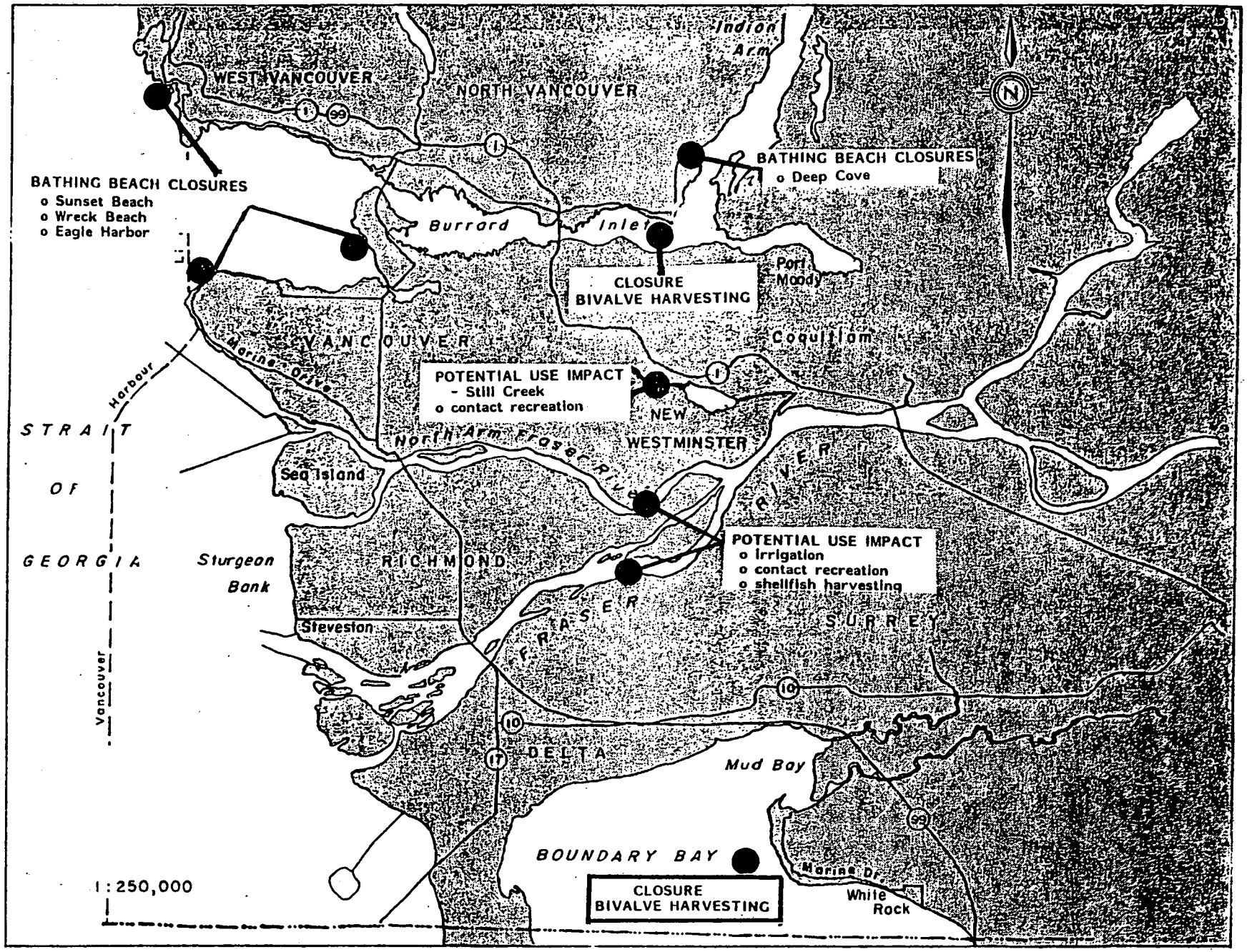


Figure 1: Areas where water use were limited during 1985-86 because of fecal contamination.

organometallic (organotin) compounds particularly in Vancouver Harbour.

Figure ii provides an over view of areas within which effects have occurred or where there is significant potential for effects from chemical releases. Clear-cut evidence of the impact of chemical releases has been limited to fish kills resulting from chlorophenol spills and mortality of birds following oil spills. Bioassays using sediments from localized areas of Vancouver Harbour indicated a high degree of toxicity to test biota. The causes of toxicity have not been identified; however high concentrations of metals and PCBs were detected in the sediments. Chlorophenols have been detected in the waters of the Fraser River at concentrations which exceed known toxic effect levels to fish. Sediments of False Creek exceed criteria of the Ocean Dumping Control Act and dredging of the area and subsequent disposal of the dredged material is subject to many regulatory complexities.

Dissolved Oxygen Depletion

Nutrients in runoff waters from agricultural land-use activities have resulted in algal blooms in the Little Campbell River, the Serpentine River and the Nicomekl River. Die-off of the algae during the fall has resulted in the depletion of oxygen causing fish kills in each of the three rivers.

Fish mortalities have been observed at Sturgeon Bank in the region of the existing Iona Island Sewage Treatment Plant outfall channel. Dissolved oxygen depletion is suggested as the main cause of mortality. The proposed new outfall is designed to eliminate this problem by the end of 1987.

Concern has also been expressed for low dissolved oxygen levels in the backwater slough areas of the Fraser River.

D. Adequacy of Environment Databases

Databases for the assessment of Lower Mainland environmental quality vary considerably, from the intensive 1979 reports of the Fraser River Estuary Study to reports on site specific problems, to the B.C. Ministry of Environment monitoring reports (discontinued after 1978), to raw in-house data collected for a variety of

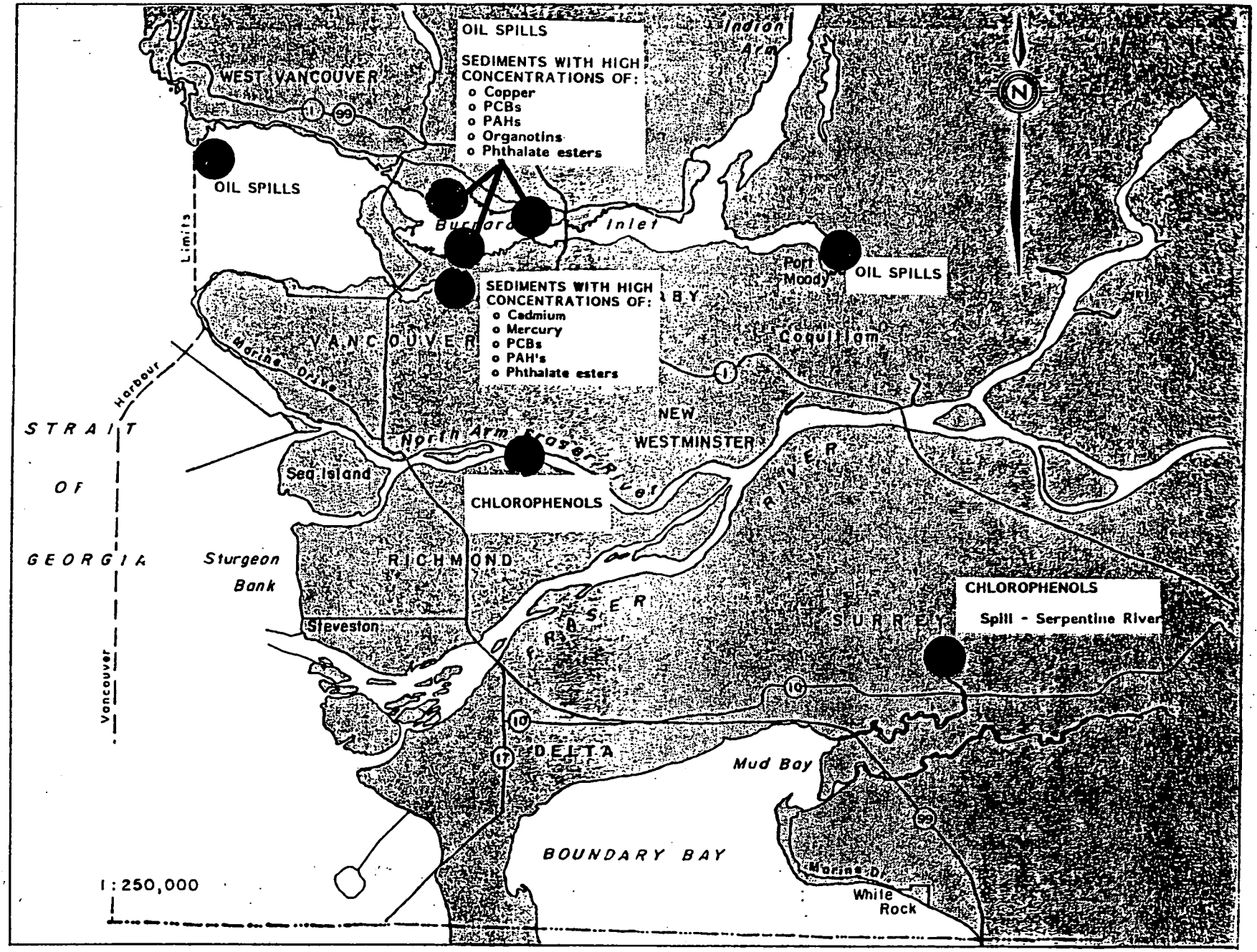
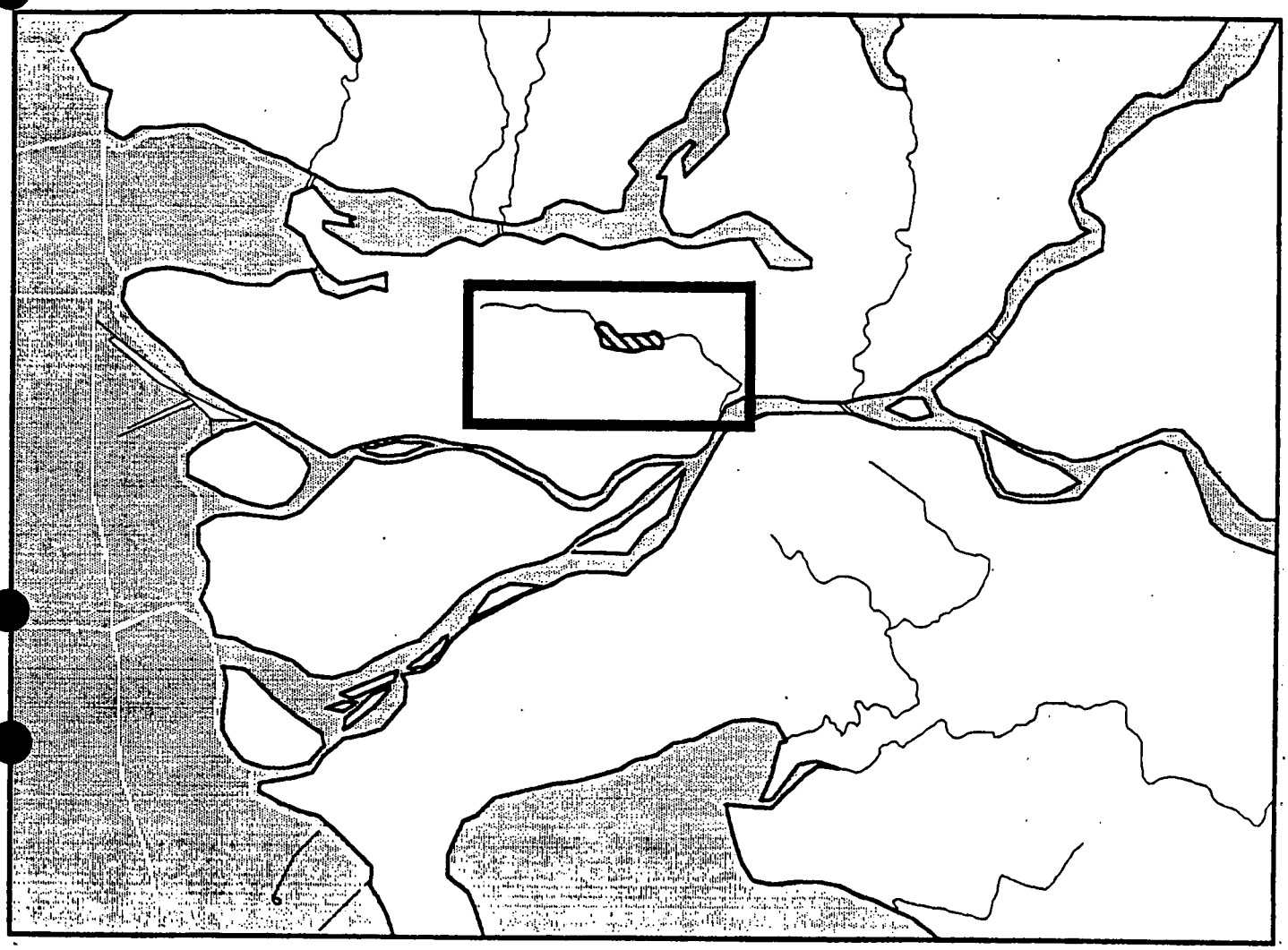


Figure ii: Areas where chemical releases have caused effects or have potential to cause effects.

purposes. The wide variety of information made it difficult to provide in this report assessments of trends and assessments of impacts to the environment. For some regions, databases were sparse and assessments of environmental quality were based on limited information.

Efforts are underway to improve data gathering efforts in the Lower Mainland. For example, the Fraser River Estuary Management Plan has been implemented to provide ongoing Federal-Provincial cooperation in improving environmental management of the Fraser River Estuary. Furthermore, programs in accordance with the recent Ministry of Environment water quality assessments and objectives for specific regions, will enable the regular gathering of data to assure that defined overall goals for the water bodies are achieved.



SECTION 3.8	Environmental Status of the Brunette Drainage System

3.8 Brunette Drainage Basin

Biophysical Description

Still Creek, Burnaby Lake, Deer Lake and the Brunette River make up the Brunette Drainage Basin in the heart of Burnaby (Figure 3.8.1).

Still Creek which flows for 9 km, originates in Burnaby, flows through the city of Vancouver and then re-enters Burnaby before entering Burnaby Lake. Still Creek has an average annual discharge of 0.426 m^3/s with an average monthly high of 1.02 m^3/s in December and an average monthly low of 0.121 m^3/s in July.

Burnaby Lake is an elongated lake approximately 3 km long and 0.75 km wide. It is fed by Still Creek, by a creek from Deer Lake, and by various minor creeks. The Cariboo Dam regulates the drain from Burnaby Lake into the Brunette River.

Deer Lake is a small rectangular-shaped lake, roughly 1 km in length by 0.5 km in width. It is fed by a number of small creeks and drains via Deer Creek into Burnaby Lake.

The Brunette River flows from Burnaby Lake, through Burnaby and New Westminster, for a distance of 7 km before emptying into the Fraser River. The average annual flow rate is 2.71 m^3/s with an average monthly high of 5.96 m^3/s in January and an average monthly low of 0.365 m^3/s in July.

Aquatic species found in the Brunette River include chum and coho salmon, steelhead, rainbow and cutthroat trout, as well as carp, bass, bullhead, lamprey, and crayfish. Burnaby Lake hosts coho, cutthroat and rainbow trout, carp, goldfish and bullhead. Rainbow trout are found in Deer Lake (Anderson, 1982).

Usage

Land use around the Brunette Drainage Basin is varied. Along Still Creek, land usage is a mixture of single family residential, commercial and industrial, transportation with a corridor of undeveloped land. Burnaby Lake is primarily surrounded by park and

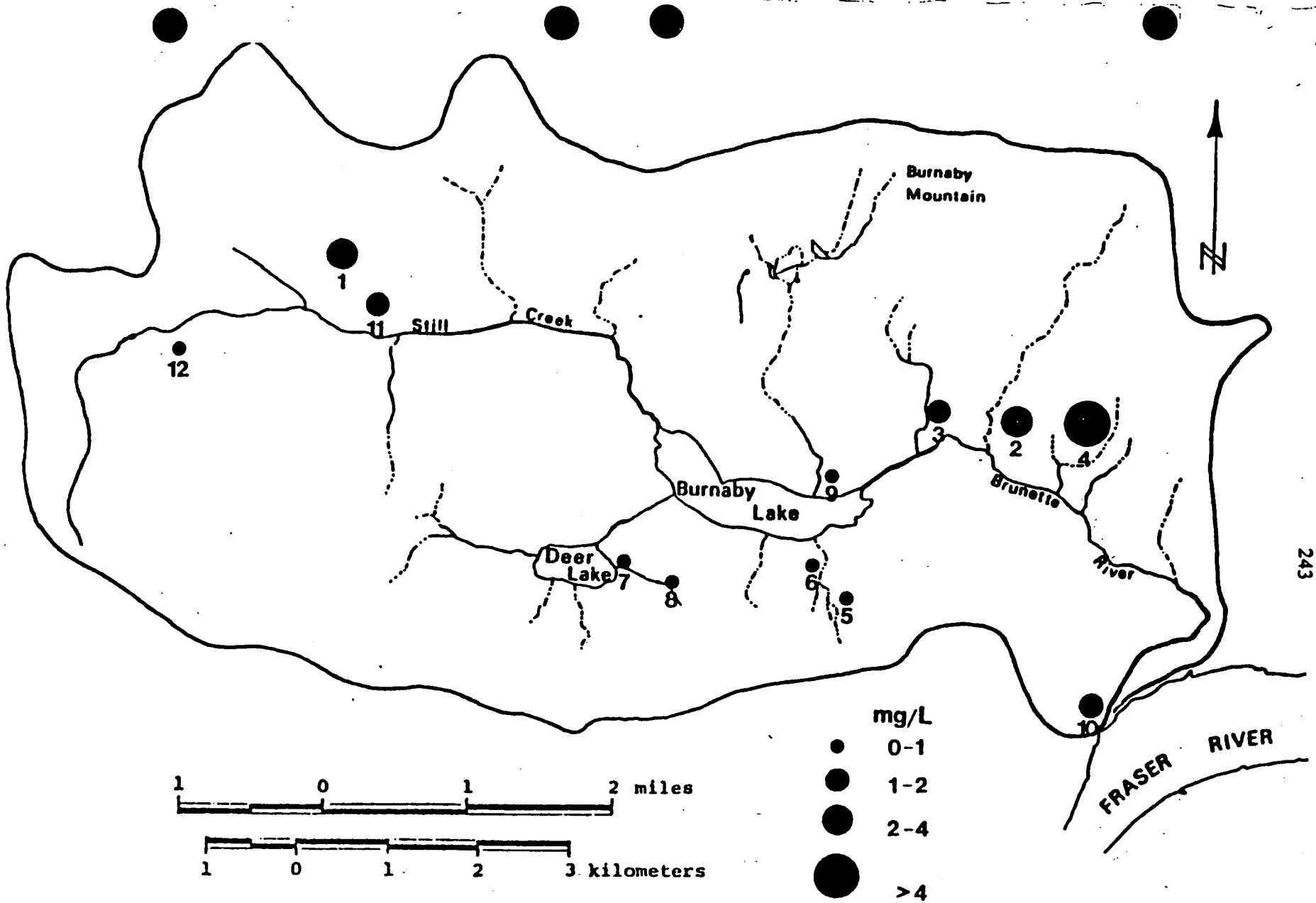


Figure 3.8.1 Lead distribution in stormwater in the Brunette River Basin (from Anderson, 1982).

recreational land, some undeveloped land and a small amount of single family residential land. Deer Lake is surrounded along half of its shore by institutional land with the remainder divided between recreational park, and low and medium density residential land. Deer Lake is used for public swimming. The Brunette River is surrounded by a mixture of parkland, undeveloped land, industrial and a very small amount of low density residential land. Water uses include support of aquatic life, and both contact and non-contact recreation. A 1972 estimate for the entire Basin suggested that land use was as follows: 42% residential, 31% open space and forested, 15% commercial and institutional, 6% industrial, 5% recreational and 1% major transportation corridors (Hall et al., 1976).

Environmental Status

Water Quality

There is a good database for the water quality of the Brunette Drainage Basin. Sampling data appear in separate tables for Still Creek, Burnaby Lake, Deer Lake and the Brunette River (Tables 3.8-1a to 3.8-1d). Parameters in Still Creek that exceeded criteria are the following:

- o fecal coliforms
- o orthophosphate
- o copper
- o lead
- o cadmium

Still Creek water quality data shows highly elevated levels of fecal coliforms, particularly in the Myrtle Arm (South Arm originating in Vancouver) and in the North Arm. These high levels are likely connected to periods of heavy rainfall with large amounts of stormwater runoff. Levels of orthophosphate have exceeded the Canadian freshwater criterion at 30 ug/L and are indicative of urban runoff. Dissolved oxygen levels were low in 1980, but recovered to healthy levels in 1981 and 1982. Levels of mercury were well within the lowest known effect levels. Cadmium and lead exceeded both recommended and lowest known effect levels in some of the years samples were taken. Copper levels exceeded the criteria every year. Stormwater runoff is one proven source of heavy metals to Still Creek. Figure 3.8.1 shows concentrations of lead which were observed in stormwaters leading to Still Creek (Anderson, 1977). Similar profiles are obtained for cadmium and other heavy metals.

In Burnaby Lake, levels of dissolved oxygen, orthophosphate and fecal coliform do not consistently meet established criteria. This situation originates in Still Creek, which feeds Burnaby Lake. Dissolved oxygen levels as low as 4.8 mg/L, a level which would affect freshwater biota (Davis, 1978), have been measured. Fecal coliform data were higher in the early 1980's, but lower in 1984, when 24% of results exceeded 200 MPN/100 mL. In 1985, only 8% of results exceeded 200 MPN/100 mL. Burnaby Lake water quality data showed low levels of chloride, mercury and cadmium. Detection limits for copper and lead were so high when samples were analyzed, that it was not possible to determine if concentrations were below the criteria levels.

Deer Lake has been sampled extensively by the Burnaby Health Department since 1981. Generally, this small lake appears to be healthy. Un-ionized ammonia levels were very low. Fecal coliform levels were also very low, with only 5% of samples exceeding 200 MPN/100 mL in 1984, and 6% in 1985. Orthophosphate levels exceeded the criteria only once between 1981 and 1985. The Corporation of Burnaby has recently hired an engineering firm to provide a preliminary design for the construction of a nutrient settlement pond and macrophyte treatment system on the west side of Deer Lake. The construction phase is proposed to start in early 1987.

Elevated levels of copper and lead were observed in the Brunette River, exceeding recommended and lowest known effect levels. Figure 3.8.1 shows that stormwaters to the Brunette River are highly contaminated with heavy metals (Anderson, 1982). Some reduced levels of dissolved oxygen were reported, although the minimum level measured still exceeds the lowest known effect level. Fecal coliform levels are periodically high. In 1984, 33% of results exceeded 200 MPN/100 mL, while in 1985, 15% of the results exceeded this level.

Sediment Quality

Limited sediment quality data were found for the Brunette Drainage Basin; much of it dates back to 1973-74 (Table 3.8-2). Data included measurements of copper, lead, mercury, cadmium, phosphorus, and PCBs. ODCA criteria are available only for mercury and cadmium. Mercury was consistently found to be well within the ODCA criteria, while the one study on cadmium showed that maximum levels exceeded the criteria by a factor of 2. Levels of copper and lead vary greatly, and are consistent

with inputs from urban and industrial sources. Recent levels of PCBs, i.e., 40 ug/kg in 1983 (Lawson et al., 1985) are much reduced over previous levels i.e., 780 ug/kg in 1974 (Garrett et al., 1980). Phosphorus levels are much higher than normal background levels.

Biota Quality

Only one study was found which involved any biological monitoring (Table 3.8-3). Elevated concentrations of copper and lead were measured in tissues of oligochaete worms (Bindra et al., 1977). However, sampling and analytical procedures for oligochaetes are subject to considerable variation due to direct sediment contamination, and other factors.

Special Situations - Issues

As a result of the existing database, the following environmental conditions exist in the Brunette Drainage Basin:

- Still Creek is ranked as "poor" because of fecal coliform, copper, lead and cadmium concentrations.

- Burnaby Lake is ranked "fair" because of excessive coliform levels which occur on occasion (i.e. 8% of the time above recreational criteria during 1985). The water quality is influenced by Still Creek.

- Deer Lake is ranked as "fair-good", also because of occasional exceedance of coliform standards.

- Brunette River is ranked as "fair" because of exceedance of criteria for fecal contamination, copper and lead.

Stormwater runoff from industrial and commercial areas of the drainage basin have been shown to be "major sources of trace metals most often considered toxic to aquatic organisms" (Anderson, 1982). Figure 3.8.2 illustrates the toxicity of stormwaters from various areas of the basin (Anderson, 1982).

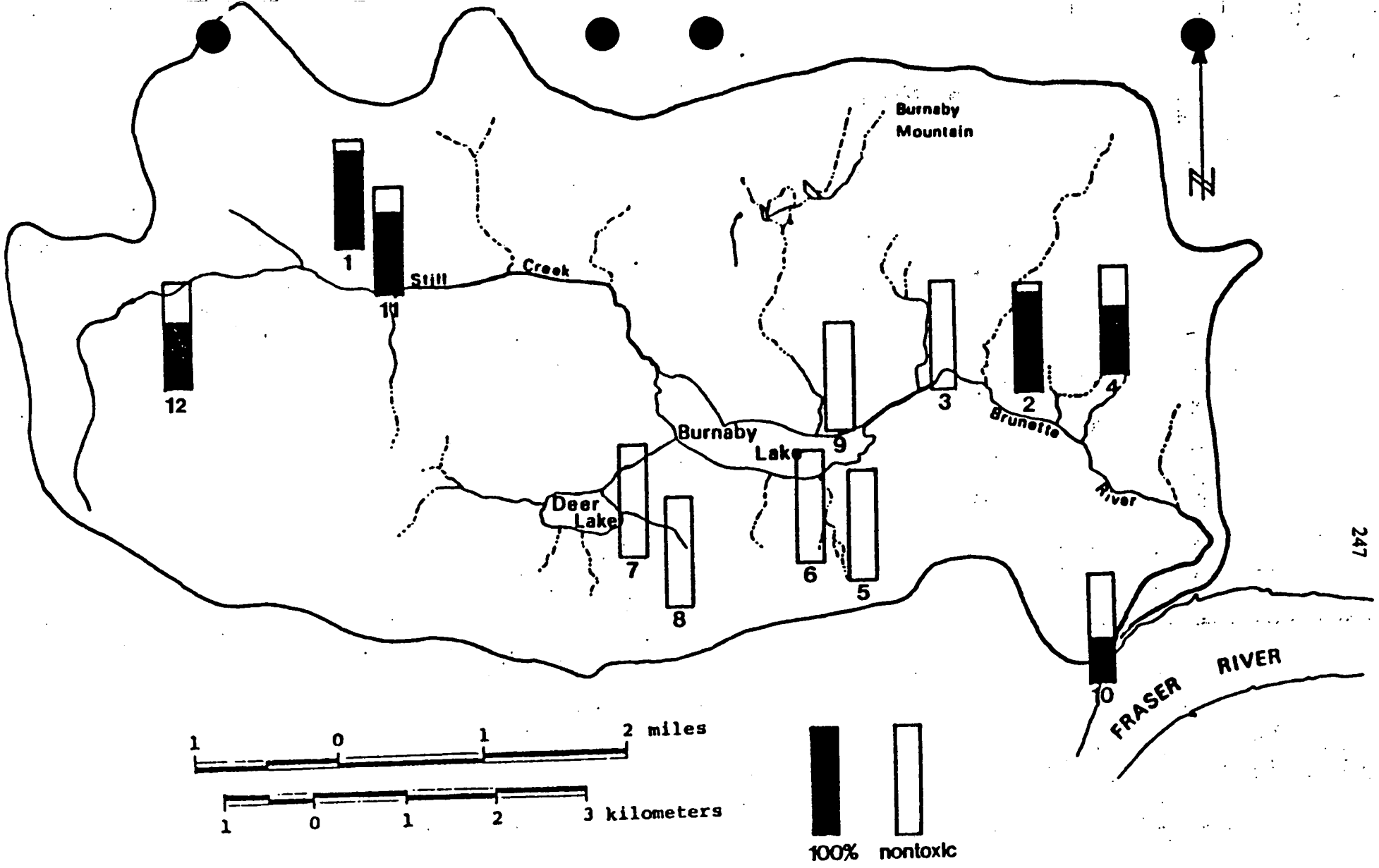


Figure 3.8.2 Acute toxicity[1] of stormwater from the Brunette River Basin.

[1] Measured as 96-hr LC_{50}, presented as 100-LC_{50}%.

Other potential sources of contaminants include industrial spills. In June of 1985, a spill of chlorophenol resulted in a large fish kill on the Brunette River. The River has since flushed itself out; indications are that there are no permanent long term effects (EPS, 1985).

In addition to urban runoff, the poor water quality of Still Creek is also largely due to suspected cross connections between storm and sanitary sewers (Hall and Ferguson, 1979). The City of Vancouver has an ongoing program to mitigate this problem.

Data Gaps and Recommendations

The water quality database, prior to 1982, for the Brunette Drainage Basin is good. Deer Lake, in particular, has been sampled routinely. It is recommended that monitoring be continued on Burnaby Lake, Still Creek and the Brunette River as they are subject to changes in water quality due to continued development in the surrounding land.

A detailed baseline data collection on the Brunette River drainage network was proposed in 1986 by Burnaby Health Department staff and Consultant. The study area would consist of thirty water/sediment quality stations. Samples would be analyzed for various chemical and biological parameters such as general water quality, inorganic/organic nutrients, heavy metals and biota. The second sampling period was proposed to be conducted in December 1986 (Burnaby Health Department, 1986).

TABLE 3.8-1a. WATER QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Brunette Drainage Basin — Location: Still Creek

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Chloride	1982	WMB Files	12.8-19.5 mg/L		NA	NA	-		
	1981	WMB Files	2.7-21.6 mg/L				-		
	1980	WMB Files	16.3-20.4 mg/L				-		
Phosphate -Ortho	1982	WMB Files	11-40 ug/L		30 ug/L[e]		-	0.75	-
	1981	WMB Files	5-28 ug/L				-	1.1	-
	1980	WMB Files	29-31 ug/L				-	0.97	-
Fecal Coliforms	1985	GVRD, Burnaby Health	<20-170,000 MPN/100 ml		200[g]				
	1984	Burnaby Health	<200-240,000 MPN/100 ml						
	1980-82	WMB Files	60-9200 MPN/100 ml						
Copper	1981	WMB Files	9-30 ug/L	6.5 ug/L	5 ug/L[e]	2.4 ug/L[e]	0.22	0.17	0.08
	1980	WMB Files	10-22 ug/L				0.30	0.23	0.11
Lead	1981	WMB Files	7-95 ug/L	1.3 ug/L	25 ug/L[e]	30 ug/L[e]	0.001	0.26	0.32
	1980	WMB Files	8-9 ug/L				0.14	2.8	3.3
Mercury	1981	WMB Files	<0.05-0.06 ug/L	0.012 ug/L	0.2 ug/L[e]	0.9 ug/L[e]	0.2	3.3	15
	1980	WMB Files	0.07-0.09 ug/L				0.13	2.2	10
Cadmium	1981	Garrett et al., 1985	<0.5-0.5 ug/L	0.66 ug/L	0.2 ug/L[e]	1 ug/L[e]	1.3	0.4	2
	1980	" "	<0.5-1.6 ug/L				0.4	0.13	0.63
Chlorophenols	No data								
PCBs	No data								

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol; criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.8-1n *(cont.)*

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Dissolved Oxygen	1982	WMB Files	10.0-11.0 mg/L			9.0 mg/L[h]	See note "i"		
	1981	WMB Files	8.0-10.6 mg/L						
	1980	WMB Files	5.6-7.2 mg/L						

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol; criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.8-1b. WATER QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Brunette Drainage Basin

Location: Burnaby Lake

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Chloride	1980-82	WMB Files	7.7-30 mg/L		N/A	N/A	-		
Phosphate -Ortho	1980-82	WMB Files	5-48 ug/L		30 ug/L[e]		-	0.63	-
Fecal Coliforms	1985	Burnaby Health	<20-700 MPN/100 ml		200[g]				
	1984	Burnaby Health	<20-24,000 MPN/100 ml						
	1980-82	WMB Files	50- >24,000 MPN/100 ml						
Copper	1980-82	WMB Files	<10 ug/L	6.5 ug/L	5 ug/L[e]	2.4 ug/L[e]	>0.65	>0.5	>0.24
Lead	1980-82	WMB Files	<100 ug/L	1.3 ug/L	25 ug/L[e]	30 ug/L[e]	>0.013	0.024	>0.030
Mercury	1980-82	WMB Files	<0.05-0.12 ug/L	0.012 ug/L	0.2 ug/L[e]	0.9 ug/L[e]	0.1	1.7	7.5
Cadmium	1980/81	Garrett et al., 1985	<0.5 ug/L	0.66 ug/L	0.2 ug/L[e]	1 ug/L[e]	>1.3	>0.4	>2
Chlorophenols	No data								
PCBs	No data								
Dissolved Oxygen	1980-82	WMB Files	4.8-16.1 mg/L	9.0 mg/L		9.0 mg/L[h]	See note "i"		

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol: criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.8-1c. WATER QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Brunette Drainage Basin

Location: Brunette River

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Chloride	1973-82	Swain & Holms, 1985	7.4-32.6 mg/L		N/A	N/A			
Phosphate -Ortho	1973-82	Swain & Holms, 1985	5-18 ug/L		30 ug/L[c]		-	1.7	-
Fecal Coliforms	1985	Burnaby Health	<20-24,000 MPN/100 ml		200[g]				
	1984	Burnaby Health	<20-9,200 MPN/100 ml						
	1973-82	Swain & Holms, 1985	50-5,400 MPN/100 ml						
Copper	1973-82	Swain & Holms, 1985	1-30 ug/L	6.5 ug/L	5 ug/L[c]	2.4 ug/L[e]	0.22	0.17	0.08
Lead	1973-82	Swain & Holms, 1985	1-35 ug/L	1.3 ug/L	25 ug/L[e]	30 ug/L[e]	0.04	0.71	0.86
Mercury	1974	Garrett et al., 1980	<0.05 ug/L	0.012 ug/L	0.2 ug/L[e]	0.9 ug/L[e]	>0.24	>4	>18
	1973-82	Swain & Holms, 1985	<0.05-0.09 ug/L				0.13	2.2	10
Chlorophenols	No data								
PCBs	No data								
Dissolved Oxygen	1973-82	Swain & Holms, 1985	6.6-14.2 mg/L	9.0 mg/L		9.0 mg/L[h]	See note "i"		

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol; criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.8-1d. WATER QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Brunette Drainage Basin

Location: Deer Lake

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Chloride	No data								
Phosphate -Ortho	1985	Burnaby Health	4-19 ug/L		30 ug/L[e]		-	1.6	-
	1983	Burnaby Health	9-59 ug/L				-	0.51	-
	1981	Burnaby Health	9-25 ug/L				-	1.2	-
Ammonia	1985	Burnaby Health	0.005-0.033 mg/L (0.0002 mg/L max. un-ionized)		0.02 mg/L[e] un-ionized	0.07 mg/L[e] un-ionized		100	350
	1983	Burnaby Health	0.007-0.064 mg/L (0.00024 mg/L max. un-ionized)					83	292
	1981	Burnaby Health	0.011-0.110 mg/L (0.00065 mg/L max. un-ionized)					30	108
Fecal Coliform	1985	Burnaby Health	<20-9,200 MPN/100 ml		200[g]				
	1984	Burnaby Health	<20-11,000 MPN/100 ml						
Copper	No data								
Lead	No data								
Mercury	No data								
Cadmium	No data								
Chlorophenols	No data								
PCBs	No data								
Dissolved Oxygen	No data								

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol; criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.8-2. SEDIMENT QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Brunette Drainage Basin

Location: Still Creek, Burnaby Lake, and Brunette River

Parameter	Period	Primary Reference(s)	Range of Values (dry wt values) Reported (A)	Canadian Criteria (B)	Safety Factors[a] B/A
Copper	1982-83	Lawson et al., 1985	32-128 ug/g		
	1973-74	Hall et al., 1976	12.2-177 ug/g		
Lead	1982-83	Lawson et al., 1985	149-300 ug/g		
	1973-74	Hall et al., 1976	24-840 ug/g		
Mercury	1982-83	Lawson et al., 1985	<25 ug/kg	0.75 ug/g[b]	>30
	1976	Garrett et al., 1980	9-101 ug/kg		7.4
	1973-74	Hall et al., 1976	11-101 ug/kg		7.4
Cadmium	1973-74	Garrett et al., 1985	ND-1.20 ug/g	0.6 ug/g[b]	0.5
Chlorophenols	No data				
PCBs	1982-83	Lawson et al., 1985	<20-40 ug/kg		
	1974	Garrett et al., 1980	<10-780 ug/kg		

a. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
b. Ocean Dumping Control Act, 1975.
c. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of tri-, tetra-, and pentachlorophenol present in surface sediment.
d. Swain and Holms, 1985. B.C. Water quality objectives. Criterion is the sum of Aroclor 1242, 1254, and 1260 present in surface sediment.

TABLE 3.8-3. LEVELS OF CONTAMINANTS IN BIOLOGICAL TISSUES COMPARED TO ESTABLISHED CRITERIA

Area: Brunette Drainage Basin

Location: Still Creek, Burnaby Lake, and Brunette River

Parameter	Period	Primary Reference(s)	Range of Values (ug/wet g except as noted) (A)	Canadian Health & Welfare Guidelines[a] (ug/wet g) (B)	Other Guidelines, Objectives (C)	Safety Factor[b] B/A	Safety Factor[b] C/A	Consumption Required to Exceed Criteria[c]
Copper	1977	Bindra et al., 1977	Worms, whole: 10.1-733 ug/g dry wt 0.5-36.7 ug/g wet wt		0.5 mg/kg body weight/day[d]			
Lead	1977	Bindra et al., 1977	Worms, whole: 147-1230 ug/g dry wt 7.4-61.5 ug/g wet wt		Tolerable intake, adults, 3 mg/week[d]			
Mercury	No data							
Cadmium	No data							
Chloro-phenols	No data							
PCBs	No data							

a. Health and Welfare Canada, 1978.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Where the criterion is weight dependent, it is calculated for a 70 kg person. The worst case reported value is used.
d. World Health Organization, 1979.
e. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of tri-, tetra-, and pentachlorophenol present in fish muscle.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of Aroclor 1242, 1254 and 1260 present in fish muscle.
g. McNeely et al., 1979. (Canadian Water Quality Criteria)

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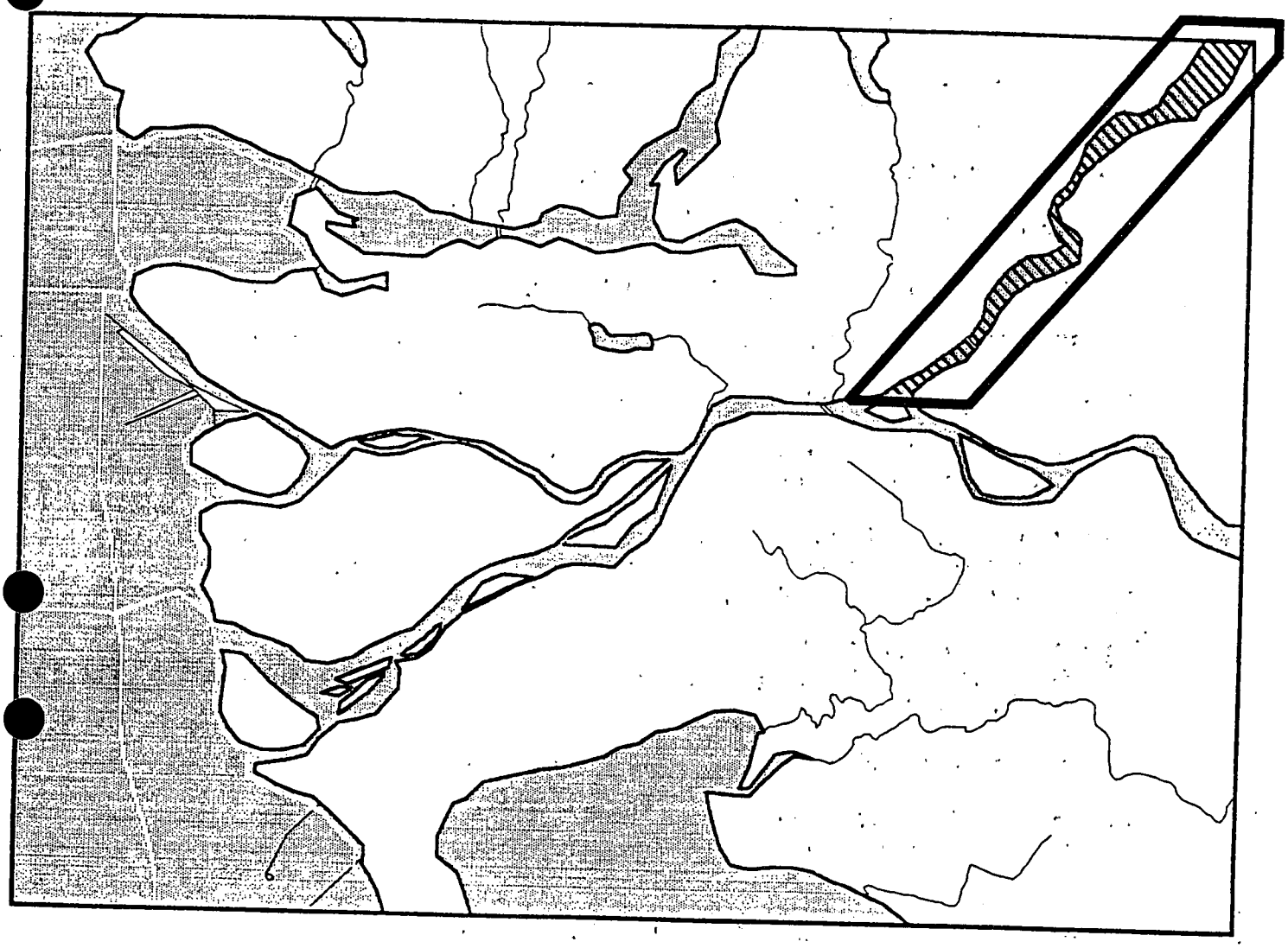

SECTION 3.9	Environmental Status of the Pitt River

3.9 Pitt River

Biophysical Description

The Pitt River is one of a series of tributaries of the Fraser River which drain the narrow valleys that penetrate the mountains bordering the north side of the Fraser Valley. Its length incorporates Pitt Lake, and it drains a total area of 515 km^2. With an annual mean discharge of 54 m^3/s, its flows range from a high of about 115 m^3/s in July to a low of about 14 m^3/s in March. The confluence with the Fraser River is about 12 km upstream from New Westminster, where the Fraser bifurcates into its two main Arms, and forms the boundary between the City of Port Coquitlam and the District of Pitt Meadows. The lower end of Pitt Lake is about 19 km upstream of the mouth of the Pitt River.

Georgia Strait tides affect the Fraser River, and their influences are felt in Pitt Lake. Times of high and low water are typically 1 to 2 hours after those in Georgia Strait, and the tidal range in the Lake is about 1 m. An interesting effect of the flood tides, which can cause flow reversals with currents of up to 1 kn at the lower end of Pitt Lake, is that sediment-bearing Fraser River waters often flow into the Lake. A "negative" delta has formed at the southern end of the Lake which extends for 6 km and is advancing at about 1.28 m each year (Thomson, 1981).

Usage

The uplands around the lower reaches of the Pitt River are used primarily for agriculture, with some residential and park lands. The uplands around the upper reaches and around Pitt Lake are generally undeveloped, with some of the foreshore of the Lake being utilized for vacation cottages, and with some logging activity in the uplands. Extensive areas of the Lake and lower River are used for log storage.

Overview Assessments

No overview assessments of the Pitt River were found in the literature. Data about the environmental quality of the river is generally limited to that of the MOE.

Environmental Status

Annual monitoring programs conducted by the Waste Management Branch of the B.C. Ministry of Environment have provided the only water quality data for the Pitt River. The program was discontinued in 1979. The authors could find no recent data on water quality, virtually no data on contaminants in aquatic animal tissues, and absolutely no information on sediment quality.

Water Quality

Water quality conditions in the River, at least before 1980, were good (Table 3.9-1). Nutrient values (orthophosphate) were low. Copper concentrations in excess of criteria levels were obtained but this probably represented natural variability in background levels. Dissolved oxygen was high at all times. No data were found on the concentrations of organic contaminants in water. It is likely that water quality conditions have not changed since the last sampling period.

Sediment Quality

There are no sediment quality data available (Table 3.9-2).

Biota Quality

Only one recent study provides data on contamination in biological tissues. PCB levels were found to be low in fish taken from a site on the lower Pitt River which was judged to be "upstream" of industrial influences (Table 3.9-3) (Chapman, 1980).

Data Gaps and Recommendations

The lack of recent information of water and sediment quality, and tissue contamination suggests that the area has been given a low priority vis a vis environmental concerns. Some routine monitoring should be carried out to assess present conditions.

TABLE 3.9-1. WATER QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Pitt River

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Chloride	1972-79	Swain & Holms, 1985	0.6-4.2 mg/L		N/A	N/A			
Phosphate -Ortho	1972-79	Swain & Holms, 1985	<3-14 ug/L		30 ug/L[e]			2.14	
Fecal Coliforms	1973-79	Swain & Holms, 1985	13-5400 MPN/100ml		200[g]				
Copper	1972-79	Swain & Holms, 1985	<1-13 ug/L	6.5 ug/L	5 ug/L[e]	2.4 ug/L[e]	0.50	0.38	0.18
Lead	1972-78	Swain & Holms, 1985	<1-9 ug/L	1.3 ug/L	25 ug/L[e]	30 ug/L[e]	0.14	2.78	3.33
Mercury	1974	Swain & Holms, 1985	<0.05 ug/L	0.012 ug/L	0.20 ug/L[e]	0.9 ug/L[e]	-	>4	>18
Cadmium	1978-79	Garrett et al., 1985	<0.50 ug/L	0.60 ug/L	0.2 ug/L[e]	1.0 ug/L[e]	>0.94	>0.29	>1.43
	1975	Garrett et al., 1985	0.70 ug/L						
Chlorophenols	No data								
PCBs	No data								
Dissolved Oxygen	1972-74	Swain & Holms, 1985	9-14.5 mg/L 87.3%-115.4% sat.	9.0 mg/L		9.0 mg/L[h]		See note "i"	

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol; criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.9-2. SEDIMENT QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Pitt River

Parameter	Period	Primary Reference(s)	Range of Values (dry wt values) Reported (A)	Canadian Criteria (B)	Safety Factors[a] B/A

No pertinent data

a. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
b. Ocean Dumping Control Act, 1975.
c. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of tri-, tetra-, and pentachlorophenol present in surface sediment.
d. Swain and Holms, 1985. B.C. Water quality objectives. Criterion is the sum of Aroclor 1242, 1254, and 1260 present in surface sediment.

TABLE 3.9-3. LEVELS OF CONTAMINANTS IN BIOLOGICAL TISSUES COMPARED TO ESTABLISHED CRITERIA

Area: Pitt River

Parameter	Period	Primary Reference(s)	Range of Values (ug/wet g except as noted) (A)	Canadian Health & Welfare Guidelines[a] (ug/wet g) (B)	Other Guidelines, Objectives (C)	Safety Factor[b] B/A	Safety Factor[b] C/A	Consumption Required to Exceed Criteria[c]
Copper	No data							
Lead	No data							
Mercury	No data							
Cadmium	No data							
Chloro-phenols	No data							
PCBs	1980	Chapman et al., 1980	Fish, epax. muscle (composites): 0.034-0.23		0.5 ug/g wet wt[f]		2.17	

a. Health and Welfare Canada, 1978.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Where the criterion is weight dependent, it is calculated for a 70 kg person. The worst case reported value is used.
d. World Health Organization, 1979.
e. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of tri-, tetra-, and pentachlorophenol present in fish muscle.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of Aroclor 1242, 1254 and 1260 present in fish muscle.
g. McNeely et al., 1979. (Canadian Water Quality Criteria).

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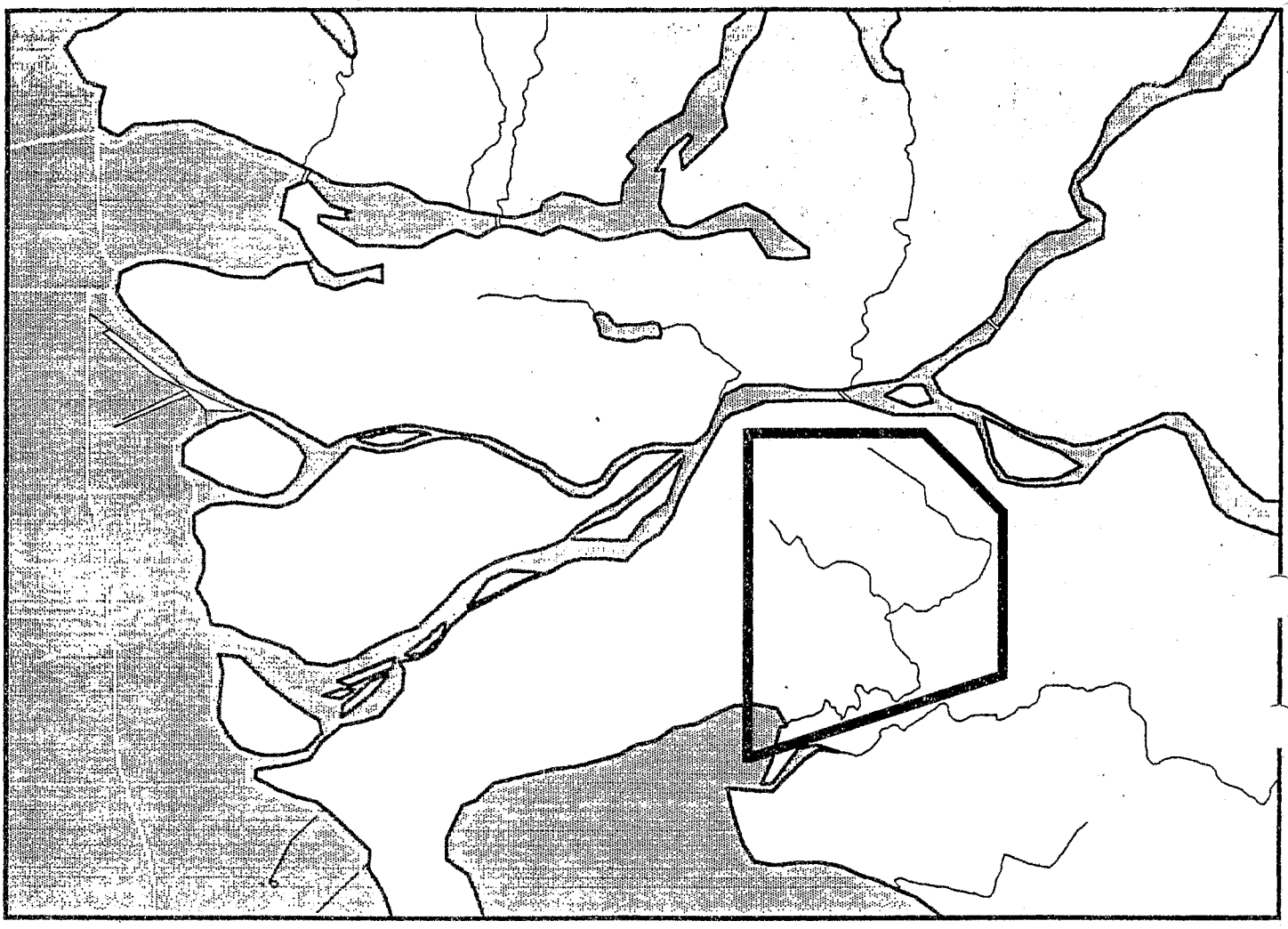

SECTION 3.10	Environmental Status of the Serpentine River

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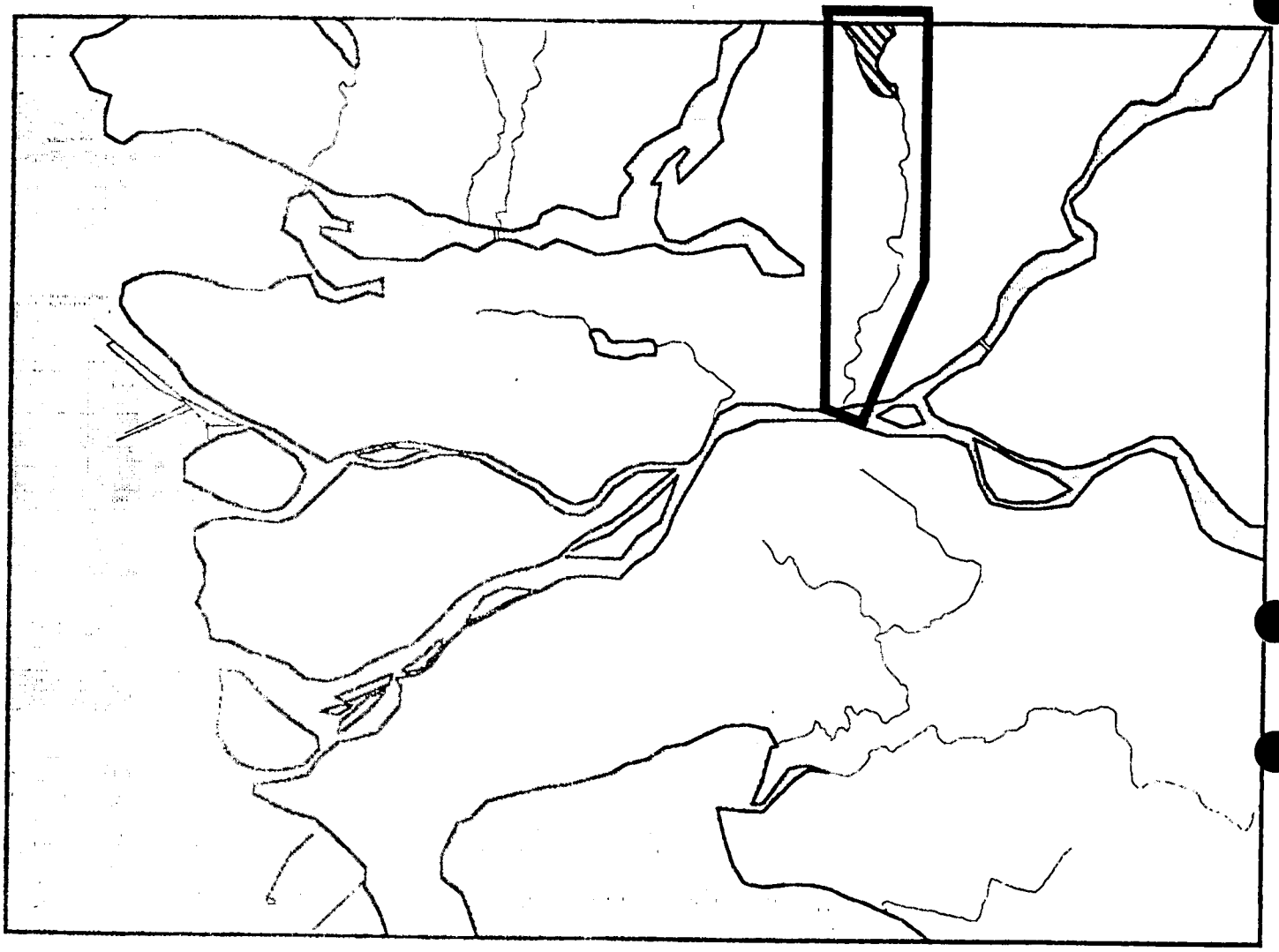

SECTION 3.16	Environmental Status of the Coquitlam River

3.16 Coquitlam River

Biophysical Description

The Coquitlam River is a tributary of the Fraser River and drains a valley to the north of the Fraser Valley. Its upper reaches have been dammed, forming Coquitlam Lake, which supplies water to B.C. Hydro and the Greater Vancouver municipalities. The total drainage area is 237 km^2. The flow of the river below the dam ranges from 1.8 m^3/s in August to 12.2 m^3/s in December, and has an annual mean discharge of 4.88 m^3/s. In addition to discharges from the watershed gate, the river is supplied by a tributary stream, or creek. The watershed gate is approximately 20 km from the confluence with the Fraser River, as the stream flows.

Usage

The upland area above the watershed gate is reserved for domestic water supply. Below, gravel removal operations have some effect on the river, but most of the land area is urban residential with some light industry. Some agricultural land lies around the mouth of the river.

Overview Assessments

Overview assessments of the Coquitlam River are limited to documents by Swain and Holms (1985) and Clark et al. (1980). Except for studies relating to discharges from the gravel operation, the river has not been subject to any holistic assessments.

Environmental Status

Water Quality

Data are on record only for water quality (Table 3.16-1). Water quality monitoring has indicated that freshwater criteria are generally met in the Coquitlam River. The exception is the presence of high concentrations of suspended sediments which have affected salmonid spawning. Chloride and orthophosphate levels are low. Measurable concentrations of copper and lead, which sometimes exceed criteria, probably represent

natural source inputs. Dissolved oxygen was always high. A slight decrease in pH (0.275 pH units) over a period of 25 years was reported by Whitfield (1985). Suspended solids, however, frequently were at unsatisfactory levels downstream of gravel operations. In a recent study, where samples were taken above and below the gravel operations after rainfall events between October, 1984 and March, 1985, suspended solid levels at sites downstream were 6 to 10 times higher than at the upstream sites (Ross and Walton, 1985).

Sediment and Biota Quality

No data on sediment quality or biota were found.

Special Situations - Issues

Upstream of the gravel operation, the environmental quality of the Coquitlam River is ranked as "good". The ongoing commercial interest in Coquitlam River gravel, combined with the occasional low flow situation below the dam, has severely damaged the salmonid spawning capacity of the river (Ross and Walton, 1985). There are ongoing efforts by the commercial group, in consultation with regulatory agencies, to reduce the release of suspended solids.

Data Gaps and Recommendations

There is a lack of sediment and tissue contamination data from this water body. Water quality monitoring conducted routinely by the Ministry of Environment was stopped in 1982. Analyses for organic contaminants were not included in this program. The area has received regulatory attention with regard to suspended solid releases from the gravel operation, with resulting legal actions.

In view of the perceived importance of the siltation issue, routine monitoring of water quality, with emphasis on suspended solids, is recommended. Sampling frequency should be coordinated with rainfall events. A spectrum of parameters should be additionally selected to reflect the multiple uses of the uplands, i.e. phosphate and fecal coliforms.

TABLE 3.16-1. WATER QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Coquitlam River

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Chloride	1982	MOE, WMB Files	0.5-4.6 mg/L		N/A	N/A			
	1981	" "	0.6-3.4 mg/L						
	1980	" "	0.6-9.5 mg/L						
	1979	" "	1.5 mg/L						
	1979-82	Swain & Holms, 1985	AT MOUTH ONLY: 0.8-10.8 mg/L				-	23.1	231
Phosphate -Ortho	1982	MOE, WMB Files	<3-5 ug/L		30 ug/L[e]		-	6.0	-
	1981	" "	<3-46 ug/L				-	0.65	-
	1980	" "	<3-21 ug/L				-	1.43	-
	1974-82	Swain & Holms, 1985	AT MOUTH ONLY: <3-46 ug/L				-	0.65	-
Fecal Coliforms	1985	Simon Fraser Health Unit	<3-240 MPN/100 ml		200[g]				
	1983	" "	70 MPN/100 ml						
	1982	" "	4-23 MPN/100 ml						
	1979-82	WMB Files	<2-920 MPN/100 ml						
Copper	1983	Sullivan et al., 1985	<5 ug/L	6.5 ug/L	5 ug/L[e]	2.4 ug/L[e]	>1.3	>1.0	>0.48
	1981	MOE, WMB Files	<1-10 ug/L				0.65	0.50	0.24
	1980	" "	<1-3 ug/L				2.17	1.67	0.80
	1979	" "	<1-5 ug/L				1.3	1.0	0.48
	1972-81	Swain & Holms, 1985	AT MOUTH ONLY: <1-20 ug/L				0.3	0.25	0.12
Lead	1983	Sullivan et al., 1986	<20 ug/L	1.3 ug/L	25 ug/L[e]	30 ug/L	>0.065	>1.25	>1.5
	1972-81	Swain & Holms 1985	<1-10 ug/L				0.13	2.5	3.0
Mercury	1983	Sullivan et al., 1986	<50 ug/L	0.012 ug/L	0.20 ug/L[e]	0.9 ug/L[e]	Indeterminate		

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol; criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.16-1 *(cont.)*

Parameter	Period	Primary Reference(s)	Range of Values Reported (A)	EPA Criteria[a] (B)	Canadian Criteria (C)	Lowest Known Effect Level (D)	Safety Factors[b] B/A	C/A	D/A
Cadmium	1978-81	Garrett et al., 1985	<0.5 ug/L	0.66 ug/L	0.20 ug/L[e]	1.0 ug/L[e]	>1.32	>0.4	>2
Chlorophenols	No data								
PCBs	No data								
Dissolved Oxygen	1982	MOE, WMB Files	12.0-15.4 mg/L			6.4 mg/L[h]	See note "i"		
	1981	" "	10.3-13.3 mg/L						
	1980	" "	8.5-12.6 mg/L						
	1979	" "	14.5-14.9 mg/L						
	1972-82	Swain & Holms, 1985	AT MOUTH ONLY: 8.2-13.2 mg/L (79.2%-113.6% sat.)						
NFR (Suspended solids)	Oct./84-Mar./85	Ross & Walton, 1985	Upst. Ref.: 5-108.5 ug/L Dnst.: 5-1105 mg/L Dnst. at Highway: 5-694 mg/L						
	1974-82	Swain & Holms, 1985	At Mouth: 3-84 mg/L						

a. Environmental Protection Agency, 1980, 1984.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Health and Welfare Canada, 1978.
d. McKee and Wolf, 1963.
e. International Joint Commission, 1977.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion for chlorophenols is the sum of tri-, tetra-, and pentachlorophenol; criterion for PCBs is the sum of Aroclors 1242, 1254 and 1260.
g. Ministry of Environment, 1975. Criterion for water contact recreation is 200 MPN/100 ml running geometric mean on a minimum of 5 samples in a 30 day period.
h. Minimum suggested value for protection of fish (Davis, 1975).
i. Not calculated, since the safety relationship is the reverse of that for the other parameters. Safety may be estimated by relating the reported value to the criteria.

TABLE 3.16-2. SEDIMENT QUALITY CONDITIONS COMPARED TO ESTABLISHED CRITERIA

Area: Coquitlam River

Parameter	Period	Primary Reference(s)	Range of Values (dry wt values) Reported (A)	Canadian Criteria (B)	Safety Factors[a] B/A

No pertinent data

a. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
b. Ocean Dumping Control Act, 1975.
c. Swain and Holms, 1985. B.C: Water Quality Objectives. Criterion is the sum of tri-, tetra-, and pentachlorophenol present in surface sediment.
d. Swain and Holms, 1985. B.C. Water quality objectives. Criterion is the sum of Aroclor 1242, 1254, and 1260 present in surface sediment.

TABLE 3.16-3. LEVELS OF CONTAMINANTS IN BIOLOGICAL TISSUES COMPARED TO ESTABLISHED CRITERIA

Area: Coquitlam River

Parameter	Period	Primary Reference(s)	Range of Values (ug/wet g except as noted)	Canadian Health & Welfare Guidelines[a] (ug/wet g)	Other Guidelines, Objectives	Safety Factor[b]		Consumption Required to Exceed Criteria[c]
			(A)	(B)	(C)	B/A	C/A	
No pertinent data								

a. Health and Welfare Canada, 1978.
b. Criterion divided by worst case reported value. Factors less than 1 indicate that the criterion has been exceeded.
c. Where the criterion is weight dependent, it is calculated for a 70 kg person. The worst case reported value is used.
d. World Health Organization, 1979.
e. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of tri-, tetra-, and pentachlorophenol present in fish muscle.
f. Swain and Holms, 1985. B.C. Water Quality Objectives. Criterion is the sum of Aroclor 1242, 1254 and 1260 present in fish muscle.
g. McNeely et al., 1979. (Canadian Water Quality Criteria)

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APPENDIX A

Impact of Pollutants and First Flush Stormwater Quality in Watersheds on Westwood Heights

by

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for

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February, 1987

APPENDIX A

1.0 INTRODUCTION

The objective of this component of the study was to:

i) determine the impact of pollutants in storm drainage from the proposed development in Westwood Heights on Hoy and Hockaday Creeks, and

ii) determine a rational split between the first flush flows and subsequent flows which might be suitable for discharge to sensitive receiving environments, i.e. Hoy and Hockaday Creek.

To achieve these objectives a loading estimate was made of pollutants that could be generated from the proposed residential areas of Hoy and Hockaday Creeks. These pollutant loads were compared to the loading from the nondeveloped land. A review of the literature was made to evaluate the importance of the first flush phenomena in removing the bulk of the pollutant load from the watershed during a storm event.

2.0 METHODOLOGY

A methodology similar to that employed in our previous report (Hall, 1983) was used to calculate the pollutant loadings. Rather than use previous rainfall records to compute runoff volumes, an estimate has been made of the mean annual runoff from undeveloped land in the Westwood Plateau by Ker, Priestman & Associates Ltd. This value (0.82 L/s/ha) was multiplied by various coefficients to calculate the runoff from the different land uses in the area (Table A-1). These unit runoff values were multiplied by the area of different land uses that will contribute to the flow of Hoy and Hockaday Creeks to generate the average daily volumes of runoff (Tables A-2 and A-3). Multiplication of the runoff volumes by the quality characteristics of the stormwater (Table A-4), that were used in our previous report, provides a loading estimate of pollutants to Hoy and Hockaday Creeks. The values are expressed as loadings/day and are compared to the loadings that would occur if no development took place in these watersheds.

3.0 RESULTS AND DISCUSSION

In our previous report, a comparison was made between the pollutant concentrations selected for the Westwood Plateau study and values from other investigations. No further observations will be made on the selection of the parameter values except to say that the literature review conducted for this component of the study demonstrated a wide concentration range for pollutants found in stormwater. For example see Brown 1980, Mikalsen 1980, Ostry 1982, Shahane 1982, Wilber and Hunter 1977, Miller and Mattraw 1982, for stormwater pollutant concentrations developed for different watersheds in North America. Deutsch and Hemain (1984) and Melanen (1978) provide stormwater quality characteristics from Watersheds in France and Finland respectively, and Wada and Miura (1984) provide data for two watersheds that they studied in Japan.

The pollutant loadings as a result of development that would occur in the areas of Hoy and Hockaday Creeks are summarized in Tables 1 and 2 respectively. There is an obvious increase in the generation of all pollutants from the residential developments which is attributable to both higher concentrations in the stormwater and a larger volume of runoff caused by impervious areas.

A comparison of the pollutant loadings generated from our calculations for the Westwood Plateau are generally higher than I have found in the literature. This is probably attributable to the fact that the annual rainfall in the Westwood Plateau area is higher than most studies in the literatue and when this higher runoff is multiplied by the quality parameters, higher loading

values are obtained. To provide a more accurate pollutant loading would require actual on-site measurements to determine how factors such as antecedent dry days, rainfall volume, intensity and other variables affect the runoff quality.

However, the relative changes that occur in the pollutant loading as a result of land use changes (i.e. forest cover to residential development) should be adequately reflected in these data since the higher rainfall will provide a higher pollutant loading estimate over all land uses.

The possible impacts of the changes in pollutant concentration and loading upon the aquatic biota were discussed in our previous report and will not be repeated here. The following section reviews the literature on the generation of pollutants over the discharge hydrograph to determine a rational partitioning of the flows to sensitive areas to minimize the impact on aquatic biota.

TABLE 1 - POLLUTANT LOADINGS TO HOY CREEK[1]

					Trace Metals					Coliforms	
		BOD_5	TN	TP	Cu	Fe	Mn	Pb	Zn	Total	Fecal
Status	Land Use	kg/day			g/day					no./day x 10^{10}	
Development	Residential (MD)	220	15.2	4.5	76	1933	174	462	61	75.8	8.3
	Residential (HD)	136	9.4	2.8	47	1200	108	287	38	47.0	5.2
	School and Parks	2	0.7	0.07	2	259	5	2	2	4.5	0,04
	Total	358	25.3	7.37	125	3392	287	751	101	127.3	13.54
No Development of above areas		19	6.5	0.65	19	2422	.52	19	19	41.9	0.4

[1] See Table A-5 for Abbreviations

TABLE 2 - POLLUTANT LOADINGS TO HOCKADAY CREEK[1]

					Trace Metals					Coliforms	
		BOD_5	TN	TP	Cu	Fe	Mn	Pb	Zn	Total	Fecal
Status	Land Use	kg/day			g/day					no./dayx10^{10}	
Development	Residential (MD)	64.9	4.5	1.34	22.4	571	51	136	18	22.4	2.4
No Development	of above area	3.3	1.1	0.11	3.3	420	9	3	3	7.3	0.07

[1] See Table A-5 for Abbreviations

4.0 THE "FIRST FLUSH" PHENOMENA IN STORMWATER

The initial shock loadings that can be delivered to a receiving water during the initial phases of a runoff event have been termed the "first flush" of the runoff event (Griffin et al, 1980). To understand how the pollutants will distribute themselves over the rainfall period requires an understanding of the relative partitioning between the soluble and particulate phases. Data indicate that the insoluble or particle associated pollutants are removed primarily by physical processes and the majority of these pollutants tend to be entrained in the rising limb of the runoff hydrograph while the soluble pollutants tend to be regulated by solubility equilibria (Griffin et al, 1980). Usually the more soluble pollutants are more available to aquatic organisms therefore the gross pollutant load does not often reflect the impact of the pollutants on the aquatic community.

The relative proportion of a pollutant that is associated with the soluble and particulate phases will depend upon the specific element or compound of interest. For example, Morrison et al (1984) found that zinc and cadmium were more prevalent in the dissolved phase in urban stormwater while lead was predominant in the suspended solid phase. Copper was distributed equally between the dissolved and solid phases. Even the relationship between the dissolved and particulate phases does not completely explain the impact upon the aquatic biota since the ease of release or exchange with the suspended material (Bindra and Hall 1977; Morrison et al 1984) and the water quality characteristics (i.e. pH, suspended solids level - Anderson 1982) can also regulate the ability of an organism to concentrate a trace metal or determine its toxicity.

In spite of the complexity of these interactions I will review several investigations on the time response of pollutant concentration and loading in stormwater and try to provide a rational framework for partitioning the storm event into phases that can be applied to the Hoy and Hockaday Creek watersheds.

In their studies in Japan, Wada and Miura (1984) found that the time of the peak runoff loads did not agree with the peak of water quality (i.e. concentration). The peak in runoff load lagged the concentration peak by 20 - 30 minutes. In the detailed storm event that they monitored approximately 80% of the BOD, suspended solids, Kjeldahl nitrogen and TP loads were transported in the first hour of a 3-hr. storm event. They developed a loading runoff model which gave correlations between 0.70 and 0.95 for estimated BOD, COD and SS loads when compared to actual. field loading measurements.

In investigating water quality patterns during a storm on a mall parking lot Black (1980) found that the concentration profile of several elements (K, Mn, Fe, P, Pb, Zn, Mg, Ca, and Na) reached peak levels after 55 minutes of rainfall. However, no information was provided on the variations in rainfall intensity over the rainfall event (11.4 mm of rain fell over the period of 1 hr. and 20 minutes and surface runoff continued for two hours from the 16 ha site).

In developing a suspended solids transport model for stormwater runoff, Price and Mance (1978) found a good agreement between the observed and predicted pollutographs. Generally the peak load of suspended solids occurred between 20 and 60 minutes after rainfall began and followed the discharge hydrograph closely.

In Quebec City where Lessard and Lavallee (1984) studied combined sewer overflows the concentration profiles of copper, suspended solids and COD followed the discharge pattern and showed maximum values after a 30-minute period of rainfall. Although the authors related most of this pollutant loading to the stormwater I don't think they properly evaluated the scouring effects of the storm event on settled solids from sanitary wastes in the combined system.

Anderson (1982) provides some of the only data on the relative toxicity of stormwater over a rainfall event. He found that there was a period of toxicity (96 hr.LC_{50} to Daphnia) during the first 20 minutes of the storm event when a high level of suspended solids was transported in the stormwater. This was followed by a period of toxicity between 2.5 - 3.5 hrs. into the storm when the highest flow occurred. It was difficult to relate this toxicity to any specific trace metal or other pollutant.

In assessing factors of the rainfall event and drainage basin which regulate the transport of suspended materials during a storm event, Desbordes and Servat (1984) found that the duration of the dry weather period and the mean maximum intensity during a 5 minute rainfall period showed the best correlation (0.5 to 0.9) in stepwise regression relationships for four drainage catchments in France. They regressed 15 variables describing the rainfall event against the total suspended solids to come up with this relationship. From a series of laboratory and field experiments, Nakamura (1984) found that the rate of removal of soluble pollutants was a function of roughness and slope of the catchment, overland flow intensity and the cumulative volume of runoff. Thus although runoff intensity appears to be

common to the transport of both soluble and suspended pollutants, a variety of other factors can be important.

From the information reported in the literature it appears that for most of the case studies reviewed the major proportion (70 - 80%) of the pollutant load is transported during the first hour of the rainfall event. However, the intensity of the rainfall has to be sufficient to dislodge and transport suspended materials during this 1-hour period since many of the pollutants are associated with the suspended solids in the stormwater. This statement has obvious limitations as has been suggested by the literature review.

From these observations, the general conclusion can be made that storage or diversion of the "first flush" component of a storm event, which usually occurs during the first hour, should provide some level of protection to the aquatic biota in Hoy and Hockaday Creeks. The relatively high slopes in the Westwood Plateau catchment area should facilitate the transportation of suspended pollutants during the early part of the discharge hydrograph. However, the low intensity, long period rainfall events, which often characterize our rainfall patterns in the coastal environment, may slow down suspended solids transport. A more detailed frequency analysis would have to be made of the rainfall intensity and runoff patterns to predict with more accuracy the exact pattern of suspended solids and pollutant transport in the catchment areas under consideration.

5.0 DISCHARGE OF STORMWATER TO HOCKADAY CREEK

It has been proposed that during periods of high stormwater flow that a component of the flow would be spilled into Hockaday Creek. During a field trip to Westwood Plateau, a visual survey was made of the creek. The creek meanders through a forested area and in some reaches it has a poorly defined channel. In one area, above a small tributary which joins the main stream, the main channel disappears and flow is through the organic forest soil and litter. Trees grow at the edge of the stream channel and there are dead falls across the creek in several places. From a hydrologic point of view it would be a poor decision to channel any excess stormwater flow down Hockaday Creek since there would certainly be severe erosion problems and a higher incidence of dead falls would occur.

The lower reaches of Hockaday Creek have already been degraded by high levels of silt deposition. This silt has originated from erosion of an exposed gravel deposit which contributes sediment to the small tributary entering Hockaday Creek from the west.

Table A-1

Runoff Coefficients for Westwood Plateau

Land Use	Coefficient
Undeveloped Land	1.0
Medium Density Residential (RS1)[1]	2.0
High Density Residential(RS4/RT2)[2]	2.2
School and Park	1.3

1. Medium Density Rsidential = 7000 ft.^{2}/lot
2. High Density Residential = 3500 ft.^{2}/lot

Table A-2

Drainage Areas in Westwood Plateau

Watershed	Total Area (ha)	Area Developed (ha)	Development Area to Creek Flow (ha)
Hoy Creek	451.3	242	91.2
Hockaday Creek	78.8	31.5	15.8

Table A-3

Land Use in Development Area that Flows to the Creek

	Land Use (ha)			
Watershed	RS1	RS4/RT2	School & Park	Total
Hoy Creek	53.5	30.2	7.5	91.2
Hockaday Creek	15.8	0	0	15.8

Table A-4

Pollutant Concentrations in Subsurface Runoff

	BOD_5	TN	TP	Trace Metals Cu	Fe	Mn	Pb	Zn	TC	FC
	mg/L			µg/L					MPN/100 mL	
Residential and Roads	29	2	0.6	10	255	23	61	8	100,000	11,000
Open Space	3	1	0.1	3	375	8	3	3	65,000	600

TC = total coliforms; FC = fecal coliforms;

Other Abbreviations see Table A-5.

Table A-5

Abbreviations

BOD_5	-	Biochemical Oxygen Demand (5 day)
TN	-	Total Nitrogen
TP, P	-	Total Phosphorus, Phosphorus
Cu	-	Copper
Fe	-	Iron
Mn	-	Manganese
Pb	-	Lead
Zn	-	Zinc
MD	-	Medium Density Residential
HD	-	High Density Residential
K	-	Potassium
Mg	-	Magnesium
Ca	-	Calcium
Na	-	Sodium

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DISTRICT OF COQUITLAM

AGENDA ITEM 503.4

Inter-Office Communication

TO:	J.L.Tonn, Municipal Manager	DEPARTMENT:	Administration	DATE:	1988 January 14
FROM:	Neil Nyberg	DEPARTMENT:	Engineering	YOUR FILE:	0281550.B16A
SUBJECT:	FRASER RIVER FLOOD CONTROL PROGRAM			OUR FILE:	01 03 06

FOR DRAINAGE COMMITTEE

Reference: A. Ministry of Environment and Parks File 0281550-B16A: Coquitlam River Fact Sheet 1987 August 19
B. Coquitlam River Water Management Study 1978

1.00 BACKGROUND

1.01 From 1982 Port Coquitlam and Coquitlam staff, the Mayor's office, Port Coquitlam Council, and the office of Member of Parliament G. St. Germain have attempted to identify federal funds from the Fraser River Flood Control Program to be used to provide 1:200 flood protection for the Coquitlam River. The original initiative was aimed at protecting land adjacent the main stem of the Coquitlam River from inundation with most low lying land located within the City of Port Coquitlam.

1.02 The attached (reduced) Ministry of Environment drawings show that Coquitlam flooding risks concentrate in the area west of Westwood Street, north of Kingsway and east of the Lougheed Highway. A proposed dyke with a 12 foot crest would protect areas of Greene Street and the Meadow Brook development. The dyke would be pierced by a flood box to accommodate Maple Creek, and a pad for a portable pump would be located south of Westwood Street.

1.03 Area 1 of the Ministry drawing A 5333-4 shows proposed bank protection (rip-rap) at the Coquitlam, River banks east of Hockaday Street.

1.04 At a briefing on 1987 August 19, Ministry officials suggested that design of the $6 million improvements to the Coquitlam River would begin as early as 1990 and continue for three years to 1993. Engineering design for the dyke, flood box and bank protection would have to commence in 1988/89 to meet the schedule.

2.00 RECOMMENDATION:

2.01 That the Drainage Committee recommend that Council endorse the bank protection, dyking and flood box project for the Coquitlam River proposed under the Fraser River Flood Control Program for 1990 to 1993; and

2.02 That the endorsement be sent to the Hon. Bruce Strachan Minister of Environment and Parks, and federal Member of Parliament G. St. Germain.

Neil Nyberg P.Eng.
Municipal Engineer

NWN/ms

JLT info

File: 0281550-B16A

COQUITLAM RIVER - FACT SHEET

Presented at Port Coquitlam City Hall - August 19, 1987

1. The Fraser River Flood Control Program current funding is $161,000,000. Expenditures to date $126,000,000. Annual budget is $5,000,000. Program terminates 1995.

2. The Coquitlam River project is currently scheduled to be designed in the fiscal year 1988-1989 and constructed over a 3-year period 1990-1993. Depending on the demands of other projects, it is possible that construction could commence fiscal year 1989-1990.

3. The original analysis of the dyke and bank protection requirements is contained in the "Coquitlam River Water Management Study" prepared in 1978.

4. An Outline Report was prepared by Ministry of Environment in 1982 which specifically addressed dyke, bank protection and floodbox requirements on the Coquitlam River.

5. The Outline Report was updated in 1984.

6. For analysis, the Coquitlam River main stem was divided into the following subsections:

   a) Area I -Hockaday Street
   b) Area II -District of Coquitlam
   c) Area III -City of Port Coquitlam
   d) Area IV -Indian Reserve No. 2
   e) Area V -Colony Farm

   The above areas are depicted on the attached drawings A5333-2, A5333-3 and A5333-4.

7. Areas I - V were estimated based on 1984 construction prices.

8. Areas IV and V, Indian Reserve No. 2 and Colony Farm are not included in the current analysis. These areas have been eliminated due to insufficient benefits. The cost estimate to provide flood protection to Areas I, II and III is $5,600,000 based on 1984 estimates. With an allowance for escalation the 1987 estimate is $6,000,000 (not including land acquisition).

... 2

Province of British Columbia
Ministry of Environment and Parks
WATER MANAGEMENT
LOWER MAINLAND REGION

Neil J. Peters, P.Eng.
Head
Engineering Section

10334 — 152A Street
Surrey
British Columbia
V3R 7P8

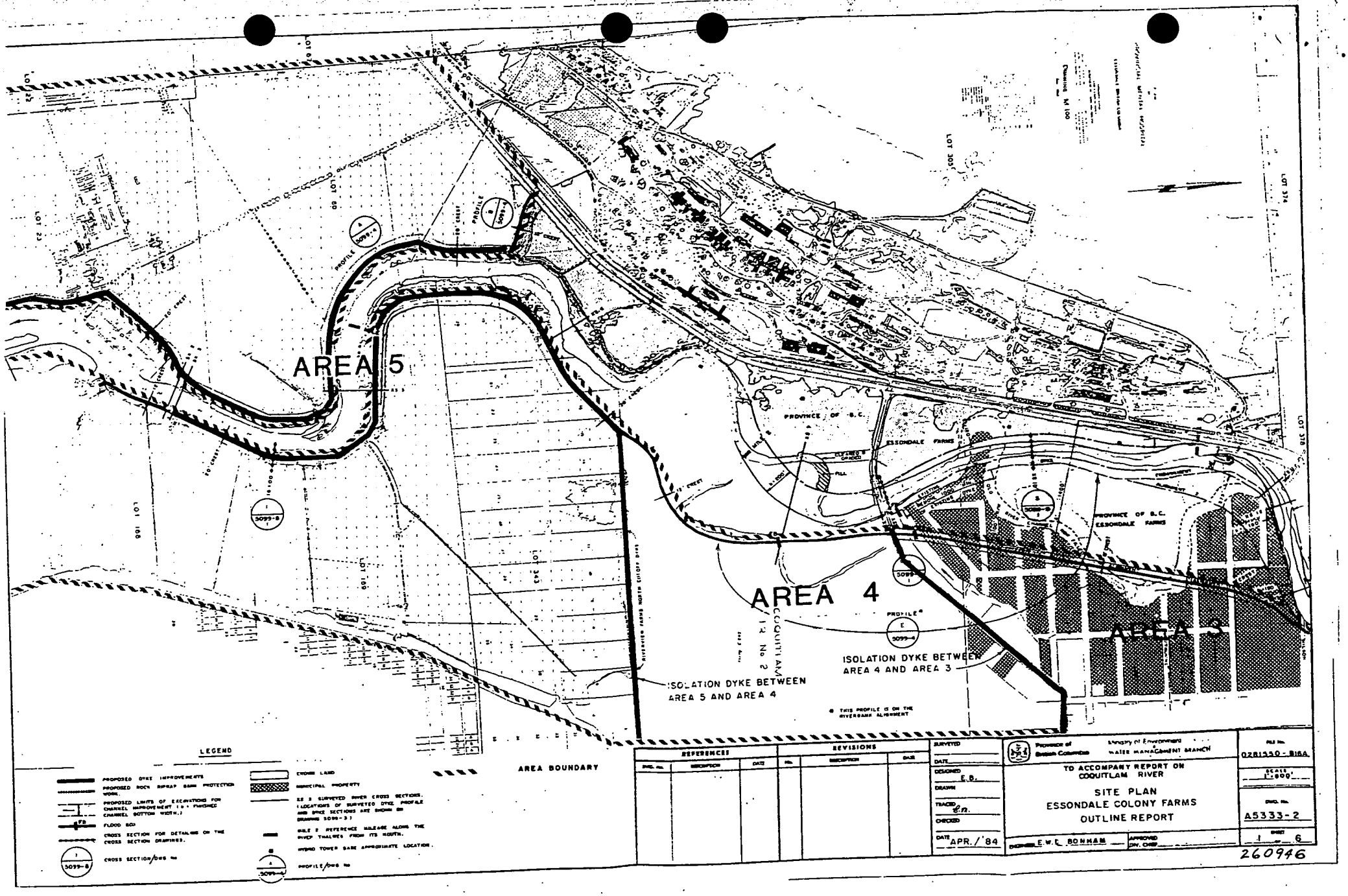
Phone: (604) 584-8822

9. Note these estimates are based on preliminary figures. Be advised that these estimates and the scope of the work are subject to the change once the design phase is completed. The consultant will review in detail flood protection requirements and refine the cost estimates.

10. The flood protection works on the Coquitlam River will be designed for a 1-in-200 year flood flow of 585 m^3/s (20,670 cfs), assuming that the Coquitlam Lake reservoir is full at the beginning of the flood event. The runoff above the lake would then contribute directly to the flood event.

E.W.D. Bonham, P. Eng.
Project Manager
Rivers Section
Water Management Branch

EWDB/gb


AREA 5
AREA 4
AREA 3
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ESSONDALE FARMS
ISOLATION DYKE BETWEEN AREA 5 AND AREA 4
ISOLATION DYKE BETWEEN AREA 4 AND AREA 3
COQUITLAM
LEGEND
AREA BOUNDARY
REFERENCES
REVISIONS
SURVEYED
DESIGNED E.B.
DRAWN
TRACED S.n.
CHECKED
DATE APR./'84
Province of British Columbia
Ministry of Environment & WATER MANAGEMENT BRANCH
TO ACCOMPANY REPORT ON COQUITLAM RIVER
SITE PLAN
ESSONDALE COLONY FARMS
OUTLINE REPORT
DESIGNED E.W.L. BONHAM
APPROVED DIV. CHIEF
FILE No. 0281550-B16A
SCALE 1:600'
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SHEET 1 of 6
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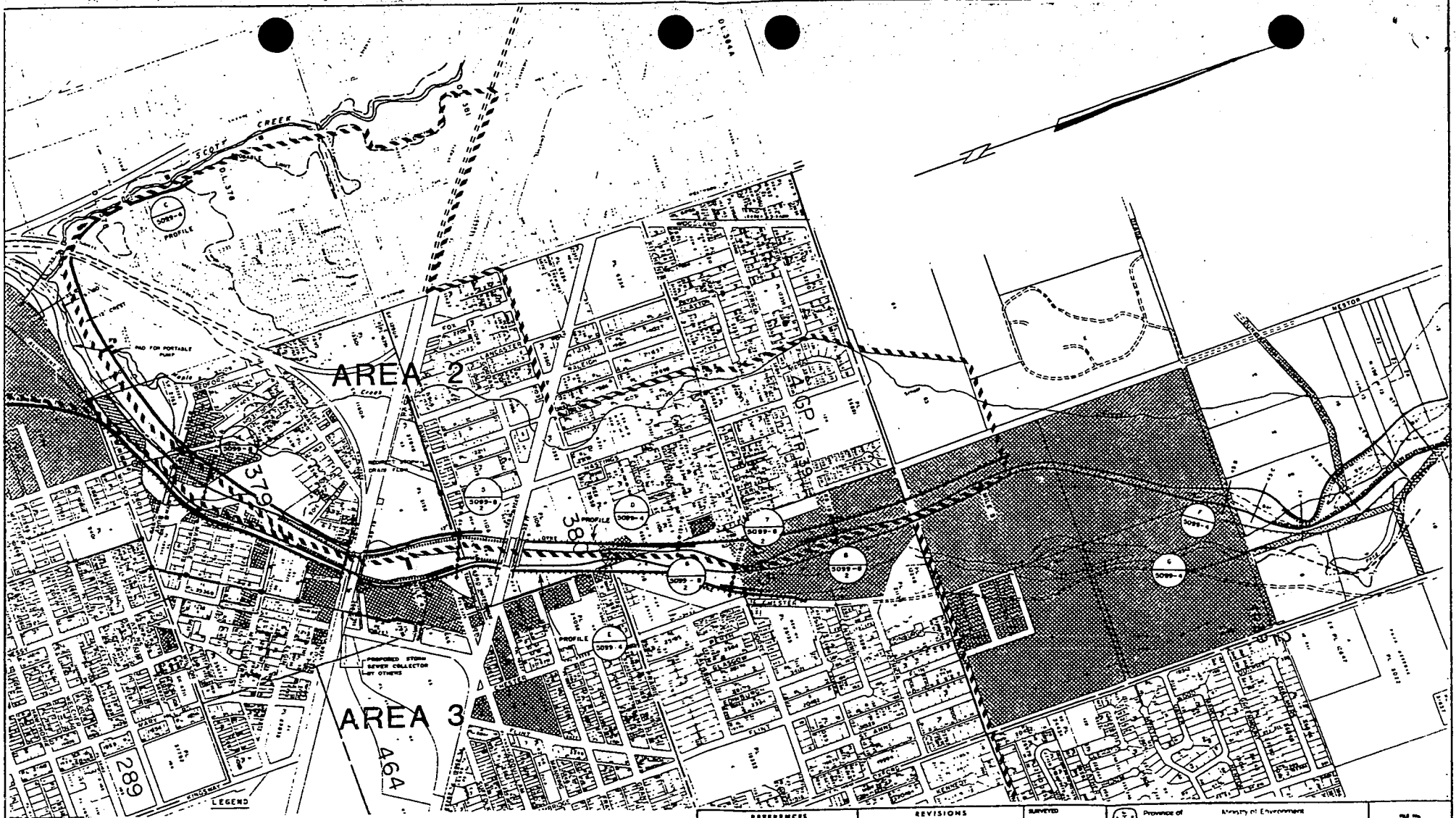

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DATE APR./84

Province of British Columbia — Ministry of Environment — WATER MANAGEMENT BRANCH

TO ACCOMPANY REPORT ON COQUITLAM RIVER

SITE PLAN CITY OF PORT COQUITLAM & DISTRICT OF COQUITLAM OUTLINE REPORT

ENGINEER E. W. D. BONHAM — APPROVED — DIV. CHIEF

FILE No. 0281550-81EA
SCALE 1:500'
DWG No. A5333-3
SHEET 2 of 6

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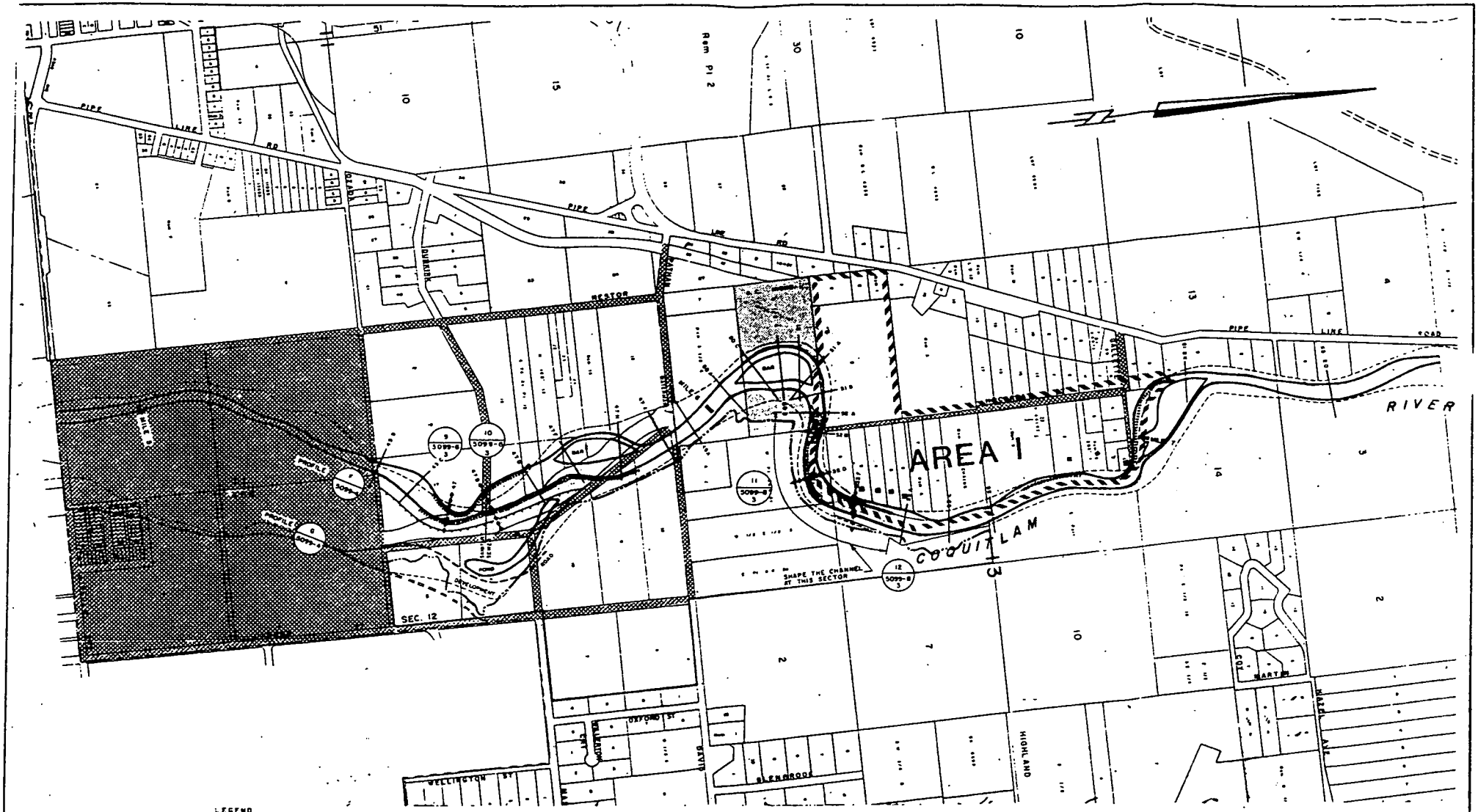

LEGEND

- PROPOSED DYKE IMPROVEMENTS
- PROPOSED ROCK RIPRAP BANK PROTECTION WORKS
- PROPOSED LIMITS OF EXCAVATIONS FOR CHANNEL IMPROVEMENT (W = PROPOSED CHANNEL BOTTOM WIDTH)
- FLOOD BOX
- CROSS SECTION FOR DETAILING ON THE CROSS SECTION DRAWINGS
- PRESENT RIVERBANK
- MAPPING BOUNDARY OF THE RIVER
- CROWN LAND
- MUNICIPAL PROPERTY
- AS S SURVEYED RIVER CROSS SECTIONS.
- DYKE PROFILE
- MILE 0 REFERENCE MILAGE ALONG THE RIVER TRAVELED FROM ITS MOUTH
- AFORD TOWER BASE APPROXIMATE LOCATION
- ESTABLISHED DEVELOPMENT SETBACK
- AREA BOUNDARY

REFERENCES			REVISIONS		
DWG. NO.	DESCRIPTION	DATE	NO.	DESCRIPTION	DATE

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DATE
DESIGNED E.B.
DRAWN
TRACED J.A.
CHECKED
DATE APP./'84
DESIGNER E. W. O. BONHAM — APPROVED DIV. CHIEF

Province of British Columbia — Ministry of Environment — WATER MANAGEMENT BRANCH

TO ACCOMPANY REPORT ON COQUITLAM RIVER

SITE PLAN
HOCKADAY STREET AREA
OUTLINE REPORT

FILE No. 0281550-8184
SCALE 1" = 800'
DWG. No. A5333-4
SHEET 3 OF 6

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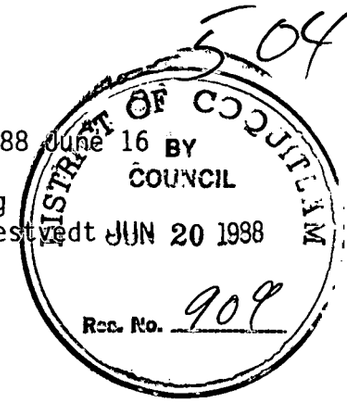

MINUTES OF A MEETING OF THE DRAINAGE COMMITTEE
held at COQUITLAM MUNICIPAL HALL at 1200 h on Thursday 1988 June 16

Attending: Alderman W. LeClair, Chairman
Alderman B. Robinson
Neil Nyberg
Sever Rondestvedt
Al Kersey

CALL TO ORDER

The Chair called the meeting to order at 1230h.

504-1 1989 DITCH ELIMINATION PROGRAM

The Committee reviewed engineering memo report 01 03 06 (attached) which recommended that preparations commence for the first year (1989) of the expanded ditch elimination program.

Council Action Required

504-1 **That Council authorize staff to prepare and present a bylaw to approve an expenditure of $60,000 of the Drainage Capital Reserve Fund for engineering and contract preparation for the 1989 Expanded Ditch Elimination Program.**

Moved by Alderman Robinson seconded by Alderman LeClair

App'd Res 910

Carried

The Committee reviewed correspondence from the Mountain View Elementary School Parent/Teachers Association regarding pedestrian safety concerns along Foster Avenue between Clarke Road and Robinson Street. The installation of a traffic signal was anticipated to increase traffic along Foster significantly. The Committee instructed staff to bring forward cost estimates and a draft by-law to extend the 1988 Ditch Elimination Program to include improvements to Foster.

504-2 HOY CREEK INTERCEPTOR CANCELLATION

The Committee reviewed the engineering memo report 01 03 06 (attached) which gives reasons for changing the 1988 drainage program to exclude an interceptor sewer planned for Hoy Creek. An alternative method of satisfying environmental concerns is anticipated, but will not be funded from drainage reserve programs.

Council Action Required

504-2 **That Council cancel the proposed 1988 Hoy Creek Interceptor Project 533054-031 $150,000. owing to environmental objections and instruct staff to seek alternative means to satisfy the flow problems in Hoy Creek indentified by Fisheries.**

Moved by Alderman Robinson seconded by Alderman LeClair

App'd Res 911

Carried

504-3 GLEN DRIVE: TOWN CENTRE DRAINAGE PROJECT

The Committee reviewed the revised scope of work for the Glen Drive Storm extention adjacent Glen Elementary School. In conjunction with the project, about $40,000 of improvements will be constructed to the municipal street adjoining the school. The Committee received the report for information.

504-4 COQUITLAM RIVER FLOOD CONTROL STATUS REPORT

The Committee reviewed engineering memo report 01 03 06, dated 1988 May 24, noting that an inter municipal Liason Committee will be established to assist with the implemention of this provincial project. The Committee received the report for information.

504-5 COQUITLAM/PORT MOODY SCARP DRAINAGE STUDY

The Committee reviewed engineering memo report 01 03 06 dated 1988 May 26 and examined the Dayton and Knight report compiled for the Greater Vancouver Regional District. The report focused on the need for further improvement to the natural watercourses and manmade drainage facilities associated with the scarp which contains the Port Moody/Coquitlam municipal boundary.

The Committee felt that the highest priority projects should be given greatest emphasis, and directed staff to endorse a program which dealt with highest priorities in the first year of the program.

Council Action Required

504-5 **(a) That Council endorse the improvement plan contained in the Dayton and Knight report entitled Study of Coquitlam/ Port Moody Drainage Area:**

Moved by Alderman Robinson seconded by Alderman LeClair

Res. 912

(b) That a formal request be made to the Greater Vancouver Regional District to prepare an action plan for Priority One projects identified in the report;

(c) That staff consult with Port Moody and GVRD technical personnel so that a comprehensive report on implementation of lower priority projects can be reviewed by the respective Councils at an early date.

Carried

504-5 DYKE MAINTENANCE PLAN

The Committee reviewed engineering memo report 03 03 09 dated 1988 June 02. The report was received for information.

504-7 ROAD AND DRAINAGE MAINTENANCE RIVER HEIGHTS

The Committee reviwed engineering memo report 01 03 06 dated 1988 June 10 regarding building construction activity in the River Heights area. Heavy rainfall in May contributed to drainage problems as catchbasins collected the heavy deposits of dirt from excavation sites. Photographs and video presentations were examined by the committee.

The Municipal Engineer advised the Committee that here had been significant improvements in street cleanliness after discussion with one firm.

The Committee discussed the policy options available to encourage more stringent standards of housekeeping and clean up on building sites. The possibilities range from more stringent by-law prosecution, to a special inspector, to collection of special bonds or security deposits to fund extra clean-up requirements.

While no clear single solution emerged to the problem, enough options were identified to warrant a further review of the problem in detail. In anticipation of such a report, the Committee agreed that a request should be made, through the Mayor's office, to enlist the active assistance of local builders and the Urban Development Institure to set and adhere to realistic standards of protection and cleaning of public roads and drainage systems during construction activity.

The Chairman adjourned the meeting at 1330h.